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LIST OF ERRATA FOR 1893.

Page.	Column.	Line.	Description.
37	2	20	From bottom: for "by ferric salts in" read "by ferric salts or," &c.
67	2	2	Below table: between "of" and "hydrogen dioxide" insert the words "sodium hydrate and 10 cc. of."
184	1	19	From bottom: for "1877" read "1887" also.
184	1	16	From bottom: delete the word "of" before "alcohol."
228	1	30	From bottom: for "light H" read "height H."
228	2	24	From top: for "rise of drops" read "size of drops."
228	2	28	From top: for "proportion" read "precaution."
228	2	32	From bottom: for "previovsly" read "previously."
230	1	..	In description of woodcut over the same: for "Get" read "Jet."
230–231	..	..	The whole paragraph, commencing "Many substitutes," &c., at bottom of col. 2, page 230, to top of col. 1, p. 231, should precede the previous paragraph.
231	1	17	From bottom: delete "really."
318	2	13 & 12	From bottom: for "antimony contained nearly" read "antimonite often contained as much," &c.
505	1	Bottom line.	For "and accepted often by Leeds" read "though not accepted by Leeds."
505	2	2	From top: for "$\frac{672}{2} = 336$" read "$\frac{672 + 18}{2} = 345$."
506	1	2	Below first table: for "up" read "by."
517	2	20	From bottom: for "which is requisite for laying" read "which lays."
528	1	17	From bottom: for "$C_{17}H_{83}COO$." read "$C_{17}H_{33}COO$."
703	2	15	From top: period instead of comma at the word "tannin," followed by new sentence.
707	2	14	From top: add following reference:—"Ber. 26, 777."
925	1	2	From top (title): for "Cyanide" read "Cyanate."
925	1	19	From top: for "cyanide" read "cyanate."
1013	1	..	Index: for VIII. read XVIII., opposite "Chemistry of Foods," &c.
1025	2	3	Of abstract in middle of column: for "used" read "fixed."
1025	2	10	For "wild" read "weld."
1047	2	5	Of abstract under XVI.: for "albiminous" read "albuminous."

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Welch, J. Cuthbert, The Brewery, Reading, Berks. analytical chemist.

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SESSION 1892–93.

1893:—
Monday, Feb. 6th:—
Mr. Oscar Guttmann. "The Manufacture of Nitric Acid."
Mr. C. C. Hutchinson, F.I.C. "A New Form of Laboratory Filter Press."

Meeting held Monday, 9th January 1893.

MR. WM. THORP IN THE CHAIR.

ON THE QUALITATIVE ANALYSIS OF COAL-TAR COLOURING MATTERS.

BY ARTHUR G. GREEN, F.I.C., F.C.S.

WITH the rapid development of the coal-tar colour industry and the constant increase in the number and complexity of the products which come upon the market, it becomes more and more important to have systematic analytical methods by means of which unknown colouring matters may be identified or referred to particular groups. It is often of great consequence to the dyer, merchant, or drysalter to know whether a certain dyestuff made by one firm is identical or not with that sold under a different name by another firm. The analytical or consulting chemist is often called upon to determine the colouring matter which has been employed for colouring various articles of food, &c., or to decide in patent cases the identity or non-identity of two competing colours. To the dye-manufacturer it is a matter of everyday necessity to be able to identify the samples of dyestuffs submitted to him, in order that he may be able to supply the same products. The mere matching of a colour to shade is no longer the only requirement; the chemical and physical properties of the colouring matter are now of equal consequence, for upon these depend its employment for the particular purpose for which it is used.

With the constant appearance of entirely new products, and the new names which are frequently given to old ones, these problems are continually growing more and more difficult, and the necessity for a systematic scheme of analysis becomes greater. When, for instance, the only artificial blue colouring matters in commerce were aniline-blue and methylene-blue it was a simple enough matter to decide what a given blue dyestuff was. Now, however, with at least 40 distinct blue colouring matters upon the market, circumstances are completely changed and we require to proceed in a more systematic manner.

The first proposal for a definite scheme of analysis was made by Witt in 1886 (Chem. Industrie, **9**, 1; see this Journal, 1886, 249), who gave the individual reactions for a great number of the colouring matters then upon the market, and proposed to separate them into groups by their shade, solubility, and behaviour with caustic soda. A more systematic method was published by Weingärtner in the following year (Chem. Zeit. (1887), 135, 165; see this Journal, 1887, 451). This depended upon the classification of colouring matters as "acid" and "basic" according as they were precipitated or not by a solution of tannin, and further sub-division by their behaviour upon reduction with zinc-dust.

The analytical tables of Weingärtner have, however, some serious faults. The reduced colours in many cases (*e.g.* rosanilines) are only re-oxidised in the air with extreme slowness and may consequently be readily mistaken for those colours which do not reappear. In several instances colours have to be separated from their allies and put into groups with colours to which they bear no chemical relationship; thus Victoria blue is separated from the closely allied colours of the rosaniline series, and erythrosine appears in the same group with the azo colours instead of with the rest of the phthaleïns. This renders it impossible to determine with certainty by means of these tables to what chemical group a new dyestuff belongs. Moreover, since the publication of Weingärtner's tables a very large number of new dyestuffs have made their appearance, many of which belong to entirely new groups (*e.g.* the oxazines, primuline colours, &c.) and very considerable modifications are necessitated.

Taking Weingärtner's system as a basis I have endeavoured to construct a scheme which shall be free from the objections above referred to, be simple and expeditious, include all the colouring matters at present upon the market, and classify them in their natural orders. The employment of a solution of tannin for the distinction of acid from basic colouring matters appears to me to be thoroughly satisfactory, and I have also adopted Weingärtners division of colouring matters into those "soluble" and "insoluble" in water, although it is open to some objection and may eventually have to be modified. In the application of the zinc-dust reaction I have found that whilst the derivatives of triphenylmethane after reduction are reoxidised by air only with great difficulty, the azines oxazines, thiazines, and acridine colours all reappear with great rapidity on exposure of the reduced solutions to the atmosphere. I accordingly make use of this difference of behaviour, which is very marked, to differentiate these two groups of colours. On the other hand the triphenylmethane colours are distinguished from those which do not yield leuco compounds, but are completely broken up on reduction by the colour of the reduced solution being restored by chromic acid. The quinoline and primuline colours are

ANALYTICAL SCHEME.

Group Reagents:—

1. A solution containing 10 per cent. of tannin and 10 per cent. of sodium acetate.
2. Zinc dust and dilute hydrochloric acid, or zinc dust and aqueous ammonia.
3. Solution containing 1 per cent. of chromic acid (for basic colours).
4. Solution containing 1 per cent. of chromic acid or potassium bichromate and 5 per cent. of sulphuric acid (for acid colours).

Distinguishing Reagents.—The members of the same group are distinguished from each other by their behaviour towards aqueous acids and alkalis concentrated sulphuric acid, alcohol, &c., and by their dyeing properties. See the reactions of the various colours as given by Witt, Weingärtner, and others.

Group I.—Dyestuffs Soluble in Water.

A.—*Precipitated by Tannin Solution: Basic Colours.*

The aqueous solution is reduced with zinc dust and hydrochloric acid and a drop of the decolorised solution put on filter paper. If the colour does not quickly return on exposure to air, the spot is touched with a drop of 1 per cent. chromic acid solution.

The original colour quickly reappears on exposure to air: *Azine-*, *Oxazine-*, *Thiazine-*, and *Acridine- Colours*.					The colour re-appears very slowly or not at all on exposure to air, but returns on spotting with 1 per cent. chromic acid solution: *Triphenylmethane Colours*, and *Basic Phthaleïns*.				The original colour does not return at all.
Red.	Orange and Yellow.	Green.	Blue.	Violet.	Red.	Green.	Blue.	Violet.	Yellow and Brown.
Toluylene Red.	Phosphine.	Azine Green.	Methylene Blue.	Mauve.	Magenta.	Malachite Green.	Victoria Blue B.*	Methyl Violet.	Auramine.‡
Safranine.	Benzoflavine.		New Methylene Blue N.	Amethyst.	Isorubine.	Brilliant Green.	Victoria Blue 4 R.	Crystal Violet.	Thioflavine T.§
Pyronine.	Acridine Yellow.		Thionine Blue.	Neutral Violet.	† Rhodamine.	Methyl Green.	Night Blue.	Hofmann Violets.	Chrysoïdine.
Acridine Red.	Acridine Orange.		Toluidine Blue.	Fast Neutral Violet.		Iodine Green.		Benzyl Violet.	Bismarck Brown.
			Meldola's Blue.	Prune.				Ethyl Purple.	
			Muscarine.	Paraphenylene Violet.				Regina Purple.	
			Neutral Blue.	Indamines.					
			Basle Blue R & B B.						
			New Methylene Blue G G.						
			Nile Blue.						
			Capri Blue.						
			Fast Black.						
			Indazine M.						
			Metaphenylene Blue B.						
			Paraphenylene Blue.						
			Indamines.						

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* The shade which returns is much greener than the original.

‡ The reduced solution gives a beautiful violet when the spot on filter paper is warmed over a flame till dry.

† The colour returns more quickly than with the resanilines.

§ Is only reduced with difficulty and very slowly.

B.—*Not Precipitated by Tannin Solution: Acid Colours.*

The aqueous solution is reduced with zinc dust and hydrochloric acid, or with zinc dust and ammonia, and a drop of the decolorised solution is put on filter paper. If the colour does not quickly return on exposure to air, the spot is touched with a drop of chromic acid solution (1 per cent. CrO_3 + 5 per cent. H_2SO_4), warmed over a flame, and then held in the vapour of ammonia.

The solution is decolorised.						Not decolorised (by zinc and ammonia), but changed to brownish-red. Original colour returns quickly on exposure to air.	Very slowly and incompletely decolorised (zinc and ammonia).	Not altered by zinc and ammonia; very slowly or not at all by zinc and hydrochloric acid.
The original colour quickly reappears on exposure to air.	The original colour does not reappear on exposure to air, or only very slowly, but returns with chromic acid, and exposure to ammonia vapour.		The original colour does not return at all: *Azo-, Nitro-, Nitroso-, and Hydrazine- Colours.*					
Sulphonated azines, oxazines, thiazines, &c.:—	The aqueous solution of the dyestuff is acidified and shaken with ether.		Heated on platinum foil.			Alizarine S.	Clayton Yellow.	Quinoline Yellow S.
Soluble Indulines.†	The ether extracts, the colour-acid leaving the solution nearly colourless:	The ether remains colourless:	Deflagrates with production of coloured vapours:	Burns quietly or deflagrates slightly, giving off coloured vapours:—*Azo-, nitroso-, and hydrazine colours.*		Alizarine Blue S.	Thiazol Yellow.	Primuline.
Soluble Nigrosines.†	*Phthaleïnes and Aurine*:—	*Sulphonated triphenylmethane colours*:—	*Nitro- colours*:—	The colour dyed upon unmordanted cotton.		Cœruline S.	Turmerine.	Thioflavine S.
Resorcin Blue.	Uranine.	Acid Magenta.	Picric acid.	Resists warm soap.	Is stripped by warm soap.		Mimosa.	Oxyphenine.
Azurine.	Chrysoline.	Acid Violets.	Victoria Yellow.	Substantive Azo-colours.	Ordinary Azo-colours.			
Thiocarmine.	Eosine.	Formyl Violet.	Aurantia.		Naphthol Green B.			
Basle Blue RS and BBS.	Erythrine.	Alkali Blues.	Martius Yellow.		Tartrazine.			
Gallamine Blue.	Phloxine.	Soluble Blues.	Naphthol Yellow S.					
Gallocyanine.	Erythrosine.*	Patent Blue.	Brilliant Yellow.					
Gallanilie Indigo P S.	Rose Bengale.*	Fast Green, bluish.	Aurotine.					
Indigo-carmine.	Cyclamine.*	Acid Greens.						
Saffrosine.	Aurine.	Guinea Green.						
Azo-carmine.	Coralline.	Chrome Violet.						
Mikado Orange.†								

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* Iodine is separated by the chromic acid, but disappears on exposure to ammonia.

† If the reduction is carried too far, the colour does not return.

Group II.—Dyestuffs Insoluble in Water.

The powder or paste is treated with water and a few drops of 5 per cent. caustic soda solution.

The colour dissolves.		The colour remains insoluble.				
The alkaline solution is heated with zinc dust and ammonia, and a drop is put on filter paper.		Soluble in 70 per cent. alcohol.				Insoluble in 70 per cent. alcohol.
		Solution not fluorescent.		Solution fluorescent.		
		On adding caustic soda (33 per cent.) to the alcoholic solution.		On adding caustic soda (33 per cent.) to the alcoholic solution.		
Decolorised or changed to light-brown. The original colour returns very quickly on exposure to air.	Decolorised or changed to brown. The original colour does not reappear on exposure to air.	Colour becomes reddish-brown.	Colour not altered.	Fluorescence destroyed.	Fluorescence remains.	
Cœruleïne.	Alizarine.	Induline, Opal.	Indophenol.	Magdala Red.	Spirit Eosines.	Indigo.
Galleïne.	Anthrapurpurine.	Nigrosine, Opal.	Sudan II. and III.		Cyanosine.	Aniline Black.
Gallocyanine.	Flavorpurpurine.	Rosaniline Blue, Opal.	Carminaphth.			Primuline Base.
Gallanilic Violet B S.	Alizarine Orange.	Diphenylamine Blue, Opal.				
Gallanilic Blue P.	Alizarine Brown.					
Galloflavine.	Alizarine Bordeaux.					
Alizarine Blue.	Alizarine Yellow G G & R.					
Alizarine Black.	Chrysamine.					
Alizarine Cyanine.	Sudan Brown.					
Alizarine Cyanine Black.	Patent Fustin.					
Rufigallol.	Myrtle or Russian Green.					
	Gambine R and Y.					
	Dioxine.					

distinguished from other dye-stuffs by the great difficulty with which they are reduced, primuline for instance remaining unaltered after long boiling with zinc-dust and ammonia.

The analytical scheme which I have based upon these reactions is contained in the annexed tables.

The reduction with zinc-dust requires to be performed with some care. It is usually best to add a little zinc-dust to the hot solution of the colouring matter contained in a test-tube, agitate, and then add dilute hydrochloric acid drop by drop until decolorised. An excess of acid must be carefully avoided. In other cases, more especially when the colour-acid is very insoluble, the reduction must be performed with zinc-dust and ammonia; but it is usually safest to repeat the tests with both methods of reduction.

Whilst it is important that the colouring matter should be completely reduced, care should also be taken that the reduction is not carried too far, for some colouring matters (*e.g.* the indulines) which usually form oxidisable leuco compounds are thereby completely altered. When reduced the solution is poured off from the greater part of the zinc dust on to a piece of white filter-paper, and exposed to the air; filtration is unnecessary, as a little zinc upon the paper has no injurious effect. If the colour does not return in a minute or two, the paper is touched with a glass rod dipped in a 1 per cent. solution of chromic acid (with addition of sulphuric acid for acid colours). Warming gently for a few seconds over a flame facilitates the reactions, and should also be employed when the reduction has been performed with zinc dust and ammonia, in order to remove the excess of the latter before adding chromic acid, which would otherwise be neutralised.

In the case of acid colouring matters, the paper, after spotting with chromic acid, should be held over a bottle of strong ammonia, for some acid colours (*e.g.* the eosines) do not show their true colour whilst acid. On reduction of those eosines which contain iodine, a brown spot of the latter is obtained with chromic acid, but this disappears on exposure to ammonia vapour, and the original colour of the eosine (or a rather yellower shade) returns. As already pointed out by Weingärtner, great care must be taken that one is not led astray by secondary colours formed by oxidation of the diamines and amidophenols obtained by reduction of azo-colours.

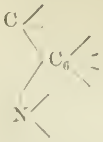
Discussion.

Dr. **Alder Wright** wished to ask how far the reactions so beautifully illustrated in the case of single dyestuffs could be utilised for the purpose of discriminating the constituents of mixtures of different dyes. He believed it was not an uncommon practice to adjust the "tone" of various dyestuffs as sent into the market by admixing small quantities of other suitable substances that would slightly modify and correct the shade; *i.e.*, if a given batch of red dyestuff were rather too yellowish-red in shade, this could be corrected by mixing a little material of a purplish or bluish-red tinge; and so on. Could small admixtures of one kind of dyestuff with comparatively large amounts of another be readily detected?

Mr. **Bevan** wished to know if Mr. Green's scheme of analysis applied to the detection of colouring matters on fabrics.

Mr. **Watson Smith** desired to ask if any colours had been recently discovered which, unsulphonated, were insoluble both in water and alcohol? If so, it occurred to him that another classification might thus be introduced of colours soluble and insoluble in alcohol, all of which were insoluble in water.

Referring to Mr. Green's quinone formula for rosaniline on the blackboard, he thought he was right in saying that the older-fashioned view of the constitution of the pararosaniline and rosaniline series of colours involved a kind of dogma to the effect that all colour or dye-forming capacity was conditioned by the direct union of carbon and nitrogen in the para-position, so as to form a kind of special triangular ring, thus—



This had been regarded as the universal colour-factor of the series named, and the disturbance or break in its integrity meant the disappearance of colour, as is indeed clearly shown when a leuco-compound is formed. He could see of course a line of reasoning that would make the use of the quinone and quinonoïd structure answer the same purpose, and probably Mr. Green had all these contingencies in view, and would make clear the advantage of the formula used, over one now so familiar to colour chemists, and which has done such good service in the past.

Mr. **Blount** inquired whether all or the majority of artificial blue colouring matters were removeable from the fabric by extraction with alcohol.

The **Chairman** asked if it would be possible to furnish in the tables some better indication of the precise nature of the colours than that given by the ordinary commercial names. Often different makers gave different names to the same substance, and sometimes different substances received the same name from different makers. Names were used in an entirely unsystematic manner, and it would be a great advantage if the proper chemical names could be given; but this would be difficult owing to the amount of space required. If, however, anything could be done in that direction, it would be of great service. The whole subject was one of great complexity, and the paper and tables of Mr. Green were of great value.

Mr. **Green**, in reply, said that the question of mixtures of colours was a very difficult one, as such mixtures would not at present admit of any systematic scheme of separation. All that could be done was to proceed upon certain general lines; thus when two or more colours had been ground together it was usually tolerably easy to detect them by the streaks of the several colours produced on blowing the powder on to wet filter-paper, or dusting it on the surface of vitriol. Sometimes, moreover, a separation could be effected by dyeing several pieces of wool in succession from the same bath, or by fractional precipitation as calcium, barium, or lead salts. Probably, also, the difference in oxidisability of the leuco compounds by air might be made use of for the separation of certain colours.

The detection of colours upon textiles could either be accomplished by removing the colour by means of a solvent, such as alcohol or ammonia, where this was possible, and then proceeding in the ordinary manner: or when the colour could not be removed, tests made upon the fibre would have to be depended upon. Basic colours could be removed from the fibre by alcohol, but the acid colours, which are usually sulphonates and insoluble in alcohol, could not generally be extracted in this way; thus indigo-carmine or soluble blue were not removed.

The Chairman had raised an important point with regard to the names used in the tables. Much, however, as he should have liked to be more definite in this respect, he did not see that it was possible in the space. To have inserted the constitutional formulæ for the colours was of course quite out of the question, and to give their scientific names was, owing to their length, nearly as impracticable. He considered that when several commercial names had been given to a colour, that name should be recognised as the correct one which had been given to it by its first discoverer.

NOTES ON THE PRESENCE AND PROPORTION OF FREE FATTY ACID IN OIL-CAKES.

BY BERNARD DYER, D.SC., AND J. F. H. GILBARD.

Some few years ago it occurred to us that some interest might attach to a knowledge of the average proportion of free fatty acids in oil-cakes. It had been observed by ourselves as well as by others that a high proportion of free fatty acid was frequently found in cakes that were in bad condition—such as cakes that had "heated" or become mouldy—and in cakes adulterated with refuse materials.

Accordingly, we determined the free fatty acid in one hundred linseed cakes, taken indiscriminately as they happened to be sent to the laboratory of one of us. They were not actually consecutive samples, the determination being often neglected during busy weeks. But whenever the pressure on the day's work allowed the ordinary analysis of a cake to be conveniently supplemented by a titration of the oil, this was done. While, however, the samples were not consecutive samples, their selection was made without regard to their source, the purity or their condition, and therefore they have been said to have been taken indiscriminately.

The collation of the notes made as to acidity and those independently made as to purity, &c. was allowed to be indefinitely deferred. As, however, an interest in this matter has been awakened abroad, we have thought it well to disinter the figures from the laboratory books and put them on record as a small contribution to the study of a subject of which is not devoid of interest even if a longer investigation of it fails to tell us a great deal that is of tangible value.

The quantity of acid in pure or genuine oil-cakes made from sound seed is probably influenced by the mode of crushing as well as by time and place of storage.

The temperature to which the crushed seed is raised and the mode and duration of steaming before it goes into the presses, may well cause a variable degree of initial decomposition of the oil. The quantity of moisture introduced into or left in the cake will certainly affect its liability to "heat" or undergo fermentation on keeping—a process that seems to result in the setting free of fatty acids. On the other hand, it seems reasonable to suggest that the process of steaming and its degree and duration may produce a variable "sterilising" effect which may tend to prevent or check fermentations and their accompanying chemical changes.

Our acidity determinations were made by treating the oil with hot neutral alcohol and titrating with alcoholic potash, using phenolphthaleïn as an indicator. The oil was the rapidly dried and weighed portion extracted by ether in the usual process of analysis. The acidity we have calculated as free "linoleic" acid, and as the proportion of oil in linseed cake is very variable, we prefer to calculate in each case the percentage of acid, not in the cake, but in the oil—that is to say, the number of parts of free acid in 100 parts of oil.

The actual percentage of oil in the cakes examined ranged from 7 per cent. to 16 per cent., and as it would probably be fairly correct to assume for linseed cakes generally an average of 10 per cent. of oil, we may conveniently form an approximate notion of the percentages of free fatty acid in the cakes themselves, by dividing the percentage of free fatty acid in the oil by 10. For convenience's sake we give the figures thus stated.

100 Linseed Cakes.

Average proportion of free fatty acid in:—

100 parts of oil	6·3
= in 100 parts of cake	0·63

Of these cakes 52 were "pure," *i.e.*, made of genuine well-screened linseed. 35 were not examined for purity, and include no doubt both pure and impure cakes. Of the remainder, 12 were reported as being impure—either through imperfect cleaning of dirty linseed, or through the deliberate addition of "screenings" or other adulterating materials in use for such purposes. The remaining sample was, we find, condemned as being mouldy and unfit for use as food.

52 "Pure" Linseed Cakes.

Average proportion of free fatty acid in:—

100 parts of oil	3
= in 100 parts of cake	0·3

The highest percentage was 14 per cent. on the oil (= 1·4 per cent. on the cake), but this was exceptional, and, in many cases, *no* acidity was detected, or only the merest trace.

35 "Linseed" Cakes not Examined as to Purity.

Average proportion of free fatty acid in:—

100 parts of oil	6·5
= in 100 parts of cake	0·65

The maximum was 21·5 per cent. on the oil (= 2·15 per cent. on the cake).

12 Impure "Linseed" Cakes.

Average proportion of free fatty acid in:—

100 parts of oil	19
= in 100 parts of cake	1·9

The acidity ranged in these cakes from 4·5 per cent. to 32 per cent. on the oil (= from 0·45 per cent. to 3·2 per cent. on the cake).

1 "Mouldy" Linseed Cake.

Proportion of free fatty acid in:—

100 parts of oil	22
= in 100 parts of cake	2·2

In a great many cases there was no clue to the age of the cakes; but in some cases we knew, and in others had variably sound grounds of presumption, that they were freshly manufactured.

In nine cases in which we had absolute knowledge that the cakes were freshly crushed, *i.e.*, within probably a few hours, we found *no* free acid, or only a trace too small to be determined under the circumstances of our tests.

In 16 other cases in which there was fairly good reason to suppose that the cakes were also newly made we found an average of three parts of fatty acid in 100 of oil (say 0·3 per cent. in the cake).

Taking then the 25 cases in which we knew or believed the cakes to be freshly crushed, the average acidity was about 2 per cent. of the oil (= 0·2 per cent. on the cake).

In addition to the cakes of which we have spoken, we determined the acidity in a sample of "Bombay linseed meal" (a ground cake containing 14·43 per cent. of oil), which had evidently "heated," and in which we found 76·5 per cent. of the oil to consist of free fatty acid. In a sample of crushed cotton-seed, fairly fresh, we found 8 per cent. of the oil to be free acid.

We examined three undecorticated cotton cakes, which gave "acidity" equal to 8·5, 9 and 11 per cent. of the oil present. A decorticated cotton cake was "acid" to the extent of 14 per cent. of its oil.

It is proposed to make some further and more systematic observations during the present year.

Discussion.

Mr. C. Sevin asked if Mr. Dyer had made any analyses of ground nut, palm nut, sesamé, and coprah (or lace-nut) cakes, particularly of the last, as to the quantities of objectionable fatty acid contained in the oil left in them. The 14 to 18 per cent. of oil left in coprah cake, imported from India where it had been made by the crude native process, was rancid and bad smelling, and contained from 11 to 12 per cent. of fatty acids which were most injurious to cattle. On the other hand fresh coprah cake made by improved hydraulic presses in India contained only 8 to 10 per cent. of fatty acids in the oil, a very small percentage on the weight of the cake.

Dr. Alder Wright believed that it was now pretty well established that even the most freshly prepared oils were liable to contain more or less perceptible quantities of free fatty acids formed by natural processes taking place during storage, involving the decomposition of glycerides. Such processes were usually more apt to occur with pulpy mucilaginous matter, moist and imperfectly ripened seeds, and the like, olives being a well known case in point where the manufacture of "huiles tournantes," containing large quantities of free fatty acids, was purposely effected by storing the fruit in such fashion that a sort of fermentation took place previous to expression. Similarly palm oil was liable to contain large amounts of free fatty acids produced by analogous causes. Again, when a seed was expressed in fractions, the cake being reground between two expressions, the second fraction of oil usually contained a higher percentage of free fatty acid than the first, owing to the occurrence of reactions bringing about more or less hydrolysis or other decomposition of the glycerides present, probably analogous to those taking place when rancidity is developed, usually accompanied by the formation of free fatty acids. He wished to ask if Dr. Dyer could give any information as to the probable nature of the impurities in those samples of cake that yielded the larger proportions of free fatty acids as compared with the much smaller average amount yielded by the purer cakes? Was the increment traceable to the admixture of any one particular kind of seed and used as adulterant?

Could Dr. Dyer give any information on a point which, though not directly arising out of his paper, was yet not entirely disconnected from the subject. The use of the oleo-refractometer in valuing butter (by examining its refractive power) was becoming somewhat general, the presence of oleomargarine and analogous adulterants being indicated by alterations in the refractive qualities of the samples examined. In general fairly trustworthy indications were thus obtainable; but some kinds of butter had been found that gave abnormal values, though genuine; and the explanation given of these abnormal results was that the cows had been feed largely on linseed cake, the suggestion being that the glyceride of linseed oil passed unchanged through the cow and came out as such in the milk. Was there any reason for supporting that by judiciously feeding cattle on margarine and such like fatty matters, the normal butter fat of the milk yielded (consisting of glycerides of an entirely different character) could be supplemented and increased by the addition of other kinds of fat introduced through the alimentary canal? He believed that it was possible to increase the quantity of milk yielded by a cow at the expense of its quality by suitably dieting, and perchance drugging, the animal; *i.e.*, by so stimulating its lacteal glands as to make them secrete a larger volume of more watery fluid. If so, from the consumer's point of view he did not see much difference between this practice and the more ancient and simple process of adding the water to the milk *after* it had been extracted from the cow. He wished to know if it were possible to perform similar juggling feats with the fatty matters of milk.

Mr. F. H. Perry Coste inquired whether Dr. Dyer could state what were the limits of variation from which the average acidity of the 25 fresh cakes had been calculated, since the variations in the 52 pure cakes were considerable, as it was obvious that the greater the variations the less meaning could be attached to the average.

He also remarked that although of course the amount of acidity seemed most probably to depend upon the length of time that the cakes had been left, still it was just possible that it might be to a certain extent a function of the composition of the cake, and it would be of much interest to investigate this point. Had Dr. Dyer, for instance, seen any reason to suspect that the ratio of the acidity to the oil was to any extent a function of the amount of oil present?

Mr. A. H. Allen said he thought the Section was much indebted to Dr. Dyer for his communication. At any rate, he, as a compiler, wished other chemists would similarly place their results on record. He should like to ask Dr. Dyer what he understood by "linoleic acid" in terms of which substance the free acid was said to be calculated. Formerly, linoleic acid—by which was meant the chief acid resulting from the saponification of linseed oil—was regarded as having the composition $C_{16}H_{28}O_2$, and the combining weight 252. But he had some years since adduced evidence to show that the more probable formula was $C_{18}H_{32}O_2$, in which case the acid from linseed oil was a stearic instead of a palmitic derivative. He had not ventured to call the acid containing 18-carbon atoms by the name linoleic acid, and hence had distinguished it as homolinoleic acid. Since that time his observations had been confirmed by several continental chemists, so that the main product of the saponification of linseed oil undoubtedly contained $C_{18}H_{32}O_2$. The question was of interest in connection with Dr. Dyer's results, for it was evident that the same measure of standard alkali would be neutralised by 252 of the 16-carbon acid or by 280 of the higher homologue, and according to the composition ascribed to it by Dr. Dyer, he might state a sample to contain either 25·2 or 28·0 per cent. of free fatty acid. Personally he considered the latter to be the more correct view.

Dr. Alder Wright said that Mr. Allen's results leading to the conclusion that linoleic acid was properly indicated by formula $C_{18}H_{32}O_2$ instead of $C_{16}H_{28}O_2$ (*i.e.*, that it was a dehydrogenised *stearic* acid, and not the corresponding *palmitic* derivative), had been completely confirmed by various continental chemists, who had shown that, on reduction with iodine and phosphorus, linoleic acid yielded stearic and not palmitic acid; whilst similarly, the "sativic acid" obtained as a characteristic oxidation product from linoleic acid by treating it with alkaline permanganate also yielded stearic acid, and not palmitic acid, when similarly reduced.

Dr. Bernard Dyer, in reply, stated that although he had occasionally examined areca-nut and palm-nut cakes and meals for acidity, he had not preserved records of his tests. He did not think that in the case of linseed the maturity and storage of the seed itself would much affect the development of acidity, for the quantity of moisture in linseed was small and not very variable, and fermentation of the seed itself (unless it got damp and germinated) would scarcely happen. The case was not analogous to the storing of olives which had been referred to, for in one case there was a dry seed and in the other a fleshy moist fruit. He had not noted in all cases the nature of the impurities in the impure cakes. They would generally be weed seeds such as were found in dirty imported seed and screened out before making pure cakes, or else refuse materials or other cakes, such as rape cake, earth-nut cake, rice meal, niger cake, &c. Some of these materials were rancid in themselves. In reply to Mr. Coste, Dr. Dyer thought he and Mr. Gilbard had indicated in the paper the circumstances of which they considered the free fatty acid was a "function," but these were too complex to allow of the observance of any definite relationship. The temperature of the steamed seed and the duration of steaming prior to crushing might cause some immediate decomposition of the oil, or, on the other hand, might "sterilise" the cake to some extent, and so avoid subsequent "heating" during storage. The proportion of water introduced, the closeness and dampness or airiness and dryness of a warehouse, the time of storage, and various other points would all have their effect. They had, however, observed no definite relation between the percentage of oil and the acidity. With regard to Mr. Allen's question, they had used the term "linoleic acid" somewhat loosely, and in no scientific sense, meaning merely the average fatty acid of linseed oil. The equivalent they had taken for calculating the fatty acid was based on the statements in Mr. Allen's book. On reference to his notes, Dr. Dyer found that the number adopted was a multiplication of the KHO required by 5, which gave an equivalent of 280 for the fatty acid. But it was really a matter of no practical consequence in this connection whether they adopted one equivalent or another, the quantities dealt with being so small. The difference between the equivalent of one higher fatty acid and another would almost vanish in the errors incidental to titration in such small quantities of oil, and an approximate equivalent was sufficient.

FURTHER NOTES ON THE FORMATION OF NITROUS OXIDE.

BY WATSON SMITH.

Since writing my paper which appeared in the November number of this Journal, 1892, entitled "The Formation of Nitrous Oxide and a New Method of Preparation," I have had my attention called by my friend Mr. V. H. Veley, M.A., of Oxford, to the work he has done, and which was published in the Phil. Trans. of the Roy. Soc. of London, 1888, pp. 257—295, and also work of still earlier date published in the J. Chem. Soc. August 1883.

Mr. Veley's results possess a singular interest in connection with the new method I have proposed for the making of nitrous oxide, since they throw much light on and in part anticipate two conditions which I have observed in starting and continuing the decomposition of the mixed salts, nitrate of sodium and sulphate of ammonium.

Mr. Veley's conclusions given at the end of his paper before the Chemical Society in 1883, *loc. cit.* were these :—

1. The rate of decomposition of ammonium nitrate into nitrous oxide and water, is dependent not only upon the mass of salt undergoing decomposition, but also upon the proportion of free nitric acid present.

2. If the reaction of the salt be rendered alkaline at starting, the rate of decomposition gradually increases while the proportion of free acid increases; a period of maximum velocity is then reached, corresponding to the greatest proportion of free acid; from this point the rate decreases very slowly, while the proportion of free acid also decreases.

3. An excess of ammonia obtained either by passing in the gas, or by the addition of a basic oxide, *will completely stop the reaction, even at temperatures* 50°—60° *above the normal point of its decomposition.*

4. If the reaction of the salt be rendered acid at starting, the rate of decomposition gradually increases, while the proportion of acid gradually decreases.

5. After heating the salt for about 13—16 hours, the rate of change becomes practically constant.

Now, the bearing of the facts forming the basis of the above conclusions of Mr. Veley, is a very important one, as regards the starting of the reaction which results in the evolution of nitrous oxide from ammonium nitrate, and there is no doubt that the first symptoms of the reaction, chemically speaking, is a lesser and incomplete reaction, in which ammonia is evolved, and a little free acid left.

This slight or incipient dissociation of course creates slight acidity in the mass, whilst the ammonia, which is more volatile, escapes quickly into the atmosphere of the retort or heating vessel. The slight acidity thus introduced appears now to upset a previous chemically structural stability, and reaction with evolution of N_2O sets in freely and easily.

But this fact possesses a more lively interest in the case of the reaction ensuing when a mixture of sulphate of ammonium and nitrate of sodium is heated, for the first symptom of reaction is marked by a slight evolution of ammonia. This development of ammonia is also more marked in the case of the mixture I propose than in that of ammonium nitrate itself. This I trace to the fact that sulphate of ammonia commences to decompose with development of ammonia more easily and at even a lower temperature than nitrate of ammonia. Of course such decomposition means that a small equivalent quantity of ammonium hydrogen sulphate ("bisulphate of ammonia") is left behind. If the temperature be kept down (say at about 200° C.) more ammonia is set free, and I have invariably found in such case, that when the heat is carried up to the point of gaseous evolution and continued, at the end of the process more or less red fumes are evolved, and the yield of nitrous oxide is diminished. Indeed it becomes clear that the nitrous oxide is the product of the reduction of the nitric acid radical or its elements by ammonia or its elements, and if ammonia be lacking at the close of the reaction, it is natural that some of the higher oxides of nitrogen should make their appearance. Now, I confess that, having overlooked Mr. Veley's valuable work referred to, I was ignorant of the effect of retardation of reaction in the case of ammonium nitrate by the presence of free ammonia; but I had, on the other hand, observed the tendency of evolution of red nitrous fumes at the end of the process in which my mixture was employed if the precise equivalent weights of the salts proposed were adopted. It was to avoid this danger that I prescribed the preferable use of the ammonium sulphate in slight excess (this Journal, 1892, 633), the slight incipient evolution of ammonia during heating up to the decomposition point with evolution of nitrous oxide, leaving a slight acid residue of subsequent advantage, as Mr. Veley has shown, and further, leaving fully sufficient ammonium sulphate intact to give the full yield of nitrous oxide, and thus preclude the danger of nitrous fumes being evolved at the close of the process.

We are now supplied with the reason for the fact that on heating up the mixture of sulphate and nitrate for the production of N_2O, even though to a certain extent some preliminary double decomposition of the salts does take place, resulting in the formation of ammonium nitrate and sodium sulphate, that any ammonium nitrate thus formed forbears to decompose at the lower temperature at which it would have decomposed had the salts consisted entirely of ammonium nitrate. For let us suppose the formation through double decomposition of the two salts, of a certain quantity of ammonium nitrate, between, say, the temperature of 180° and 230° C., amongst this ammonium nitrate there would be present some vapour of ammonia from slightly decomposing ammonium sulphate. But it may be asked, "If ammonia be thus evolved and check the decomposition of any little nitrate of ammonium formed, till a yet higher temperature be reached, would not the collateral formation of acidity involved in the production of "bisulphate of ammonia" in small quantity counteract such retardation? In reply to this I would ask that it be remembered that in the development of ammonia, we have a permeation of the mass by a gas or vapour, and thus an intrinsically close physical contact sufficient for "chemical contact," but the trace of bisulphate in a mass only softened, and by no means fused, and moreover only locally formed, probably at those surfaces nearest the source of heat, can as yet not effect any adequate measure of concentrating influence. Thus, in the ordinary course of things, when the heat is raised directly to that which is known as the point requisite for the incipient evolution of nitrous oxide, viz., 230° to 240° C., any little proportion of ammonium nitrate formed, is not as yet decomposed. At and over such point, however, decomposition ensues with decomposition of any ammonium nitrate formed, and double decomposition of the larger portion of remaining mixture to the direct formation of nitrous oxide, steam and sodium sulphate.

The question may be now very well asked, "If on heating nitrate of ammonia to decomposition, some ammonia is evolved with resulting acidity of the mass, and also with final evolution of nitrous fumes to a certain extent, and by the use of a small excess of ammonium sulphate in the mixture I propose, this can be avoided, will not the yield of nitrous acid be increased above the amount obtained, when only the bare equivalents are used?

In some experiments recently made for me by Mr. J. C. Chorley, this has been found to be the case, and Mr. Chorley actually obtained from the mixed salts proposed, in which such excess of sulphate of ammonium was used, a proportion of nitrous oxide actually above the equivalent that would have been practically obtained had nitrate of ammonium alone been used.

The excess of sulphate of ammonium employed in the experiment, in the mixture giving the above favourable result as to yield of N_2O, was five per cent., $3\frac{1}{2}$ litres of N_2O being obtained as compared with $2\frac{1}{4}$ litres hitherto obtained when no excess of sulphate had been used. The volume actually obtained from the equivalent weight of ammonium nitrate was $3\frac{1}{4}$ litres. The conditions were otherwise the same in both cases.

The next point of considerable interest, is the answer to the following question :—"Suppose the mixture of ammonium sulphate and sodium nitrate were not heated to 230 or 240° C., with the object of producing nitrous oxide, but were maintained for a prolonged period at a temperature, say of 215° C., sufficient to produce a soft, semi-fused mass but not sufficient to generate nitrous oxide, what would result?"

This experiment was tried, and the mixture kept at about 215° C. for some 2—3 hours. The mass, of fairly strong acid reaction, was then pulverised, and finally extracted, with well-dried absolute alcohol. On evaporation of the alcoholic extract a residue consisting of impure ammonium nitrate was obtained, representing about 80 per cent. of the total quantity of the pure salt theoretically possible. Subsequently, however, a small part of this was found to consist of sodium nitrate probably due to the solvent action of a small quantity of water still present in the alcohol. We might thus take about 75 per cent. as being the actual amount of conversion into ammonium nitrate, after two hours and a half heating, during which period, the soft mass was diligently stirred about with the thermometer. This experiment at all events shows us that during the period named, the reaction, though considerable, was by no means quite complete. It could never I admit be quite *complete* since during prolonged heating, prolonged though slight evolution of ammonia ensued. Another portion of mixture was also heated to incipient fusion at about 215° C. for a brief period, about ten minutes, and then cooled and extracted, the amount of NH_4NO_3 then extracted, was but comparatively small.

When the mixture is *quickly heated up* to about 240° C. as already stated, though ammonia is first evolved, and would check any decomposition leading to the formation of N_2O from any little nitrate of ammonium formed, yet as the temperature rises this ammonia is soon either expelled, or more probably, neutralised by free acidity resulting from the reaction of bisulphate of ammonia on nitrate of soda.

I have, moreover, tried the experiment of prolonged heating of the mixed salts to about 220° to 230° C. until incipient evolution of N_2O ensues, forming as we have seen nitrate of ammonium in considerable proportion, and then I have cooled the mixture and again tried the point at which evolution of N_2O would commence on a second heating. Incipient decomposition then shows itself at about 215° C., or very little over. In the first case we had *quickly* attained a temperature (230° C.) a little above which (240° C.) decomposition proceeds directly on the line $2\,(NaNO_3) + (NH_4)_2SO_4 = Na_2SO_4 + 4\,H_2O + 2\,N_2O$, but on prolonged heating (to about 220° C.) double decomposition more completely ensues with formation of NH_4NO_3, and on cooling down and again heating, this ammonium nitrate commences to decompose in its normal way and at more nearly its normal temperature. But such a course would only result in considerable loss of ammonia during the prolonged heating, and a very incomplete yield of N_2O.

I have tested the mass fused, and kept fused a long time, at 215° C., for hydroxylamine, but found not a trace.

If the mixture were *slowly heated up*, or kept some time semifused, at say 220°—230° C., ammonia would continually be lost and a much diminished yield of N_2O would inevitably result on finally heating to 240° C. and above.

If the mixture of ammonium sulphate and sodium nitrate be heated together till softening thoroughly sets in, NH_3 will be found to be given off, and on testing the residue it will be found to have an acid reaction from formation of NH_4HSO_4. This in turn, as the temperature rises, reacts upon $NaNO_3$, probably to form NH_4NaSO_4 and HNO_3, which then combines with NH_3 to form NH_4NO_3 if the temperature admits of it. This peculiar sequence of reactions seems to aim at a *full and vigorous activity*, for which a temperature of about 240° C. is required, when the indirectness of action seems gradually to merge at that temperature into the more direct and smooth reaction, probably best represented as already stated—

$$2\,(NaNO_3) + (NH_4)_2SO_4 = Na_2SO_4 + 4\,H_2O + 2\,N_2O$$

In this case the elements of nitric acid and ammonia, of course, at once react upon each other in the gaseous state at the high temperature specified to form by mutual reduction N_2O and H_2O. Let the temperature drop sufficiently and of course a condition arises at which the nitrate of ammonium may be formed and remain stable, but, it must be reiterated, during such period ammonia is also continually lost, and its loss diminishes the ultimate yield of nitrous oxide.

Conclusions:—The conclusions briefly expressed are the following:—

I. On heating the mixture of nitrate of sodium and sulphate of ammonium, as the temperature rises, ammonia is at first evolved:—$(NH_4)_2SO_4 = NH_3 + NH_4HSO_4$.

II. As the temperature further rises the NH_4HSO_4 commences to react upon sodium nitrate, with formation probably of $NH_4NaSO_4 + HNO_3$. But this further stage suffers delay and proceeds with comparative slowness, since the mass is kept saturated (in the physical sense) with ammoniacal vapour.

III. The nitric acid now combines with ammonia as the temperature rises to form ammonium nitrate.

IV. But when the temperature rises to 240° C. or thereabouts, the point is attained at which probably, NH_4NaSO_4 can react upon $NaNO_3$ forming—

$$Na_2SO_4 + \underbrace{NH_3\,.\,H\,.\,NO_3}$$

which elementary constituents in the state of vapour at once mutually react without any actual formation of ammonium nitrate at all, to yield $N_2O + 2\,H_2O$.

V. Let the temperature drop below the point of evolution of N_2O, *viz.*, about 240° C., and we then fall to conditions prefigured by Mr. Veley, in which any ammonium nitrate formed cannot decompose amongst the semi-fused material, to form nitrous oxide, *viz.*, one in which, $(NH_4)_2SO_4$, is continually suffering semi-rupture to form $NH_3 + NH_4HSO_4$, whilst the latter with $NaNO_3$ is continually following up with the reaction $NH_4HSO_4 + NaNO_3 = NH_4NaSO_4 + HNO_3$, the NH_3 and HNO_3, uniting to NH_4NO_3, which cannot, as Veley shows, in presence of NH_3, break up to form N_2O and H_2O, below something near that temperature (240° C.).

IV. This quintuple cycle of reactions is then as follows:—

1. $(NH_4)_2SO_4 = NH_4HSO_4 + NH_3$
2. $NH_4HSO_4 + NaNO_3 = NH_4NaSO_4 + HNO_3$
3. $NH_4NaSO_4 = NH_3 + HNaSO_4$
4. $NaHSO_4 + NaNO_3 = Na_2SO_4 + HNO_3$
5. $NH_3 + HNO_3 = N_2O + 2\,H_2O$ (over 230° C.)

No conclusion can be drawn as yet as to whether the action of the normal sodium sulphate finally produced, has any physical effect in accelerating the reactions or any of them, such as the effect discovered by Mr. V. H. Veley in the case of ammonium nitrate by such inert substances as barium sulphate, finely-divided glass, graphite, finely-divided silica, or pumice. (Phil. Trans. Roy. Soc. 1886, 257--295).

I desire in conclusion to acknowledge the care and skill with which my assistant, Mr. J. C. Chorley, has carried out many of the experiments leading to the conclusions embodied in this communication.

DISCUSSION.

Mr. VELEY expressed his satisfaction that his previous observations upon the fusion and decomposition points of ammonium nitrate, published in the Journal of the Chemical Society, 1883, had been confirmed by Mr. Watson Smith in his paper published a short time ago in the Journal of the Society of Chemical Industry. When ammonium nitrate was heated two decompositions took place simultaneously, the one into ammonia and nitric acid, the other into nitrous oxide and steam, the latter being conditioned by the former. From the neutral salt ammonia was at first given off and subsequently nitric acid. If the salt were rendered alkaline the rate of evolution of the nitrous oxide at first slow, then increased up to a constant point; on the other hand, if the salt were rendered acid the rate decreased up to the same point which corresponded to the presence of 0·5 per cent. of free nitric acid. These remarks were illustrated by curves. Mr. Watson Smith's results confirmed the necessity of the presence of a slight excess of acid for the more or less complete evolution of nitrous oxide from the mixture of ammonium sulphate and sodium nitrate.

In conclusion Mr. Veley described a simple lecture experiment to illustrate the effect of the presence of free alkali upon the decomposition of ammonium nitrate; this consisted in dropping a small quantity of litharge into the molten salt heated to a temperature of 210° or thereabouts, at which the nitrous oxide would be given off freely. The ammonia liberated by the action of the litharge completely stops the decomposition, not for a few minutes only but for some hours.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893.

1893:—
Friday, Feb. 3rd.—Dr. C. O. Weber. (1.) "An Experience with Pyroxyline." (2.) "On Wool Dyeing in Copper Pans." (3.) "On the Oxidation of Cotton in Alkaline Baths."

Meeting held Friday, 13th January 1893.

MR. IVAN LEVINSTEIN IN THE CHAIR.

THE PATENT LAWS.

The Chairman, in opening the proceedings read a letter communicating the following resolution passed at a meeting of the Board of Directors of the Manchester Chamber of Commerce:—"That a strong recommendation be made to the Government asking them to take early steps to bring in a Bill reforming the present patent laws, so as to make them, so far as relates to preliminary examinations, analogous to the law and practice at present in force in the United States of America." Further resolved, "That Chamber of Commerce, the Institute of Inventors, the Chartered Institute of Patent Agents, the Society of Chemical Industry, and other kindred Societies be invited to co-operate in this movement."

Mr. Levinstein then went on to urge the necessity for a reformation in the law with regard to patents. He thought it did not require many words of recommendation to gain from his hearers a thorough support of the above resolution. At present the Government took fees and granted patents indiscriminately without preliminary examination such as was practiced in America for example. There was really no confidence whatever in the mind of the public, especially so far as capitalists were concerned, in the value of any patent. The patentee had really no valid title in this country, and consequently it was most difficult for a poor inventor to introduce his patent. The consequence was a want of enterprise in the exploitation of patents owing to the endeavours of the patentee being frustrated at the outset. A further great drawback lay in the number of bogus, bluff and speculative patents which had been taken out, and which sadly interfered with industrial progress. Objection was also taken to section 18, clause 1 of the Patent Act on the ground of ambiguity and want of provision against unscrupulous inventors. In the case of section 22, clause A, the wording was again of such a character as to make it absolutely ineffective. Then again the law did not distinguish in any way between chemical patents and mechanical patents notwithstanding the great difference in their nature, while another question had been raised concerning the reduction of fees. He thought the Manchester Chamber of Commerce was very wisely advised in pressing the point of preliminary examination, for the reason alone that it scarcely admitted of controversy on the part of inventors. The true inventor could not possibly entertain any objection, and would readily realise the benefits accruing from such a system. The resolution was intended to press Government to bring the matter forward, and he hoped that their petition would be cordially supported. He thought they owed a little to themselves for the good results which had been already achieved. It had taken some years and some patience on the part of the Chemical Section of the Chamber of Commerce to induce people to take the matter up. The Board of Trade had been already communicated with, while invitations had been issued to all the Chambers in this country as well as various learned societies and associations for the purpose of securing their co-operation in the matter, so that there was the greatest probability they would accomplish that for which they had been labouring so long. He therefore begged to move the resolution to the following effect:—

"That this section pledges itself to support in every manner possible the efforts of the Board of Directors of the Manchester Chamber of Commerce to induce the Government to amend the present patent laws."

He would also suggest to them that they should couple with that resolution a motion to appoint a special committee inviting all other sections of this important Society to hold a meeting for the purpose of co-operating to support the endeavours of the Manchester Chamber of Commerce. The Manchester Chamber of Commerce was also a powerful body and its weight and influence would go a long way towards securing the end they desired. The resolution he would lay before them would therefore run as follows:—

"That this section appoint a special committee to impress the improvement on other Sections of the Society and on the Council."

He had a few names in his mind of gentlemen who could be appointed to the special committee, which he would suggest, leaving it open to the members to decide upon the matter. The gentlemen he desired to name were Mr. W. E. Heys, Mr. Harry Grimshaw, Mr. Wm. Crippin, Mr. Charles Dreyfus, the Chairman, the Vice-Chairman, and the Secretary.

Dr. Schunck seconded the resolution, which was carried unanimously.

THE ADVANTAGES OF COP-DYEING.

BY W. CRIPPIN.

In the discussion which followed the reading of the very instructive paper dealing with the chemical side of cop-dyeing, read by Dr. Weber at our last meeting, certain members asked to see cloth woven with cop-dyed yarns. It occurred to me that I might, as a practical manufacturer, read a paper on "The Advantages of Cop-dyeing," which I will endeavour to make both interesting and instructive, and at the same time produce, for the inspection of the members, samples of cloth woven, at my works and also in Germany, with yarns cop-dyed by the Young and Crippin's process. From these it will be apparent that for evenness of shades, brilliancy of colour, and for general effect, they compare favourably with either hank or warp-dyed yarn. It is not my intention, to-night, to enter into any controversy on the merits of the different systems of cop-dyeing machines, but I may say fearlessly that the Young and Crippin's machine, for evenness of shade, simplicity, and absolute reliability of working, to say the very least, will be very hard to beat.

I think cop-dyeing excels the old way from the fact that after the yarn is dyed in the cop it is not disturbed in the same way as it is when dyed in the skein or hank which has to be wound on pirns or tubes. It also enables, in the case of certain colours, say blacks, browns, &c., to do away with the grease which has to be put in the dye, or on the yarn by the winder, to prevent the yarn cutting in the cup in winding, and which, should there be any neglect on the part of the operative, often leads to stains, when the goods come to be passed on to the finisher.

The treatment of yarn by the spinner in the cop for dyeing is a very important matter, and one upon which they, as a body, seem very reluctant to devote time and attention; and one of the greatest obstacles we have had to overcome has been to make the spinner understand this point. Indeed, several English spinners "turned it up" rather than take the trouble that was necessary to prevent mistakes arising, assigning as a reason the difficulty they experienced with their workpeople. I may say in passing that the yarns I have seen, that have been spun on the Continent, far and away excel our English spun yarns, and it is no use our blinding ourselves to the fact, that unless we rouse up we shall be left behind in the race for supremacy.

It is here we are met with our first and only difficulty in cop-dyeing, *i.e.*, the putting of the cops on the special skewer for dyeing and the waste arising therefrom. Of course with a well-built cop and one that has had care in the packing no difficulty exists. When the cop is on the skewer we then have no further cause for anxiety, as after being dyed and dried you can put any reasonable pressure on it and it is impossible to destroy the dyed cop for shuttling and weaving.

I illustrate this to you by showing a dyed cop before placing it on the shuttle. I now place it on the shuttle ready for weaving and take it off again. I now place my entire weight upon it, about 200 lb., and I then replace the dyed cop in the shuttle and of course it is apparent that it will weave off just the same in every respect as a grey cop which has not been put under any pressure.

Now as to the evenness of shade produced by these processes. In the case of hank and warp dyeing it is all a question of the dyer's experience. By the immersion of the hank or warps in his vat, and by the the time occupied in the process, he judges as to the shade required and he feels his way until he has obtained the shade wanted. This process is in some cases a very long and tedious one, whereas in cop dyeing by machinery under the Young and Crippin process no skilled workman is necessary; and I may say it is only a matter of a few hours for any person to thoroughly understand the working of the machine.

I now produce a photograph of the Cops-Farberei at Barmen, Germany, showing the dyehouse at work, and also a photograph of a Young and Crippin machine. The reason why this machine is enabled to dye yarns in the cop perfectly is apparent. The cops are placed in the chamber, 5 lb. of weft cops or 8 lb. warp cops at a time, (larger quantities can be done at a time, it all being a question of the size of the machine). Then by means of a movement of the handle here shown, a vacuum is caused in the large receiver and a measured quantity of dye liquor of a given strength is drawn out of the vat through the cops into the receiver and allowed to pass back into the bath again. To you gentlemen acquainted with the use of beakers it is apparent that the dye-bath and receiver are the two beakers, and it is by means of a connecting pipe and a cop chamber that the liquor is drawn through the cops. The quantity is under perfect control by means of a glass gauge which indicates the exact amount of liquor in the receiver at any point of action, and the ebb and flow can be stopped instantaneously at the will of the operator.

Having now got to the position of the cop reaching the weaver's hands, it is here that the great advantage of our system comes in, *i.e.*, the increased production of cloth, from the fact of the dyed cops have on them a greater length of yarn than can be put on a pirn. We find the gain to the weaver is from 10 to 15 per cent. on account of less shuttling being required. I may here state that at a works in Germany, after the weavers had been working with cops dyed by our process, my friend had about 600 kilos. of dyed yarn on paper tubes to receive, being the balance of a contract, but to his surprise the very hands who had at first raised obstacles against the use of cop-dyed yarn, turned round on him and would not weave the yarn on paper tubes, unless they had an allowance of 60 pfennige per piece for doing so.

In the dyed cop, another advantage is that the cloth is fuller, which enables a manufacturer to use finer yarns. This arises from the fact that a softer spun yarn can be used than it would be possible to dye in the hank, and to wind back again on to the pirn; and another fact that I would just mention is that the thread is not impoverished by the knocking about in the dyeing, and by the friction caused in winding, and this tends to make the cloth fuller to the hand.

There being no difficulty in dyeing the finest yarns spun in the cop, and weaving them with perfect ease after dyeing, the silk manufacturers are once more giving their attention to this point, and I believe there is a great future for cop-dyeing in mixed silk and cotton goods.

We have carried out a series of experiments at our works, as follows:—

We take 100 lb. of cotton yarn in the hank, put it into the boiling keir, then through hydro-extractor, dye indigo, then dry; what do we find? We have a loss of 5 to 6 per cent. in the weight, the yarn only now weighing about 95 lb. The above test was made with 24 s. weft, medium quality, which wrapped before dyeing exact counts, and after dyeing came out 24½ s., thus confirming the loss of weight.

Now what do we find in the case of cop yarn, placed under exactly similar test? No loss of weight, but the same weight of yarn back as at the start.

The reason I submit is, that the yarn being in a softer state in the cop takes up more dye, and being in the cop form does not suffer the same loss and shrinkage in the process of dyeing. I also produce a portion of two pieces of cloth woven on similar looms, and for simplicity calculate on 100 yards of woven cloth.

— —	Bundles.	Cops.
NUMBER OF LOOM, 138.		
	Lb. oz.	Lb. oz.
Calculation of blue required } Usual allowance for waste.	5 4	5 4
„ grey „	3 8	3 8
Weight given to winder	5 4½	..
„ „ weaver	..	5 3
„ of waste in winding	0 0½	..
Yarn to weaver. Amount consumed	5 2½	5 0
Waste made in weaving	0 1½	0 3
	Yds.	Yds.
Length of piece	100	100
	Lb. oz.	Lb. oz.
Weight „	15 10	15 14
NUMBER OF LOOM, 135.		
Blue required as above	4 6	4 6
Grey „ „	3 4	3 4
Weight given to the winder	4 9½	..
„ „ weaver	..	4 9½
„ of waste in winding	0 0½	..
Yarn to weaver	4 9	4 7¼
Waste made in weaving	0 1½	0 2¼
	Yds.	Yds.
Length of piece	100	100
	Lb. oz.	Lb. oz.
Weight „	14 6	14 7

Now, on comparison what do we find? that the use of cop-dyed yarns produces a better cloth and with no increase of waste as compared with the hank-dyed yarns. It will be noticed that when the winding and weaving waste are put together the amount in weaving with the cop is almost the same. Of course this is liable to a variation by reason of the capability or incapability of the weaver. Another purpose for which cop-dyed yarns can be used is the manufacture of Grandrell yarns, and here there is a great future before the cop-dyeing machine, as by this process combinations can be made never thought of before; also for twined yarns.

I now come to the concluding part of my paper, as to the cop-dyed yarn and to the yarn spun from dyed loose cotton, which is submitted to the usual process in spinning; viz., carding, drawing, and spinning. I say fearlessly that for self-colours, cop-dyed yarn far and away excels the yarn spun from loose-dyed cotton; but for mixtures the loose cotton only can be used on account of the mixing to form the required yarn. It is now almost 30 years since I gave the subject of dyeing in loose cotton my attention. I abandoned it on account of the serious loss that accrues to any one adopting this system, as, after a lapse of about four years, the whole of the card filleting is ruined from the action of the atmosphere and the particles of fine dye dust which attack the cards just like a canker worm. Another process which has been adopted is to dye it in the sliver; but here we are met with another serious difficulty, and that is the derangement of the fibres after the carding, which makes the sliver impossible to pass through the rollers afterwards in the process of spinning. I have overcome this by the Young and Crippin machine, by dyeing it in the roving, the last stage before spinning, and can get very satisfactory results, having spun yarns from 24 to 130, both in single colour and two coloured rovings together.

Discussion.

The Chairman said that Mr. Crippin's paper had touched upon several very important points. As far as he (the Chairman) was concerned, he fully believed that cop-dyeing had a great future. A great many attempts to bring the process to a satisfactory issue had been made during past years, and much experience had to be gained before the present results had been arrived at. He, however, believed that Mr. Crippin, in connection with Mr. Young, had certainly perfected the system of cop-dyeing, and that with further efforts the process could be made successful from a pecuniary, as well as a technical, point of view. Till the present it had been all money spent, but he hoped that would not continue to be the case. Any gentlemen present who knew anything about the difficulties in indigo-dyeing of yarn would be surprised at the evenness displayed in the samples brought by Mr. Crippin for their inspection. The great difficulty had been to get the yarn anything like as even as was shown by the sample cops. He only hoped that they were not going to be led in this matter by the Continental people, as had been the case before, but that this country for once would take the lead, and that Mr. Crippin would be encouraged to extend his system. Some of the cloths which had been woven and spun were really perfect. There was one question he should like to understand, and that was why dyeing in the cotton was not more successful. He understood it was to the carding. In Italy he had noticed a good deal of dyeing of raw cotton and loose cotton, whilst Mr. Crippin stated in his paper he had gone through with the process, but had had to give it up owing to it injuring the carding. He (the Chairman) understood the colour came off from the cotton.

Mr. Crippin, in response to the Chairman's question and to further questions by Mr. Harry Grimshaw, said that the reason foreign yarns excelled English yarns was because foreign mills were better equipped than the average mill in this country; whilst Continental manufacturers took greater care of their yarn. He himself had had endless trouble, on that matter. In Russia, where they did not get power from the Government until six weeks ago, they had had none of the difficulties to contend with that he had had on that score. A chemist had been out there from this country, and he had persuaded the people to take that amount of care—necessary care—which he could not obtain here, the consequence being that things were going smoothly. In this country they got the yarns spoiled simply because the spinners said they could not do better. With regard to the question of weight the cop was not in the form of a skein as it was taken here. If weight was lost his idea was that it was attacked by the liquor, and some short fibres would go. Also when going over the drag some fine fibre would be pulled. That would all be invisible loss, and hence the yarn was impoverished.

Mr. Harry Grimshaw said he thought that would be due to mechanical abrasion, the manipulation in the bath, and the winding off again. He thought a great deal of the loss would be due to the winding.

Mr. Crippin further said the dust in the dye was always working and got into the card at the bottom, and whether it was the action of the atmosphere or the rubber upon the wire card he did not know, but in four or five years, according to the district, almost every card would collapse.

Dr. Weber pointed out that wood colours were very frequently set upon a copper mordant, and it was a well-known fact that copper had a most deleterious action upon india-rubber, and that action, if only the copper were sufficiently fine, caused oxidisation, which he could easily understand would cause a breakage. With regard to the greater loss in dyeing hanks over dyeing cops he had seen a statement in Thorpe's new Dictionary of Applied Chemistry that cotton when under the influence of alkalis must always be kept under the level of the water or otherwise oxidisation of the cotton would set in and would lead to the production of bodies in the nature of steam. That in itself would cause a very serious loss in the handling of the yarn. The colours were always taken in alkaline solution, the dyeing operation being at or near boiling point, so that there was every chance of leading to a loss.

The Chairman said he could quite understand that in the case of an alkaline colour which had been tin mordanted that the colour "flew" off.

ON THE UTILISATION OF SKIM MILK FOR MANUFACTURING PURPOSES.

J. CARTER BELL, A.R.S., M.I.C.

Many will think that skim milk has very little to do with manufacturing chemistry, or the scientific chemist, but my attention has been called to it in connection with the Rivers Pollution Act. A large firm of cheese-makers in Shropshire were in the habit of sending all the whey and skim milk which could not be used for their pigs into the nearest river, and I was applied to for information as to the best means of utilising these waste products.

Two methods have presented themselves to me, the first being an invention for making all kinds of buttons, door knobs, electric lighting furniture, umbrella handles, and many sundry small things from lactite, a substance made from skim milk.

In this process the milk is heated to 85° or 88° F., and to every 58 gallons is added about 4 oz. of rennet. As soon as the milk is coagulated the curds are washed once in warm water and then put into a masticator, which is warmed to about 150° F.

In the masticator should be placed about $2\frac{1}{2}$ lb. of borax with about 4 pints of skim milk. When the masticator has been run for a short time until the curd is almost converted into a solid mass, about 2 lb. of starch (arrowroot is preferred) are made into a paste with some of the milk or whey, and 3 oz. of alum are also added, and the whole mass well incorporated.

The masticator is run for about one hour, and at the end of this time three pounds of acetate of lead dissolved in half a gallon of acetic acid are added to the mass, and carefully worked in; when the mixings have been well made the mass is taken to the hydro-extractor, and then put into a hot press with a daily change of cloths, until it is properly set; it is then dried in the air and made up into the various articles you see before you.

A large factory was fitted up near Manchester for the manufacture of lactite, but I am informed that up to the present time it has not been a financial success, for the articles which have been made, such as buttons, &c., when sewn on to clothes, have the unpleasant property of readily breaking in pieces on the slightest touch, or often on none at all; so I cannot see how lactite buttons handles, &c. can compete with the time-honoured and well-tried bone articles. Still there are cases when the skim milk has to be thrown away; at such times it may be profitable to make lactite, and it may be an industry for the British farmer, who is at present sorely tried with severe competition. This lactite when well prepared will keep for any length of time.

The second process which I have been experimenting with is to convert the skim milk or whey into a portable article of food; for since, as is well known, it is impossible to send skim milk or whey at a profit to distant towns, some simple process by which the farmers could get rid of the water at a small cost and leave a residue rich in nitrogenous matter is a thing very much to be desired. The specimens which I place before you have been made from skim milk and whey. The name given to this new compound is lactoserin. This is prepared in a variety of ways as food for man, cattle, and poultry :—

No. 1 is dry curds, not ground.

No. 2, the same, but ground to fine powder.

No. 3, serin. This consists chiefly of milk sugar from the evaporated whey.

No. 4, lactoserin, which consists of one-third of skim milk, two-thirds whey.

No. 5, double lactoserin, half skim milk, half whey.

No. 6, brown roasted lactoserin, for mixing with cocoa instead of starch. I have not had time to make analyses of all these preparations, but I think it will be sufficient if I give one the mean of several analyses :—

Double Lactoserine.

Water	3·32
Protein matters	22·56
Fat	1·34
Carbohydrates	66·13
Ash	6·92

The manufacture of these products ought to possess great interest for the English farmer, for it will enable him to turn to marketable value what has too often been a waste product. This manufacture of dry curds and serin can be carried on at small places as well as large, but I need not say that it would be more economical to work 1,000 gallons than 100.

The dry curds are obtained from the skim milk in quite the same way as in the production of cheese, by putting rennet into it. The curds are pressed and ground, and then dried in a drying oven.

It has been estimated that the manufacture of the dry curds will not cost more than about one farthing a gallon for the skim milk used.

The serin is manufactured by evaporating skim milk and whey together in different proportions for different purposes. For this purpose a special evaporating vessel is required which will hold about 250 gallons; this costs in Sweden (where the process is being worked) 55*l*., and a machine for the stirring up the mass as it is cooling down. This apparatus will cost 10*l*. for the size corresponding to the 250 gallons. The expense in Sweden is only one farthing a gallon, therefore the cheapness and simplicity of the process ought to recommend itself to the attention of our agriculturists at home.

Discussion.

The Chairman said that the paper dealt with a useful application of a waste product. The utilisation of skim milk and whey for the purposes of food would certainly be more appreciated than when used in the manufacture of door knobs, electric bell furniture, and handles for walking sticks.

Mr. Grimshaw thought cattle would be more likely to take kindly to whey than human beings.

Mr. J. Carter Bell said the process was invented by Wm. Rehnström, of Sweden (this Journal, 1892, 933).

Mr. Crippin said he should like to volunteer a word on this point. He had had the misfortune to lose 98 calves about two years and a half ago and had had to give up milk since. The milk trade was a very peculiar one in certain districts. In some it was a very good one and in others not so good, and in some cases instead of sending milk to market they made butter and cheese, and so forth. It was then that they met with a difficulty as to getting rid of the surplus skim milk and whey they had to dispose of. Pigs and cattle required careful treatment, and he did not think they would flourish on a diet of pure whey or skim milk. In order to keep pigs successfully they wanted to be near a good hotel where they keep a good swill tub. In feeding them with skim milk they must add a little meal, and he thought that was a subject upon which chemists might assist poor unfortunate farmers out of their difficulty. He did not think that there was any farmer at the present time, even if he had a good homestead, who was making money, and the further utilisation of skim milk would be very advantageous to farmers' interests.

Nottingham Section.

University College, Nottingham.

Chairman: L. Archbutt.

Vice-Chairman: F. Clowes.

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Treasurer: J. M. C. Paton.

Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

Meeting held Wednesday, December 14th, 1892.

MR. L. ARCHBUTT IN THE CHAIR.

THE USE OF "CHEMICAL" LEAD.

BY F. J. R. CARULLA.

There are few more surprising changes of their kind than some met with by the chemist when he leaves the experimental operations of the laboratory for those of an industrial character in the works. Where he has used glass and porcelain on the small scale he has now to employ metals when working on a commercial scale, and of these lead will be the chief if engaged in the manufacture of sulphuric acid or with processes that require its employment.

Liebig has well said that without cork, platinum, glass, and caoutchouc, "we might have made some progress (in chemical investigations), but it would have been slow; we might have accomplished much, but it would have been far less than has been done with their aid." It may, with equal truth, be said that without lead chemical industry would have made little progress, seeing how intimately it is bound up with the production of sulphuric acid and how unsuccessful have been the attempts to find substitutes for a metal so soft that it can be eroded and perforated by insects, but which has proved nevertheless very useful.

Widespread though chemical knowledge has become anyone may yet be excused for ignorance on the importance of lead to the industrial chemist when even such an exhaustive work as Percy's classical treatise dismisses the subject in half a dozen lines, mentioning only its application to sulphuric acid chambers. Other authors are still more brief and some do not even refer to the chemical use of this metal, as is the case, for example, in what is also an excellent book, viz., "The Useful Metals and their Alloys," published so late as 1866, a time when already immense quantities of lead had been employed to carry on numerous processes of chemical manufacture.

The quantity of lead used in the construction of sulphuric acid chambers is no doubt very large, yet there are works where this acid is manufactured in which the very considerable yearly outlay for this metal includes few items for their repair. Although wear and tear is certain they may yet be so slow as hardly to be felt, except when the time arrives for the complete renewal of the chambers. The concentrating pans for bringing up the strength of chamber acid to that of brown oil of vitriol where towers are not employed, and the saturators where the manufacture of sulphate of ammonia is carried on may be found, although making less show, to give in the long run greater employment to the lead mills than the chambers do.

The chemist who takes up manufacturing operations may very naturally imagine that for him the term "chemical" lead requires no definition, and it may be a surprise for him to read that: "In the North of England those rolling mills which roll the sheet lead for the many large vitriol works supply a special kind of "chemical lead," which is made from the melted-up old chamber lead, pipes, &c.; in this case many impurities, especially antimony from "regulus" valves, &c., get into the lead, which seems to improve its quality for acid chambers" (Lunge's "Sulphuric Acid," 1879, Edition, p. 42). The supposition that chemical lead should be a very pure article would therefore not appear correct, although the contrary opinion has also been stoutly maintained.

It was not originally intended to discuss in this paper the interesting point as to what impurities, if any, improve lead for the various purposes to which it is applied by the manufacturing chemist, yet, as the subject has undergone a most painstaking and laborious investigation at the hands of Professor Lunge and Mr. Ernst Schmid, the details of which have just been published in the Journal of the German Society of Chemical Industry (Zeit. f. angew. Chem. 1892, 21—22), a few of the results arrived at may not be thought out of place here.

It should be premised that upwards of a thousand tests were made by Mr. Schmid, during a period extending over two years, on various kinds of lead, the chief of which yielded the following on analysis :—

Soft lead…………	Cu 0·001, Bi 0·044, Sb 0·004, Fe 0·0005, Sn 0·0004, Ag 0·0005 per cent.
Soft lead, No. 2…..	Cu 0·0034, Bi 0·0019, Sb 0·0029, As 0·0047, Ag 0·0010, Cd 0·00025, Zn 0·0002 per cent.
Hard lead……….	Cu 0·05, Bi 0·01, Sb 1·81, As 0·10, Fe 0·01, Sn 0·04 per cent.
Antimonial lead ….	Cu 0·1 to 0·3, Sb. 18·1 to 18·3, As 1 to 3·1 Sn 0·1 per cent. (not homogeneous).

The concentrated acids employed in these investigations were non-nitrous sulphuric acid of 1·84 sp. gr. and nitrous vitriol of the same strength with 1 per cent. of N_2O_3.

Diluted acids were also used, ranging from 1·725 to 1·765 sp. gr., that is to say of the strength of B O V.

The main and most important conclusions arrived at by Dr. Lunge from a consideration of the tabulated results are—1st. That the purest soft lead is the most suitable material for the construction of apparatus to be employed in the manufacture of sulphuric acid, such as chambers, cisterns, towers, and the like. This is also the case with concentrating pans, at all events, when these are so arranged that the heat is not first directed under the pan containing the strongest acid, so that the temperature may never, even for a short time, rise above 200° C. 2nd. The presence of 0·2 per cent. of antimony in the lead is not injurious. With cold acid it is certain that the corrosive action is not so strong on such an alloy as it is on soft purer lead. This, however, only holds good with cold acid, and if the percentage of antimony exceed 0·2 the antimonial lead is attacked much more vigorously than is the soft lead, and the action increases enormously as the temperature rises. The use of antimonial lead for concentrating pans is therefore specially to be guarded against. 3rd. The presence of copper, which lead will only take up to the extent of 0·2 per cent. so as to form a homogeneous alloy, at temperatures under the boiling point of water has little or no effect on [the action of vitriol on the lead. At 200° C. its protective action is just perceptible, but as higher temperatures are reached the presence of this small percentage of copper is a decided protection to the lead from that sudden attack by the hot acid to which the presence of any bismuth in the lead makes it so liable.

As no doubt a full abstract of Dr. Lunge's interesting paper will appear in due course in our Journal, it is the less necessary to give here more than the important results above described. These suffice to show that "chemical" lead should be the purest that can be made, but a special quality, with 0·1 to 0·2 per cent. of copper for exceptional purposes when very hot acid has to be dealt with, might be manufactured. As the admixture of this special lead when sent back as scrap would not injure the ordinary chemical lead, there is no obvious reason why the lead mills should not avail themselves of this new knowledge, and adopt the suggested course at once.

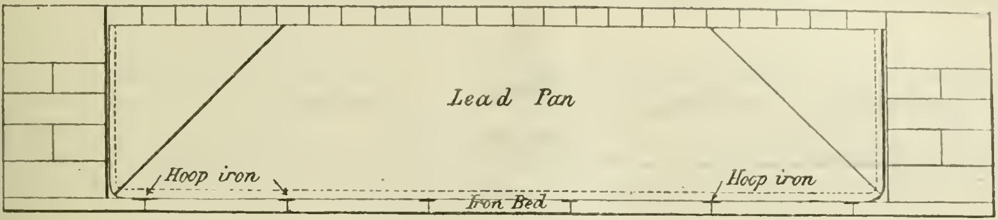
In the main the matter is left very much as the scientific chemist would expect to find it, namely, that the purer the lead, the less easy it is for acids to act upon it, and important as is the exceptional result obtained at abnormally high temperatures when the lead is alloyed with a small percentage of copper, we can still suppose that the physical conditions of its employment may also deserve consideration. The question is not an idle one :—Can the life of any apparatus made of this metal be lengthened by changing or modifying any of the conditions under which it is at present employed?

Covering in the passages between the various acid chambers so as to protect them from the weather not only makes the lead last longer but prevents the dilution of the chamber acid that must occur in rainy weather, however carefully the water may be led away, when they are placed in the open. In this connection the writer remembers no treat like that afforded him by one of our worthy Vice-Presidents, Mr. Crowder, when taken over the works so well managed by that gentleman. The numerous passages between the chambers were covered over and so clean that in the subdued light they looked more like the long aisles of some ancient temple than like portions of a chemical works. It was no surprise to learn that a woman—a veritable "chambermaid"—periodically swept them. It can be imagined that chambers so well kept—apart from their preservation — must materially contribute to the comfort of everyone engaged about them, and thus tend to increase the efficiency of the works.

It is difficult to think of any other metal that is employed under such comparatively severe conditions as lead is, by the chemical manufacturer. The concentration of sulphuric acid in lead pans is an operation that may well make the man stand aghast who is accustomed to ample "factors of safety." When it is considered that the boiling point of the strong acid is about 338° C., whilst the melting point of lead, variously given as from 262° to 334° C., is generally accepted as 322° C. (= 612° F.), it will be obvious that the slightest oversight in allowing the concentration to be carried too far in the leaden pan must bring about its destruction. The acid made in the chambers is thus converted into brown acid of about 1·74 sp. gr. The heat seldom rising above 150° C., but the small margin for safety is evident especially in view of the rapid rise of the boiling point as the acid increases in strength.

No much simpler vessels, in form, could be devised than the pans used for this concentration. A plain oblong or square sheet of lead whose thickness may be anything from $\frac{1}{4}$ inch to $\frac{5}{8}$ inch is spread out on the iron platform that has to bear the pan. The sheet of lead is then turned up all round so as to form the sides of the vessel some 14 or 16 in. high. The triangular lugs that are formed at the corners are beaten flat to the ends or sides, and the pan is finished, requiring only to be walled round in order that the sides and ends may be protected and supported.

Fig. 1.

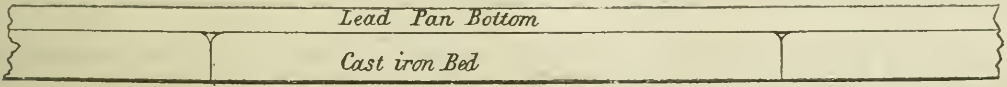


Elevation of square concentrating pan, with part of wall removed. Scale, 1 in. = 1 ft.

It is plain that as the pans rest on cast-iron plates placed over the flues and fireplace, imprudence or inattention may land the attendant in a serious difficulty. The acid may get up to strength whilst the fire is still in the furnace, and the flues are still hot, making it unsafe to empty the pan, whilst at the same time a certain element of danger arises if the acid be left in the lead pan, because under the supposed conditions concentration will continue. Of course a careful and experienced man safeguards himself by due attention against such an occurrence, but the possible dilemma is worth mentioning as on one occasion when the demand for acid was urgent, a well-meaning, but none the less rash foreman destroyed a pan by emptying it whilst the flues were too hot, well aware of what the result might be. His excuse was urgency. Such action may well be compared to that of a man, who being on the top of a tower, should throw himself to the bottom, instead of carefully descending by the stairs because he happened to be called down in haste.

The iron plates making up the platform that covers the fireplace and flues, are usually plain open sand castings, about a foot wide and an inch thick. They are placed edge to edge so as to make as level a surface as may be. It is easy to understand, however, that with the distortion that will in the course of time occur through unequal heating, which cannot be avoided, the sharp corners of the iron plates will at some places rise above the general surface, and constitute a danger for the lead. This is frequently guarded against by placing thin hoop iron over the joints, but the writer has adopted with success the plan of rounding the corners of the smooth side of the open sand plates (Fig. 2). This in no way adds to the cost of the castings, whilst it also distinguishes their smooth side, so that on looking over a completed bed one need have no doubt as to whether any plate has been put the right way up. The V-shaped space left between each pair of plates may remain open without detriment of any kind if the radius of the curved corner be not too large. $\frac{3}{16}$ inch has been found a convenient radius.

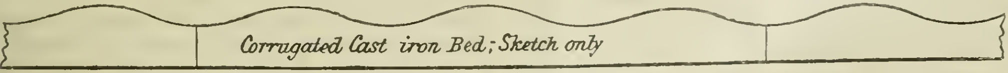
Fig. 2.



The fact that the linear expansion of lead is between two and three times that of iron, introduces a difficulty in such a combination as we are considering that soon makes itself obvious by the puckered character, that the bottoms of the lead pans assume especially when the actual difference between the expansion of the two metals is accentuated by great length. Iron expands 0·00118 of its length when raised from the freezing to the boiling point of water, whilst lead will expand as much as 0·00301 of its length under the same circumstances. This means that with a pan, say 28 feet long, whilst the expansion of the iron bed or platform will only be a little over $\frac{1}{3}$ inch, the expansion of the lead will actually exceed one inch, a dimension that will be considerably added to by the further increase of temperature when acid is being concentrated. Indeed at the higher temperatures the difference between the two expansions will be more than one inch. This addition to the length of the pan must be taken up somewhere, and in the case supposed would show itself by a number of transverse puckers or folds, dividing the bottom of the pan as it were into a number of shallow compartments.

In the case of a very long pan it would appear possible to take up this extra expansion by corrugating the surface of the iron plates (Fig. 3). The lead as it expanded would by the mere weight of superincumbent acid bend itself in place, although the distance between the corrugations in relation to the thickness of the lead would be an important factor in the success of the experiment, as if too great the weight of the acid would be certain to cause extension of the lead long before the heat expanded it to the required dimensions for bedding it completely. Such a plan judiciously carried out must, one would think, be in any case beneficial, as the expansion would be taken up evenly all over the length of the bottom of the pan instead of by irregular folds at chance intervals, as happens with the ordinary level bed. The lead would not be strained so severely as is now the case, a point of some importance when it is remembered that the tenacity of lead which is 2 kilos. per sq. millimetre between 15° and 20° C., becomes reduced to 0·54 kilos. at 100° C., and must be still more largely reduced at the higher temperatures with which we have to deal.

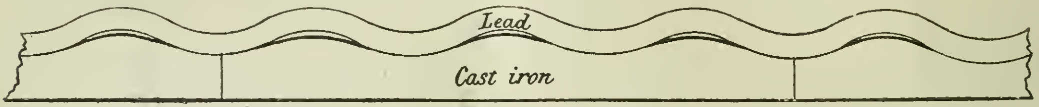
Fig. 3.



Corrugations not drawn to scale.

After a pan had bedded itself into place by expansion whilst concentrating acid, it may be supposed that on cooling the lead would contract and the corrugations in it become effaced. The complete accomplishment of this result would, however, depend, as has already been hinted, on the thickness of the lead and its relation to the depth of acid left to cool in the pan, together with the width of the corrugations, for it is obvious that the weight of acid might under certain conditions easily overcome the feeble elasticity of the lead; an elasticity so small as to be reckoned at one-tenth that of wrought iron. Should this occur the effect would of course be that when the pan was again heated the elevated part of the corrugations would rise still more by the excess of expansion forming crescent-shaped spaces at each elevation where the lead would not touch the iron at the time when contact is most important (Fig. 4). It may be true that on the next contraction occurring the lead would now bed itself fairly over the whole surface of the iron, but as we are seeking to do this when the apparatus is hot, and not when it is cold, there is no advantage in bringing about this state of affairs. How little such a condition of things would help us may be inferred from the fact that taking gold as the standard and calling its conducting power 1000, the conducting power of copper for heat is 898·2, that of iron is 374·3, and that of lead is only 179·6. The danger would therefore arise by the superposition of lead in the manner supposed that it might become over-heated where this metal came in contact with the iron in the concave part of the corrugations where the iron is thinnest. The thin parts of the iron would not only give up their own heat to the lead, but would receive the heat from the thicker sections and convey that also to the lead. This concentration of heat at intervals with such a bad conductor as lead might constitute a serious danger.

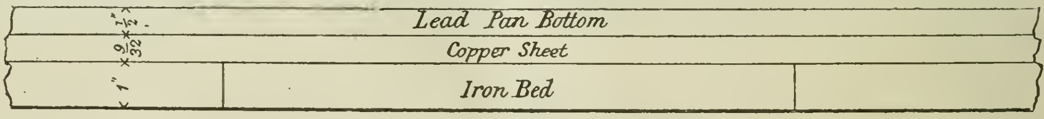
Fig. 4.



Sketch only; not drawn to scale.

It was, in fact, the risk that constantly exists, even with the ordinary flat cast-iron bed, of getting those portions over and near the fire dangerously hot that led the writer to devise the plan, for which provisional protection has been obtained, of inserting some good conductor, such as copper, between the lead and the iron, sandwiching it, as it were, in order to more evenly distribute the heat (Fig. 5). For this purpose gold of course would be the ideal metal, and though silver is not far behind the nobler metal in its conducting power for heat, still it is to be feared that, notwithstanding the complaints of the bi-metallists, it is hardly yet cheap enough for using under lead pans. Copper then, very little below silver in its efficiency, must be selected as a conductor to take away any excess of heat from a dangerously hot place to some cooler part where it can be safely and advantageously employed. The conducting power of copper for heat compared with that of lead being, as has just been stated, 898·2 : 179·6, it will be obvious, especially when taking into account that the corresponding figure for iron is 374·3, that a sudden access of heat from any particular portion of the iron surface will be more quickly spread over a large area than could be the case with the lead alone in contact with the iron.

Fig. 5.



It hardly needs demonstrating that the great conductivity of the copper presents no element of danger, still it is possible to object, that as this metal allows the heat to pass through it so readily, the lead might be imperilled. But, sandwiched between the iron and the lead as the copper finds itself, this metal can receive no more heat than that which the iron imparts, and this is exactly the same amount that the lead would be offered were the copper away. As, however, the copper readily conducts away the heat presented to its under surface laterally as well as through its thickness, it must be clear that any over-heated place in the iron cannot be so dangerous to the lead when the copper is interposed as if the lead were in actual contact with the hot iron.

As the linear expansion of copper when heated between 0° C. and 100° C. is 6·00172 of its length, a figure that is nearly a mean between that of lead and of iron, the arrangement above explained reduces, if not quite by half, yet in a considerable degree the great difference in the dilation that occurs between the two metals in contact when the lead pan is placed directly on the iron bed. The greater elasticity and tenacity of copper as compared with lead would also permit the use of the corrugated surface previously discussed, and which was shown to be impracticable with the ordinary plan of placing the lead pans directly on the iron. The greater elasticity and tenacity of the copper would, though in the form of a thin sheet, enable it to return to its flat position when cold, carrying up with it the lead from the hollows of the corrugations, again adapting itself to these concavities, when once more the metals might be subjected to heat.

The writer has now under observation a pan 6 ft. by 6 ft. placed over a pyrites burner with a plate of copper $\frac{9}{32}$ in. interposed between the plain iron platform and the bottom of the lead pan. The result in regard to the equal distribution of heat over the whole area of the pan is all that was anticipated or that could be desired, the temperature hardly varying one degree between the points that are exposed to the greatest and to the least heat. The interposition of the copper also seems in no way to diminish the efficiency of the apparatus as an evaporator. In point of fact it works so well that there is some difficulty in preventing the belief from gaining ground that the heat has actually increased!

The even distribution of heat proves that the desired object has been attained, and that the lead pan is thoroughly protected from those places in the iron bed where there is an excess of heat. At some future time it may be possible to bring before you results of working that cannot as yet be given, the apparatus having been completed and set to work only a few days ago.

It may be mentioned that the presence of any solid matter with the acid on the bottom of concentrating pans constitutes a serious danger. A piece of slate that may have accidentally dropped in or some crystalline accretion, however formed, that may prevent the acid from conveying away the heat may cause a local overheating that will destroy the pan. Such events should not be frequent; in fact, there is no reason why, with proper working, they should ever happen, but as they *have* occurred it is pleasant to think that the inserted copper plate would certainly afford a measure of protection in such cases.

The lead pans being all of one piece made from a single sheet, as has been above explained, require no autogenous soldering or burning. It is best, if possible, to replace them altogether when requiring repairs than to have them patched. Should this, however, from any cause be necessary, it is well to make sure that the lead strips used by the plumbers are actual lead and not some kind of solder. It is difficult to make some people realise that the strength of a chain is only that of its weakest link.

The lead saturators, in which sulphate of ammonia is produced, also require considerable care in management, although the heat in them is largely generated within the liquor they contain. The ammonia-gas coming from the still is led into the sulphuric acid with which the saturators are charged with considerable local evolution of heat. Brown oil of vitriol is usually employed by works that do not make acid, but chamber acid may be found strong enough to answer the purpose when this is available. The use of rectified vitriol would be wasteful in the extreme, nevertheless a dearth of other acid may justify its employment rather than bring operations to a standstill. It may appear superfluous to add that when such a contingency occurs it should be seen that the acid does not enter the saturator anywhere near the lead. Indeed the best plan would be to dilute it with due precautions before passing it into the saturator. The caution, however, may be worth noting, for the writer once saw a hole thus produced some 6 in. by 4 in. in lead $\frac{3}{4}$ in. thick, a result that might have been expected by anyone who considered the great heat evolved when concentrated acid is diluted.

In Mr. Levinstein's admirable address to the Manchester Section of our Society, printed in the number of the Journal just to hand, great stress is laid on the importance of technical schools to impart practical knowledge to students who may subsequently have to direct manufacturing operations. Whilst not minimising in the least the advantages to be derived from such a course, one may point out that there is an equal if not greater necessity for working men, the actual producers, to acquire a knowledge of the elementary principles of science. The want of this frequently leads to the most prejudicial waste and damage to their employers, and of course indirectly to themselves. Certainly it may happen that if a workman tries to ascertain the temperature of an acid by floating his thermometer and reading it as if he were taking the specific gravity of the liquid, the incident may be more likely to raise a smile than cause grief at the time, but on reflection it will be admitted that much damage must occur from ignorance of an analogous character in other directions.

A knowledge of geometrical rules and figures may not appear so important to the man who has to use lead as to the worker in iron, the disposition to feel that lead scrap is worth very nearly as much as the new lead being always present. None the less it may be a real misfortune to cut lead to waste on some occasions, and when a man has to rip open a new leaden scoop formed of parallelograms and triangles in order to make another like it the benefit that would accrue in his case from a better knowledge of geometry is very apparent. As this knowledge is equally useful to the girl who has to cut out a dress from the piece, or to her who spends her time in fancy work, as to the man who has to shape a piece of wood or metal, one may be permitted to express the opinion that practical geometry (not Euclid) should form a branch of elementary education and be taught to every boy and girl in the land.

This might go hand-in-hand with free-hand drawing the universal teaching of which has also been advocated, but desirable as efficiency in this art may be, in the opinion of the writer it is far below geometrical knowledge for practice purposes. The inaccurate measurements frequently given by men who one would think might be trusted encourages the belief that a little geometrical training in their younger days might have made them more reliable. Chemical industry is so intimately bound up with the mechanical arts whose very essence is geometry, that it may be inferred a more general knowledge of the principles of this science would put an end to many imperfect methods that promote waste. Doubtless we want good officers for the technical contests in which as a nation we are engaged against other countries of the world, but although it is not impossible that we may succeed even with imperfect soldiers, the result will be more glorious if we can lead good men to victory.

Discussion.

The Chairman said that Mr. Carulla in his paper had touched upon points of very considerable interest. He did not, himself, profess to have any special knowledge of lead, but he did recollect one statement, which he had acquired probably from the text-books, and that was that the presence of a certain proportion of antimony in chamber lead was advantageous in protecting the metal from the action of sulphuric acid. In "Thorpe's Dictionary" reference was made to researches by Calvert and Johnson, and others who had come to the conclusion that lead containing a proportion of impurities was better than lead which was pure and free from these impurities. It seemed strange that it had taken manufacturers so long to find out what lead was best to use for sulphuric acid chambers. We had still much to learn as to the effect of small quantities of foreign elements upon metals generally. Copper occurred to him as an important example. We found engineers specifying that locomotive fire-box plates should be made of pure copper, whereas the opinion was gaining ground that a moderate proportion of arsenic was a great advantage, though he did not know that the subject had ever been scientifically investigated. The Research Committee of the Institution of Mechanical Engineers had an intricate and difficult subject under investigation, the results of which would be of great value. He congratulated the author of the paper upon the application of scientific reasoning in order to find a protection for his leaden pans. He had adopted a very ingenious arrangement. One would have thought that the use of high pressure steam under the pan would have been safer, but perhaps it would not be so easy to supply steam as, of course, the top of the existing furnace was used in this case and the evaporation was done by waste heat.

Professor Clowes said he would like to ask the writer of the paper a few questions. He wished to know how the iron surface became corrugated permanently. He would like to know also whether these lead evaporation pans were used to any large extent. He had been to a fair number of vitriol works in different parts of the country and he had not seen many of them. They wished Mr. Carulla a wide adoption of his patent. Professor Clowes further stated that he had had occasion to report to an engineering firm why their leaden saturators became violently attacked by heating strong sulphuric acid in them. The specimen of lead cut off the saturator, when heated with the boiling oil of vitriol used, gave off torrents of sulphur dioxide, with formation of lead sulphate. This action could not be repeated with other samples of lead and of strong acid in the laboratory; would Mr. Carulla express an opinion as to whether the difference noticed was due to a difference in the acid or in the lead?

Mr. Taylor said he believed that competition and reduced prices had of late years led to inferiority, and he asked the writer of the paper whether he could suggest any ready tests for determining the quality of chemical and other lead upon its delivery from the manufacturer.

Mr. Forth mentioned an instance of a bleacher's lead-lined cistern, used for holding dilute H_2SO_4, wearing out in a very much shorter time than similar ones which had been used in precisely the same way. He wondered whether the bismuth given in Mr. Carulla's analysis of lead could vary enough to be the cause.

Mr. Paton pointed out that lead has such a low limit of elasticity that he thought, even with the suggested arrangement of corrugated iron bed, the buckling of the lead would still occur in the form of little folds on the larger corrugations of the cast-iron plates. He also thought the results obtained with the treble thickness of metals somewhat interesting, for they were hardly what might have been expected.

Mr. Carulla said in reply to Professor Clowes that the corrugation arrangement, as Mr. Paton had stated, was simply suggestive. With regard to another question as to a saturator which had disappeared suddenly, it seemed to him that there could not be much doubt that it was due to the heat produced by the strong acid entering into combination with the ammonia and steam from the still. The contact of oil of vitriol even with water might induce a temperature sufficient to cause an explosion. As to weak acid and its action on lead, the quicker wear of the dilute acid vessel was probably due, as Mr. Forth had anticipated, to the bismuth in the lead.

Mr. Carulia sends the following supplementary note :—

When replying to the discussion on my paper (see above) I omitted to answer Mr. C. Taylor's important question whether there is any ready test to ascertain the purity of lead when it comes into the works. The readiest test would appear to be to find out its specific gravity, at any rate if Percy's statement be correct that "the specific gravity of lead is diminished by the presence in sensible proportion of any of the substances which constitute the usual impurities in commercial varieties of the metal; so that other things being equal, the greater the purity the higher the specific gravity of lead" ("Percy's Metallurgy Lead," page 4).

Mr. Archbutt has been good enough to call my attention since the meeting to the researches of L. Pitkin given in two papers that appeared in the "Journal of the American Chemical Society," republished in "The Analyst" for 1884, pp. 119—125. The following paragraphs on the question of testing raised by Mr. Taylor are worth quoting :—

"We can easily see from the results we have obtained the importance of testing the lead employed in H_2SO_4 working, and for this no extended analysis is required. The operation consists simply in immersing the lead in acid, more or less concentrated, according to the strength of the acid with which it will be brought into contact in actual working, and at the temperature to which it will be subjected in the manufacture of acid."

"Mr. MacTear says:—'The simplest safeguard against risk to pans, &c., giving way would be a careful testing of the lead previous to being made into sheets. For this purpose it will not be necessary to make an analysis, but simply to put clean thin shavings of lead into a test-tube and cover with pure cold vitriol; the amount of action would then be clearly visible.'"

"It is, however, clear that the action of cold acid is no sure criterion of the effect that hot acid will have upon the lead; so, to avoid error, it is much safer to test the lead under the conditions of its actual employment."

If your space will allow I would refer to the remarkable results obtained by Pitkin with the alloys of lead and bismuth. It should be stated that he exposed a surface of 2 sq. in. of the alloy under investigation to the action of 10 cc. of c.p. sulphuric acid of sp. gr. 1,825 at a temperature of 100° C. for one hour. The amount of lead or alloy converted into sulphate per square foot is given in grammes.

The results he obtained are as follows :—

		Grammes.
57.	Pb 100 parts, Bi ½ part	24·840
58.	„ Bi 1 „	22·248
59.	„ Bi 2 parts	1·800
60.	„ Bi 3 „	1·008
61.	„ Bi 5 „	1·008
62.	„ Bi 10 „	2·160

The results given in 57 and 58 appeared so exceptional, not only in comparison with other alloys—when the corrosion at most reached only 4·392 grms.—but in regard to the sudden change shown in 59 and 60 that Pitkin decided to make experiments 57, 58, and 60 in duplicate, obtaining—

		Grammes.
57.	(Duplicate) Pb 100 parts, Bi ½ part	25·920
58.	„ Bi 1 „	22·750
60.	„ Bi 3 parts	1·224

The author continues "We here have a case in which not only the relative solubility in hot or cold acid is changed as regards other alloys, but one in which an excess of the deleterious substance seems to act as a corrective."

"The alloys containing $\frac{1}{2}$ and 1 part of bismuth to 100 of lead gave off gas very plentifully, not only at the start, but throughout the whole hour, while the acid became opaque almost immediately, and the lead sulphate formed could be removed in scales at the end of the experiment."

These very interesting experiments throw much light on several points raised during the discussion, besides being of considerable importance practically.

Glasgow and Scottish Section.

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E. C. C. Stanford.
R. R. Tatlock.
G. Watson.

Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, November 1st, 1892.

MR. CHAS. A. FAWSITT IN THE CHAIR.

DISCUSSION ON MR. D. R. STEUART'S PAPER ON "THE FLASH-POINT AND HEAT OF BURNING OF MINERAL OIL."

Part I.

Mr. Beilby said that in the report of Sir Frederick Abel and Mr. Redwood, it was throughout assumed that safety was to be gained by modification of the lamps alone. From that point of view the report appeared to deal with the question in a very satisfactory way. Possibly that satisfactory treatment of the one phase of the question might have blinded some of them to the absence of any practical suggestions as to the other and larger side, viz. :—the modification of the oil itself so as to ensure safety. He said the absence of practical suggestions as to the oil, because as Mr. Steuart had shown, though a new theory as to the safety of low flash oils was advanced, no attempt was made to follow this theory to its practical conclusions; for instance, it was not proposed that the flash point should be brought below 73 degrees with a view to increasing the safety of the public. As he understood it, Mr. Steuart's paper amounted to a plea for the consideration of that phase of the question which had been practically passed over in the official report. Mr. Steuart had acted wisely in bringing the matter before an independent Society like this, and he ventured to suggest that it was a subject which the Scottish Section might take up and pronounce upon in an unbiassed spirit. All, or most of the chemists of the Scottish oil trade were members of the Section, and it would be for them, if they saw fit, to confirm or controvert Mr. Steuart's experiments and the conclusions he had founded upon them. On the other hand it was to be hoped that members and others who were not commercially connected with the trade would so take part in the proceedings as to guard against any undue preponderance of the trade point of view. The questions raised in the paper were few and simple. What was the highest temperature reached by ordinary lamps burning under such unfavourable conditions as were likely to be met with in ordinary life? Having ascertained this, were there good reasons why the Government flash point should not be raised to such a point above the maximum lamp temperature as would ensure that there never could be an explosive mixture of oil vapours and air in the lamp, so that oil spilt from the lamp would not give off inflammable vapour. Surely such a condition in the lamp was more worthy to be called safe than that referred to in the official report where the safety or danger turned merely on the degree of explosibility of the vapour which was recognised as necessarily existing in the upper part of the lamp. Mr. Steuart's experiments seemed to him to answer both of these questions in a satisfactory way, but naturally it was a subject in which the observations of many experimenters would be valuable.

Mr. W. Ivison Macadam said that the oil he burned at home had a flash point of 147°, and he was of opinion that burning oil should not have a flash point of less than 100°. He agreed with Mr. Steuart when he spoke of the American oils being not homogeneous in character. Any one who tested samples of oils must have been struck with the difference in composition between foreign oils as compared with Scotch oils. For safety he considered oil as one of the best illuminants.

Mr. J. A. Thomson said that it seemed to him very strange that the Government should fix the minimum flash point of oils used by themselves at 105°, while for the general public they considered an oil with 73° flash as safe enough. Another strange thing appeared in the Inflammable Liquids Bill. That Bill imposed very stringent regulations upon the general public, but there was one clause in it which exempted nearly all Government departments from its control. A very great danger existed in London and other English towns where petroleum was extensively hawked through the streets, by fixing the flash point as low as 73°, whereas if it were fixed at 100° or 105° this would be avoided.

Meeting held in the Philosophical Institution, Edinburgh, on Tuesday, 6th December, 1892.

MR. CHAS. A. FAWSITT IN THE CHAIR.

DISCUSSION ON MR. D. R. STEUART'S PAPER ON “THE FLASH-POINT AND HEAT OF BURNING OF MINERAL OIL.”

Part II.

Mr. E. C. C. Stanford wrote, regretting that a previous engagement prevented his attending the meeting, and stating that he thought the question was simply whether the Government standard flash-point of 73° was safe for burning oils for general use. For Government use it evidently was not, seeing that they required 105° for the War Office, and 145° for lighthouses. Could it therefore be safe for the general public, especially the ignorant and poor? It appeared to him that 100° was quite low enough for public safety, and that a reform in the law was required. All safety-lamps he regarded as a confession of weakness somewhere. The safest general lamp would always be that which burns the safest oil. A safety-lamp attacked the problem at the wrong end. He had had long experience in the use of oils for lighting, and had come to the conclusion that the ideal lamp was that in the lighthouses where the oil was raised to the level of the wick. This would require the use of a safe oil, and probably some expensive sort of moderator lamp. He much preferred glass reservoirs to metal ones.

The Chairman, in opening the discussion, said that Mr. Steuart's paper brought before them very forcibly the danger of burning low flash oils. That a large amount of interest had been awakened in the matter was plain from the number of letters and articles which had appeared in the journals and newspapers since the paper was read. The consensus of opinion seemed to be that the majority of lamp accidents had occurred on account of the low flash-point of the oils. The matter was not a local question, but was one of national importance, and, if the Society could by any means prevent or lessen the occurrence of accidents, it would be doing a national service. He thought the remarks should be confined to the question, whether oil of 73° F. flash-point—no matter whether Scottish, Russian, or American—was safe for burning in any lamp. It would, of course, be advisable to hear the remarks of oil chemists, and business representatives from the oil companies; but they must also obtain the opinion of disinterested parties, because outsiders would naturally say, if only oil chemists took part in the discussion, that it was one-sided. If they concluded that oil of 73° F. flash was not safe, then they must certainly aim at some practical issue; but what practical form the issue would take would have to be settled after they had heard the views of the meeting. Should a committee be formed to make further investigations, it might be well to ask some independent gentlemen to make a few experiments, or review the evidence, and give the section their report, because to outsiders—while Mr. Steuart brought everything forcibly before members of the Society, and his figures seemed quite correct,—the paper had perhaps a savour of the Scottish oil trade. The Glasgow Chamber of Commerce, he knew, was very stiff to move in such matters, but the Edinburgh Chamber of Commerce might be persuaded to take the matter up and carry it forward. It seemed to him to be a point of great interest to the country generally, and, therefore, quite a subject for the Chamber of Commerce to investigate.

Mr. Steuart said, in the paper he read in Glasgow, he argued that the temperature of the climate and the heat developed in lamps by burning, demanded 100° F. as a minimum flash point. He thought that this was a matter that all could appreciate and pass judgment on. Abel and Redwood's report practically said that safety should be sought in the lamp, and that oil with the present flash-point of 73° was safer than an oil of a higher flash, and as they thought that high flashing oils developed more heat in burning, they warned people against trusting to those oils. His experiments proved, he thought, that the general rule, as far as there was a rule in the matter at all, was that higher flashing oils tended to produce less heat, and, therefore, were safer in every respect. The numerous deaths caused by lamp explosions, and the greater destruction of property arising from oil fires, warned the public to investigate the matter anew, so that, if possible, the mineral oil trade might be developed on lines consistent with public safety.

The dangers of storing and carrying low flash oils were very obvious. The facts regarding them were to be found in a Memorandum on the Inflammable Liquids Bill, 1891, to be had from Eyre and Spottiswoode, price 1s. In this were also to be found the flash-points adopted in other countries, and in the different States of North America and Canada, and the regulations for storage and sale of oils.

The different States of the Union had different regulations, the test varying from 100° to 150° fire point. Some

States had adopted a close test of 120°. Canada, which was a petroleum-producing country, had safety point 95° Abel test. In Germany the point between spirit and burning oil was 21° C. (70° F.) with restrictions as to storage and sale of both. In Austria it was 100° open test. If they in Britain were in error, they were, by their example, responsible for the deaths and the destruction of property occurring in other countries.

At the inquest on Lord Romilly in London, "Mr. Alfred Spencer, deputy clerk to the County Council, gave evidence as an expert under the Petroleum Acts. He said that the oil used in the lamps of the late Lord Romilly was of the best quality. These high test oils were, however, practically no safer in actual use than the ordinary petroleum oils used by the poor people In fact, under certain conditions, they were a greater danger, because they generated a greater heat, and thus gave off an inflammable vapour at an earlier period." These words were from a London daily paper, and showed that the interpretation which he had put on Abel and Redwood's report was the natural one. In connection with this case, Mr. Redwood afterwards explained that his remark in the report did not apply to such oils as Lord Romilly had, viz., the high-flashing, water-white petroleums, as these burn with less tendency to heat than the ordinary petroleum, but that if ordinary petroleum had its flash-point raised by merely distilling off some naphtha then the higher flashing residue so obtained might produce extra heat, and that it was by trying an experiment of this kind that Abel and he obtained the higher heat with the higher flashing oil. He (Mr. Steuart) had experimented by distilling off some naphtha from ordinary petroleum, and taking the residue without distillation and comparing it with some of the original oil. Distilling off naphtha in this way darkened the oil owing to decomposition of the sulpho-compounds, which, with their decomposition products, were concentrated in the residual oil. He found a slightly higher temperature in some cases with the residue, in others not; but in no case did he consider that the increase in temperature would neutralise the effect of higher flash. He, at most, got 3° higher, and it would have had to be 22° to neutralise the height of flash. In another case, where there were 50° of difference in flash the higher flash gave the least heat. But he thought those present would see that treated oil with naphtha distilled off was not comparable with oil in its original state. In the experiments he gave in his paper he distilled all over so as to ensure the oils being quite comparable. If the Americans made an oil of higher flash they had to keep out a little heavy oil as well as naphtha, otherwise the oil would not burn well. So the dangerous oil that Abel and Redwood were so carefully guarding people against was one that was never put in the market and never would be. He was very much pleased to find that with respect to the high flash oils in the market, Mr. Redwood held the same opinion in regard to their increased safety as every other scientific man.

It seemed to be a common result of allowing a lamp to burn low to get a higher temperature developed at the burner. With the lamps he had he could not get this increase of temperature; to burn the lamps low with him was always to reduce the temperature. Why should burning a lamp low cause heating? No doubt because the flame was brought into closer contact with burner and dome. With an ordinary large flame it was only comparatively cool unburned gases that were near the metal of the lamp. One would expect that with the small flame caused by heavy oil being present, increase of temperature of burner might take place. With the lamps he used, as a general rule, he got a lower temperature. There might be lamps that gave a higher heat with oils containing a heavy oil residue. High flash did not necessitate the presence of heavy oil; and even with heavy oil left in he did not think the extra safety of the higher flash could be anything like neutralised.

He thought he had thoroughly disposed of Abel and Redwood's remark—"that safety in the case of mineral oils is not to be secured simply by the employment of oils of comparatively high flashing point, and that the use of such oils may even, in certain circumstances, give rise to dangers which are small, if not entirely absent, with oils of comparatively low flashing point." He thought he had proved that high flash was increased safety in proportion to the flash point, and, as a general rule, even more than in proportion; and there was no unknown danger to counterbalance this result, but that Messrs. Abel and Redwood's remark arose from the mistake he had pointed out. He thought Abel and Redwood's proposal to attain safety in a lamp from low flashing oil warmed by the burning, an exceedingly foolish and dangerous one, and was sure from theory that safety even from explosion could not be attained in this way.

He had tried experiments, heating the lamp in a water-bath and exploding the vapours with electric spark. The oil reservoir was half filled with Royal Daylight Petroleum flashing at 80°. He found that the oil attained the temperature of the bath in 25 minutes and he heated for half an hour. In one series of experiments made in imitation of the ordinary lamps in use in Scotland he corked the reservoir tight; he exploded the mixture at 85°, 90°, 95°, and so on at every five degrees up to 140°. All exploded violently. Dr. W. Thörner had experimented on exploding vapours, but he had only tried the lowest temperature at which he could get an explosion, which, on the average, was less than 1° above the Abel flash-point, and in general the explosions were not violent. Dr. Thörner's experiments were published in "Chemiker Zeitung," 1886, Nos. 34—39, 80—86, and translated in "Oil and Colourman's Journal," August 1886, March, July, and August 1887. As far as he (Mr. Steuart) could judge, the explosions were all about the same severity. He tried some experiments with a hole in the cork, so that the vapour might blow out the air. After heating 1½ hours at 120° he got a sharp explosion. So at 40° above the flash-point the safety point had not been reached. With 1½ hours at 140°, however, there was no explosion. He tried another sample of Daylight Petroleum, which flashed at 73°, in a similar manner, with a hole in the cork. After 1½ hours at 93°, 20° above the flash-point he got a sharp explosion, and the same after 1 hour's heat at 113°, 40° above the flashing point. So the Abel and Redwood's so-called safest condition was not to be reached in any practical temperature of lamps, and if it were, it could not be depended on to have been reached in any particular case, but to reach that state in every case, the state of greatest danger had first to be passed through.

Ordinary Scotch 730 naphtha, heated in the reservoir of an ordinary paraffin oil lamp, half filled, did not explode after heating to 80° for 1½ hours. So if anybody wished to attain in their lamps the greatest safety conceivable by these authorities, they would have to fill their lamps with naphtha; but how long it was before the safe state was reached, he had not tested.

In contrast to Abel and Redwood's recommendation of attaining safety with strong metal lamps, and vapours in oil reservoirs guarded by wire-gauze, as in a miner's safety lamp, Mr. Steuart quoted from Dr. Chandler, chemist to the Department of Health of the City of New York, who says, "It is an axiom that no lamp is safe with dangerous oil, and every lamp is safe with safe oil. * * * Nor is any oil safe that can be set on fire at the ordinary temperature of the air. * * * Half the so-called safety lamps are no safer than those which make no claim to safety, while the other half are only safe as long as they are in perfect order, and subject to no carelessness in the filling or handling. Persons will be careless and thoughtless; it is human nature to be so. What we want is safe oil; with it all lamps will be safe. The safety lamp is positively objectionable, as it leads persons to purchase dangerous oils without question. They allay one's fears of explosive oils, and the accident, which is much more likely to occur outside than within the lamp, is just as likely to take place."

This report was written in 1871, but it was common sense for all time. Dr. Chandler said common petroleum flashed at 86°, and he thought all should be made 100° flash. He showed how this could be done by cutting out the naphtha. He said, "The increased expense of this plan would not reach more than three or four cents per gallon. The addition would be cheerfully paid by the consumer to insure himself and his wife and family from a horrible death." Mr. Steuart was sure that increasing the flash to 100° F. would not increase the price in this country by more than one penny per gallon.

The danger of ordinary petroleum at present was not an imaginary one. Mr. Alfred Spencer gave (from the Registrar-General's Returns) the average number of deaths from lamp explosions as 100 a year in England and Wales, and he believed there were twice as many from upsetting of lamps. That would make a total of 300 deaths per year for England and Wales. Then there was the destruction of property, and the constant fear of accident. Against the proposed change of flash-point, there would be a temporary inconvenience and decreased dividend to the foreign producers of petroleum. This, he was sure, would only be temporary. And what was still a greater objection, an increase in the price of oil to the poor, of perhaps a penny per gallon. The oil of the rich would probably be cheapened. The saving of life and property, and the absence of risk and fear, were strong reasons for the proposed alteration.

By the extinction of the Scottish oil trade, they would be at the mercy of foreigners, who would combine to raise the price of oil, and in time of war, with foreign trade impeded, the inconvenience and hardship to the poor would be very great. Yet not even to avoid this would he propose anything of the nature of protection. If the home trade could not compete with foreigners on true terms of equality, it should cease to exist. He would, however, like the trade to get fair play in the competition. He did not think, however, that the Scotch oil manufacture was in danger of extinction at present.

His experiments were more than sufficient in his own opinion to neutralise the report by Abel and Redwood; but he could not expect others to be so easily satisfied. He might be looked on as an interested witness. If so, a committee should be appointed of sufficient weight to satisfy the world. It was ascertainable facts they had to deal with, and mere opinion was nothing. If high flash did not produce extra heat in burning, then the higher the flash, the safer the oil.

He thought it was most important that qualified men outside the trade should speak and tell them, whether they considered that the flash-point should be raised, and also whether they were sure that by doing so, they were not incurring any other danger. If all were satisfied as to these points already, and passed a resolution to that effect, no doubt it would help greatly to induce the Government to reconsider and re-investigate the matter. He thought 100° was quite safe enough for ordinary lamps in an ordinary state of cleanness. They must not go beyond the practical requirements of the case for fear of raising the price too much. There had been a few bad accidents from overturning lamps with high flash oil, but they must not let these influence them more than justice required. Flour dust in mills was explosive, and coal dust in mines, yet flour and coals were not looked on as dangerous; so neither should high flash oil be looked on with any fear, or burdened with onerous restrictions, because of a few fires produced by unusual circumstances not likely to be repeated.

Mr. J. Gray said he thought it would be admitted by all who looked at the subject in an unbiassed way, that a clear case had been made out by Mr. Steuart in favour of raising the legal minimum flash-point of burning oil.

He hoped to have had some experiments made in connection with the subject, but his time had been otherwise taken up since the reading of Mr. Steuart's paper. He had observed, however, that in the case of an ordinary Scotch burning oil flashing about 120° F., and working with a small oil container filled exactly half-full (which condition might be taken as a probable average of the lamps in general use), the temperature required to produce an explosive mixture was considerably above the flash point of the oil, whilst, in the case of a sample of American petroleum, flashing at 76° F., the difference between the flash-point and the temperature at which an explosive mixture was formed, under exactly similar conditions, was very much less. The explosive force in the case of the low flash-point oil was slightly greater than in the case of the high flash-point oil. In his experiments, the explosions were effected by means of an electric spark, and the force of the explosion was measured by means of a mercury gauge fitted with a registering arrangement. He drew attention to the large quantity of mineral oils used at the present time in heating stoves. He did not remember ever hearing of any accident due to the employment of mineral oils for this purpose, but he had noticed the oil-container in some cases got very hot from radiation. In one instance the temperature of the oil reached 93°, a very dangerous temperature for a low flash oil. In the event of further inquiry into the matter, he thought some information should be obtained on this point.

The employment of lamp shades had a decided influence on the heat of the oil container, and consequently on the oil itself. In the case of opal glass shades, especially, there was a large amount of heat reflected on the oil font. He had had occasion to handle lamps for a good many years, privately as well as in business, and he had frequently found the oil in the fonts over 80° F. under ordinary conditions. He had never seen even the semblance of an explosion under these conditions, but then the oil was always from 110° to 120° F. flash-point.

Great stress had already been laid, and rightly too, on that most peculiar, and as yet unexplained anomaly whereby Government legalised oil having a flash-point of 73° F. as safe for the general public, whilst a minimum flash-point of 105° F. was required by the War Office, and 145° F. by the Lighthouse Commissioners for all mineral burning oils supplied to them. That of itself was surely sufficient to demand an impartial inquiry into the question.

Since Mr. Steuart's paper was read, there had been several petroleum accidents reported. A lamp explosion in Ireland caused the death of two girls, a fire in a workhouse in England resulted in the death of two inmates, and an explosion on board a British vessel on the Seine, was accountable for the loss of nine lives. In all, 13 lives within a month. And yet the Home Secretary had written to Mr. Steuart that "he was advised that there are not sufficient grounds either of safety or convenience, for an alteration of the existing flashing point for mineral oils."

In Allen's Commercial Organic Analysis, Vol. II., page 391, under the heading of petroleum, there occurred the sentence, "Clearly, the lower the temperature at which an oil 'flashes,' the more dangerous its transportation, storage, and use must become." Page 400, foot-note 1, it was stated, "B. Redwood to whom the author is indebted for a perusal and revision of the entire article on petroleum products." He argued that as Mr. Redwood had revised this article, he must be held as concurring in it. It would be interesting to know how he reconciled this statement with the views expressed in his joint report, and with his remarks before the Society of Arts.

That a high flash-point tended to increased safety was freely admitted even by those responsible for the manufacture of low flash-point oils. He quoted from an advertisement of an American petroleum in which it was claimed that "its fire-test is so high as to make it the safest lamp oil made from petroleum." The flash-point of this brand he found to be 104° F. Regarding another brand of American petroleum, it claimed that it had "the splendid record of absolute immunity from accident." Mr. Fox, chemist to the Petroleum Association, certified the flash-point to be 116° F. and testified "that this oil possesses the maximum amount of safety to be procured in a petroleum." Mr. Boverton Redwood too, gave this oil a testimonial, in which he said, "possessing in a high degree the various qualities which are desirable in a product of this description." This testimonial bore a date so recent as June 1892. Could Mr. Redwood have changed his mind on this vital question, since he compiled his joint report with Sir F. Abel?

He submitted that it was abundantly proved that a high flash-point secured greater safety, and that 100° F. was the lowest point which could safely be fixed upon as the minimum flash-point. The subject was fully ripe for inquiry. Public interest was aroused in it, and action must be taken in one way or another. He awaited with great interest, the steps which the Section might decide to take with a view to bringing the subject to a satisfactory issue.

Mr. Young, of the Linlithgow Oil Company, did not claim to be an oil expert, but desired to make a few remarks on a subject of such public interest. In their report Sir Frederick Abel and Mr. Redwood admitted that when the flashing point of oil was even a little above the legal standard, *i.e.*, 73°, vapour would be given off comparatively freely. But they went on to say that oil of a high flash-point evolved a vapour more dangerous than that evolved by a low flash oil. In view of this statement it would be interesting to know what mean point Sir F. Abel and Mr. Redwood would name as that of perfect safety. In connection with the standards fixed by the War Office and by the Lighthouse Commissioners, it was worthy of remark that Sir Frederick Abel himself, being chemist to the War Department and chemical referee to the Government, doubtless gave the advice by which the War Office and lighthouse standards were fixed. Why had Sir F. Abel and Mr. Redwood fixed these standards so high? Americans laid great stress upon the high flash test, and it was a significant fact that all their "low grade" oils were sent to this country. The British Government standard admitted of those low grade oils being imported. It was rather unfair that the United Kingdom should be the dumping ground for inferior qualities of American and Russian oil. Mr. Bedford of the Standard Oil Company said that no American would burn low grade oil, and expressed some surprise that the British should be content with oil considered by Americans to be inferior and unsafe. He (the speaker) repudiated insinuations which had been made to the effect that this movement on the part of the Society had for its object a revival of protection in this country. Protection was not desirable, nor could they get it, but the question before them was a practical one which concerned the public safety. He suggested that the Society should appoint a committee, with power to consult two or three chemists of high standing, who should be asked to state whether, in their opinion, the present standard was proper or should be raised. If they said that the present standard was safe, the minds of people would then be at rest. If, upon the committee's advice, Government raised the flash point to 100°, 105°, or 110°, there would be no difficulty in making oil of these standards; it might cost an extra penny per gallon, probably less.

The Chairman said that while it was most desirable that such a committee should be appointed, and experts consulted, he questioned if the Section had power to grant the necessary funds.

Mr. Young did not anticipate the slightest difficulty in getting the money.

The Chairman suggested that the money might be raised by the Oil Association, but a committee so subsidised would be liable to be considered somewhat one-sided, and so lose weight. In justice to Sir F. Abel and Mr. Redwood he might remark that he did not think those gentlemen took upon themselves the responsibility of fixing the flash point at 73°. Sir Frederick Abel read a paper in 1881, in which he stated that oil which flashed at the old standard of 100° with the old apparatus, flashed at 73° in the new one. That was how 73° F. was fixed. Tests with the same oil were made by several independent chemists, and 73° F. was accepted by the Scottish Mineral Oil Association. In 1888, before the consultative committee on petroleum legislation, which included four members of the Scottish Mineral Oil Association, Mr. Mann, of Young's Oil Company, Mr. Scott, of the Clippens Oil Company, Mr. Wishart, of the Oakbank Oil Company, and Mr. Young, of Linlithgow, Mr. Mann acknowledged that the Government had been wise in fixing the flashing point of burning oil at 73° F. He (the speaker) certainly thought that 73° F. was too low, but he did not think that Sir Frederick Abel and Mr. Redwood would altogether accept the responsibility for having fixed it.

Professor Crum Brown said that he would be sorry if anything went out from that meeting which would appear to reflect upon Sir Frederick Abel. They all knew that Sir Frederick was a perfectly honest and fair man. He was sure that even in the heat of argument none of the speakers suggested anything beyond possible mistake. Their only desire was to secure safety from accident, and it had occurred to him that help, and possibly even funds, to carry out investigations might be obtained from the fire insurance companies, who were interested in promoting legislation calculated to diminish risk of fire. Referring to the constitution of an investigation committee he deprecated the employment upon it of chemists, and especially of those interested in the manufacture or sale of oil. In his opinion the committee should rather consist of business men who would be guided by competent evidence, including that of experts. Personally, he had never investigated specially the character and composition of burning oils. He had once been present when a lamp was upset; it went out immediately, and no damage was done. In making these remarks his judgment was influenced by no interest in the sale or manufacture of oils, but solely by a desire for public safety.

The Chairman asked if he would consider an oil of 73° flash too low?

Professor Crum Brown replied that as he had never made personal experiments his opinion was valueless, compared with that of people who had made them, but common sense dictated the conclusion that any substance which gave off inflammable vapour at ordinary summer heat, or in warm rooms, was dangerous, and demanded special precautions in its use as an illuminant.

Dr. Stevenson Macadam said, that the subject was one of great importance. He had great experience in the testing of paraffin oil. From the first the general understanding had been that any oil which, under ordinary circumstances of burning in a common lamp, gave off inflammable vapour under 100° F. was unsafe for domestic use. It was upon that understanding that the first testing apparatus—the open one—had been employed. But when by and bye the close-testing apparatus came into use it was found that an oil, which had been considered safe because it had not flashed below 100° in the open tester, evolved inflammable vapour as low as 80° in the close tester, and was therefore dangerous. When the testing apparatus got still further improved, it was discovered that this same oil would give off inflammable vapour at 73°. So that an oil, which was previously supposed not to flash below 100°, was now found to flash at 73°. Government had made the mistake of assuming that having fixed the standard at 100° they might, in the light of more recent experiment, safely bring down the standard to 73°. They should have adhered to the original standard of 100°, no matter what the testing apparatus was. If they had done so the quality of paraffin burning oils would have been improved, until the country would have been supplied with really safe oils, with a flash point of something like 120° F. in the old open apparatus. He did not attribute the mistake to any bias on the part of any experimenter. It seemed rather that by an error of judgment the standard had been lowered to suit the dangerous oil, instead of the dangerous oil being refined to the safe standard. He was confident that 73° was not a safe flash point for lamp-oil. A lamp which, while clean, might burn a 73° oil with safety would, when the free current of air was obstructed by dirt, get heated as to its fittings, with the result that the temperature of the oil would rise to 80° or more. They all knew also that inferior cheap lamps were so constructed that great heat was communicated to the fittings, and thence to the oil. The question was one not of the safety of oil when burning in the best lamps, but when burning in the lowest class of lamp. As to the very high flash point required for mineral oils used in lighthouses, he might state that the Northern Lighthouse Commissioners were the first to introduce paraffin oil into the lighthouses of the United Kingdom. He along with others conducted the experiments, which resulted in the recommendation that for lighthouse illumination, an oil ought to be used which, whilst giving a good white light, had the highest flash point obtainable in a free burning mineral oil. In consequence of that recommendation the standard had always been from 130° to 140°, or even higher. In lighthouse lamps the highest temperature that the oil attained in any part of the lamp and connections was about 86° F., so that it was quite impossible to use anything like 73° oil with safety. Oils could now be obtained of much better quality and much more evenly run than they were 20 years ago, and since they could now get better and more evenly run oils, not a mixture of various degrees of gravity and firing point, but of more uniform quality throughout, there was all the more reason to insist upon the original standard of safety, viz., that in the United Kingdom a safe burning oil for ordinary domestic and trade purposes should be one with a flash point not under 100° F. in any recognised testing apparatus.

Dr. Aitken commended Mr. Steuart's paper as drawing attention to a very important matter, upon which it was evident that Mr. Steuart felt very keenly. But from what he knew of Mr. Steuart, he was perfectly sure that he was actuated by purely humanitarian feeling and not by any self-interested desire to relieve the presently depressed oil trade of Scotland by directing public attention to the superior safety of Scotch over imported oils. He quite agreed with the main drift of the paper, and the general conclusions arrived at, viz., that there was danger in the use of oils of low flash-point. It was evidently the original intention to prohibit the sale of oil flashing below 100°. But in the light of more perfect means of testing the flash-point ought to have been raised, because the conditions under which an explosion might take place in a paraffin lamp, were just the conditions established in the improved apparatus. He hoped the suggestion as to the committee of enquiry would be carried out; not an expert committee entirely, but one which would take the advice of experts. It was a very peculiar thing that in this country, there was in use oil of a flash-point lower than the standard in those countries where low flashing oils were produced.

Mr. J. Falconer King said that his opinion that the flashing point of oils was too low, was probably shared by most chemists who had considered the subject. Why the reduction was from 100° to 73° it was difficult to comprehend. The invention of more accurate means of ascertaining flash-point, was no reason for lowering the legal limit of safe temperature below 100°. Several reasons might indeed be stated for raising it. The chief of these was the public safety, but beyond that it was important that, by immunity from accidents in its use, the popularity of paraffin oil as an illuminant should be increased. He would be pleased if, by a resolution of the meeting, or in any other way, something could be done towards putting the matter right.

Mr. W. Ivison Macadam said they would naturally expect that the flash-point of all oils, to be safe in this country, would be fixed at a point somewhat higher than summer heat. Last summer the temperature one morning stood at 102°. A flash-point of even 100° would obviously not cover that temperature. Therefore it was an argument for a flash-point of at least 110° or 120°. An American oil which he had tested flashed at 69° F. That was the lowest flash he had met with, but he had had samples at 78° or 79°, and these on a day of ordinary summer heat would certainly be most dangerous. He was glad to know that Mr. Redwood agreed that a higher flash-point did not mean increased temperature in burning. Mr. Steuart's experiments, as well as some made by himself, proved that point. At first sight it appeared that glass lamps were safer than lamps made of metal, because metal conducted heat more readily than glass. This was true to some extent where the wick fittings were of metal, and where the heat of the flame was practically conducted down through the centre; but a glance at the reports of Sir Frederick Abel and Colonel Majendie showed that in all the accidents investigated by them, 23 were in glass apparatus, and four only in metal. He had tried experiments with both metals and glass fittings, and did not find his first conclusion hold good. He did not recollect Mr. Steuart's conclusions on the point, but his impression was that Mr. Steuart rather advocated the adoption of metal than glass.

Mr. Steuart said that on the contrary he advocated glass rather than metal. The metal lamp he used gave an unusually high temperature, 10° higher than the glass lamp.

Mr. Ivison Macadam continuing said that—The fact remained that of the accidents, 23 were in glass, and four only in metal. He had not the least doubt that the best lamp for ordinary purposes was a fountain lamp, and yet in that kind of lamp, of the best construction, filled with 145° flashing oil and starting with a temperature at 54°, he had found that in 4½ hours the oil in the burner had risen to 82°, and the oil in the fountain to 76°. A certain temperature was necessary for the burning of this oil. A flat 1¼ inch wick gave only 12 candle-power, and 22 lb. of sperm value of oil, while an Argand burner which conserved the heat, and with only 1 inch wick, gave 18·83 candles, and 27·2 of sperm. Other experiments showed that at high temperatures certain oils actually decreased in illuminating power. Dr. S. Macadam knew of one instance in a lighthouse where an extra series of reflectors, by increasing the temperature so diminished the light power that the reflectors had to be removed. He (the speaker) experimented with shaded lamps and found that the temperature below the shade frequently rose to 86°; the oil used was a lighthouse oil of 145° flash-point. In oil stoves, the front temperature was frequently over 84°. The flash-point should not have been lowered below 100°. A strong corroboration of that view was to be found in the report by Sir Frederick Abel and Mr. Redwood to the Secretary of State for the Home Department, in which a number of lamp accidents were summarised. (Paragraph 33, page 8.) In one case the oil flashed at 73°, in one at 74°, one at 77°, one at 78°, two at 79°, one at 82°, one at 83°, one at 84°, one at 86°, one at 88°, and one at 110°. Notwithstanding that information the Government still retained the low flashing point of 73°. The Society ought to memorialise the Government to increase the flash-point and so increase safety.

Mr. J. Stuart Thomson, thought that one point ought to be made clear. Prior to the introduction of the Petroleum Act of 1879, the Scottish Mineral Oil Association, along with other interested parties, were asked to experiment with the new close test apparatus introduced by Sir Frederick Abel for the purpose of determining what flash temperature in the new apparatus was equivalent to the flash temperature of 100° F. in the open test. The equivalent was ultimately fixed at 73° F., that being the average of a number of experiments made by different operators. Several attempts had been made by the Scottish oil companies to get the minimum flash-point raised, but the opposing interests had in every case been too strong to allow of their proposals being carried through Parliament. So firmly, however, did the Scottish oil companies believe in the wisdom of their proposal, that they had voluntarily adopted 100° F. close test as their own minimum standard of safety, and it was to this that the immunity of Scottish oil from explosion and accident was solely to be attributed. The proposal to nominate a committee to take evidence and lay the matter before the proper authorities, was a satisfactory movement on the part of the Society.

Mr. Irvine, alluding to lamps in which the air supply is fed to the wick through the centre of the oil vessel, thought that it would be interesting to know whether in lamps so constructed the temperature in the oil reservoir was maintained at a lower point, than in lamps where the air was drawn to the wick from the outside.

Professor Crum Brown remarked that, in the case of oils which could not be supposed to be homogeneous, Mr. Steuart's table showed that, after burning for a long time, the residue of oil left in the vessel had practically the same specific gravity and flash point as the original oil put in, so that the oil which would be fractionated in a retort, was apparently not fractionated by the wick, and and although evidently a mixture it burned as though homogeneous.

Dr. Stevenson Macadam moved the following resolution: "That this meeting is of opinion that further investigation "should be made into the matter of the proper standard of "safety for mineral oils, and that it be remitted to the "committee of the Section to consider the whole subject "and bring up a report at the next meeting of the Section "indicating their views with regard to the whole matter." Professor Crum Brown seconded the motion, which was adopted unanimously.

Mr. Steuart referring to Mr. Ivison Macadam's remarks as to the comparative safety of metal and glass lamps, said that in order to be of any use the statistics relied upon must take into account the comparative numbers of glass and metal lamps in use in London. As that was not known the numbers quoted by Mr. Macadam offered no reliable data for the conclusion arrived at by that gentleman. Referring to Professor Crum Brown's remarks as to the non-fractionation of the oil by the wick, he (the speaker) accounted for that by the fact that in his experiments the lamp was filled only once. In practice fresh oil would be added to accumulated residues in the lamp, and thus the oil in the font would become heavier. This cumulative effect was not shown by his experiments.

With regard to certain portions of his paper he did not well know what to say. Had he calculated upon its arousing so much interest he would have written some portions with greater reserve and under greater restraint than he had done. He confessed that he had discussed the report of Sir F. Abel and Mr. Redwood under some feeling of indignation and under a strong sense of the duty which lay on him to prove that the report was wrong. The matter was not one of mere rival trades, it was ripe for being taken up in the interests of the public. For he felt that so long as that report was recognised as true scientific teaching, it was a report full of danger and responsible for the annual loss of hundreds of lives. It was doubtless possible to discuss the scientific question without making direct personal reference to the report or its authors, but the matter could not be discussed without passing judgment indirectly on its authors. He had preferred to be rather direct. If this had been an error of judgment on his part he hoped that it would not deter others from supporting a good cause.

Dr. Stevenson Macadam thought there was one fact which the investigation committee should take into consideration. It had been shown that oil which gave off inflammable vapour at 73° in this country, gave a flash point of 66° in India. The same result could be obtained in Britain by experimenting in rooms heated to tropical temperature.

The Chairman said that the German Government fixed the flash point at 72° F., and after the British Government legalised 73° F. and after Sir Frederick Abel read his paper and drew up his report in conjunction with Mr. Redwood. He thought it strange that a nation who usually investigated scientific matters with great thoroughness should fix the flash point for burning oil at 72°.

Dr. Stevenson Macadam believed that the Germans adopted the general principle of Sir Frederick Abel's apparatus, but had so improved the mode of heating, that the oil which flashed in Sir Frederick Abel's apparatus at 73° flashed in their improved apparatus considerably below 73°.

The Chairman asked Dr. Macadam if he did not think a temperature of 72° too low for national safety?

Dr. Stevenson Macadam thought so. The fact that such a temperature had been fixed in Germany was due to the delicacy of the testing apparatus.

The Chairman said the experiments that Mr. Ivison Macadam had made showing that shades on lamps caused a rise in temperature to 86°, appeared to him to be valuable; for in ball rooms, where lamps with shades were so very much employed, the heating of a lamp even 10° or 15° F., when filled with 73° F. flash oil, might be very disastrous, as the air was often over 73° F. to begin with.

A statement had been made at the last meeting, to the effect that oils should be labelled. Government should certainly force the vendors to label oils in the way that other chemicals were distinguished. If the barrels were different colours for different flash points people would know what they were buying, and they would willingly pay a little extra money for an oil which they knew to be perfectly safe. People had wondered why it was the Government stipulated for 105° for the Army Stores, and 145° for the lighthouses. He thought that the 105° oil was intended for use in India or in other hot climates. It appeared to him that as petroleum tank steamers carried low flashing oils, it was a source of danger to these ships and crews. The Government should put restrictions on such boats, and make their owners take precautions.

If the course was taken which had been suggested moved by Dr. Stevenson Macadam, and seconded by Professor Crum Brown, he was sure that a practical issue would come of the discussion, which would be of national importance.

Mr. Ivison Macadam said he thought it right to mention that the flash point for India was really 73°, and that the 105° flash point oil was intended for use in Aldershot camp.

Mr. J. Stuart Thomson, confirmed the statement that 73° was the legal flash point in India. He pointed out that full details regarding the effect of high temperatures on the flash point would be found in a paper by Sir Frederick Abel in the first volume of the Society's Journal. The trouble could be got over by cooling down the oil to somewhere about 40° or 50° below the flash point, and keeping it at that temperature for some time. The phenomenon was due to vapour tensions.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The Purification of the Feed-Water for Boilers.
H. Schreib. Zeits. f. ang. Chem. 1892, 514—517.

The author draws the following conclusions from his experiments:—(1.) There is no method of purification that can be regarded as the best; local conditions must determine the method to be adopted. (2.) As a matter of principle the removal of bicarbonates by heating, and of sulphates by means of sodium carbonate is better than the employment of caustic soda, but for practical reasons the use of the latter is often preferable. (3.) No prejudicial results on the boiler attend the use of caustic soda.—C. A. K.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

Smoke Prevention. Report of the Special Committee of the St. Louis Engineering Club, U.S.A. Journal of the Association of Engineering Societies, Chicago, 1892, 291; Proc. Inst. Civil Eng. 1892—3, **111**, (1) 42—46.

The authors of this report having been charged with the duty of investigating the coal-smoke problem, while making such recommendations as may tend to abate the evil prevailing to a very serious extent in the city of St. Louis, have given careful consideration to a number of general questions relating to the use of fuels which are everywhere applicable. Large coal-users are, as a rule, disappointed with the results they obtain with such smoke-preventing inventions as have hitherto been devised. These inventions are in some cases unsuccessful because of an entire misconception of the principles involved in the combustion of bituminous coal, and in others because of a want of appreciation of the conditions which fix the limitations of successful application; and, lastly, the general public, when inveighing against the want of skill of manufacturers, engineers, and men of science, is too ready to assume that a smoking chimney necessarily represents wasteful combustion of fuel. It seems, then, that the whole community must be educated to a more intelligent understanding of the problem before a satisfactory solution can be successfully brought about.

Examining the principles upon which combustion depends, and the conditions under which smoke is produced or can be prevented, it is pointed out that although by the application of heat the organic matter in coal is decomposed, and gaseous carbon and hydrogen given off, yet the heat may be insufficient to effect a chemical combination between those gases and the oxygen of the air, in which case further heat is not developed, but, on the contrary, absorbed. Again, when the hydrocarbon vapours are decomposed, carbonic acid and water ($CO_2 + H_2O$) may result from the complete combustion of some portion of them, while another portion has some of the carbon separated and set free, leaving a light hydrocarbon gas ($C_2H_4 = C + CH_4$). It is this separated carbon, in an incandescent state, which in the main causes the luminosity of the flame when a heavy hydrocarbon is burnt, and it is this same separated carbon which makes the visible smoke during the combustion of bituminous coal. For the rapid combustion of this separated carbon, not only is a strong oxidising action necessary, but a very high temperature as well, probably not less than 2,000° F. If this high temperature is not supplied in the fireplace, where the gases are generated and the carbon separated, the latter will be carried along by the rapid draught, and pass out unchanged as visible smoke; and, under the usual conditions of coal-combustion, it is impossible to obtain such a temperature at once, because the coal is thrown into the fireplace in cold heaps, and generally in excessive quantities. Its moisture and combined water (together amounting to from 10 to 20 per cent. of the whole weight of the coal) have first to be volatilised, and while their vapour, mixed with a great volume of cold air, is passing off, a large quantity of the produced heat is absorbed.

Not one of the innumerable devices so far brought forward for the prevention of smoke is capable, in its present form and application, of fully meeting and satisfying all the requirements for success. The more important types are classified under the following seven heads:— A. Steam jets. B. Firebrick arches, or checker work. C. Hollow walls for pre-heating air. D. Coking arches or chambers. E. Double combustion, F. Downward-draught furnaces. G. Automatic stokers,

A.—The object of the steam-jet is to force air into the fireplace, either directly or after being heated, in sufficient quantity above the fuel-bed for the combustion of all combustible material, and to effect such a thorough mingling of the air, gases and carbon that combustion will take place readily, and not far beyond the fireplace. The steam-jet system can undoubtedly be made to yield satisfactory results where the demand upon the boiler is comparatively light and does not vary much; but with variation in the demands upon the boiler, the jets require corresponding adjustment, and such a system is therefore largely dependent upon the skill and care of the fireman. When the nozzles are not very carefully adjusted, they are apt to cause a blow-pipe action upon the boiler-shell or grate-bars, which results in a rapid burning of the metal, especially from the strong oxidising action of the decomposing steam.

B.—Firebrick arches are usually placed near the rear end of the fireplace, or over the bridge wall. They cause the smoke, gases, and air to pass through a constricted passage close to the fuel-bed, and serve not only to reflect the heat from it, but as a strong accumulator of heat, which tends to keep the heat up to a more uniformly high temperature. The checker-work is intended to produce the same result in a different way by dividing the general volume of smoke and gases into a number of small currents. With careful firing both these appliances can be made to produce good results, but only to a limited extent; and another and more serious objection is their want of durability and the consequent high cost of repairs and frequent interference with regular operations.

C.—A number of patents have been taken out based upon the system of providing hollow walls for pre-heating air, but the committee considers that they all fall short of the requirements.

D. and E.—The systems classed under the heads of coking arches or chambers, and double-combustion, are also shown to be objectionable.

F.—Downward-draught furnaces consist essentially of a fireplace with the back closed, so that the smoke and gases can only pass away downwards through the fire-bed. This causes such intense heat upon the grate that instead of ordinary bars water-tubes have to be used, and these are so connected with the boiler-shell as to form a part of the water-circulating system, and supply so much additional heating surface. As they require to be at a greater distance apart than ordinary grate-bars, an auxiliary grate of ordinary type is sometimes set some distance below, into which the incandescent fuel falls from above, and through this all the air is delivered for completing the combustion of the gases issuing below the upper grate. Such a system is well adapted to insure a good smoke record, and it has the advantage also of being readily attached to a variety of boilers; but it is liable to defects in construction, while the water-tubes of the grate and the connecting pipes are subjected to unusual strains at the joints, and the latter are not altogether reliable. The system has, however, so many valuable features that it gives great promise for the future, and is well worth the attention and study required to secure the needed improvements.

G.—Automatic stokers are intended to secure regular and uniform feeding of coal to the fireplace by mechanical action, in place of the irregular and unreliable service of the ordinary fireman. The mechanical action may be applied in the form of screw or hopper feeders to fixed inclined grates, or to moveable inclined or step grates. They require the coal to be properly sized as nuts or peas, and under favourable conditions are capable of giving good results, but their limitations are such that they cannot be regarded as applicable to any important extent.

It has been found in practice that, as a rule, all these devices for the prevention of smoke occasion a loss in the heating-power of the fuel. Experiments made at the New York Navy Yard with four different types of nozzles showed that the loss of steam, when steam-jet boilers were employed, was as follows:—

—	Single Round Hole of			Thirty-three Holes each of
	$\frac{1}{16}$-inch Diameter.	$\frac{1}{8}$-inch Diameter.	$\frac{9}{64}$-inch Diameter.	$\frac{1}{32}$-inch Diameter.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Per cent. of steam.......	8·3	12·0	14·0	20·7
Pounds of steam per hour	7·5	15·8	19·06	30·0
Loss in HP..............	0·25	0·53	0·653	1·0

Some practical tests made in Chicago by the chief engineer of the Rookery Building, Mr. Wm. C. D. Gillespie, offer a further illustration of the losses due to smokeless combustion. The tests were divided into three series, each recording the average results reached by improvements in the furnace. They show both a decrease in power and a loss in economy the more they approach perfectly smokeless combustion.

Tests.	First Series.	Second Series.	Third Series.
Duration of Tests.	Four Days of Nine Hours each.	Five Days of Nine Hours each.	Five Days of Nine Hours each.
Pounds of coal burnt per sq. foot of grate per hour.	24·34	24·59	23·82
HP. developed..............	102	93	89
Boiler ran above rating, per cent,	25	13	10
Conditions as to smoke......	Moderate smoke.	Smoke much reduced.	Practically smokeless.
Loss in power by reducing smoke, per cent.	..	12	15
Loss in economy by reducing smoke, per cent.	..	7½	13⅓

At the Home Cotton Mills steam-jets over the fire were tried as smoke preventers, and the result was an increase of 12 per cent. in the fuel consumption for the same work.

On the other hand, the amount of carbon even in dense smoke represents but a very small percentage of the weight of the coal under combustion. Mr. J. C. Headley passed through water all the gases from the flue of a boiler fired with bituminous coal producing a very black smoke, carefully collecting all the solid, which he dried and weighed. The amount of coal burnt was 12,890 lb. or about 6¼ tons; the total weight of the gases generated was 325,215 lb., and the total quantity of solid matter contained therein was 42·63 lb., of which not more than one-half was carbon. From this it appears that the separated carbon which made the smoke visible as a dense black cloud represented only about one-sixth of 1 per cent. of the weight of the coal used.

The greater part of the State of Illinois being underlaid by workable seams of bituminous coal, no other fuel can compete with it in economy; anthracite coal, coke, and gas are in the matter of cost all out of reach for industrial purposes, but these are, nevertheless, recommended for domestic use, especially the two latter for cooking purposes, with a view to reducing the smoke due to domestic fires, for the smoke nuisance affects the whole community, and all are interested in getting rid of it. "All will admit," says the report in conclusion, "that it occasions a great money loss in destruction of goods and furnishings, in defacement of buildings, in labour and material expended in the vain effort to keep clean, and in increased necessity for artificial light; an æsthetic loss through discouragement of the ornamentation of buildings, houses, and grounds; a sanitary loss in impaired health, and prevalence of lung and throat diseases; a population loss in those who cannot or will not live in a begrimed city; and last, not least, a moral loss in the effect of those who are forced to endure dirt and unwholesomeness."

The time has come when a decided step should be taken to enforce a remedy, and the committee advises the appointment of inspectors, the making of tests and experiments with all devices for the prevention of smoke, and the enactment by the Municipality of Ordinances declaring the emission of dense volumes of visible smoke, subject to certain limitations, to be a nuisance involving stringent fines.

PATENTS.

Improvements in the Construction of Compressing Machinery or Apparatus for the Condensation and Liquefaction of Gases. J. Pullman, London, and H. Lane, Birmingham. Eng. Pat. 22,870, December 31, 1891.

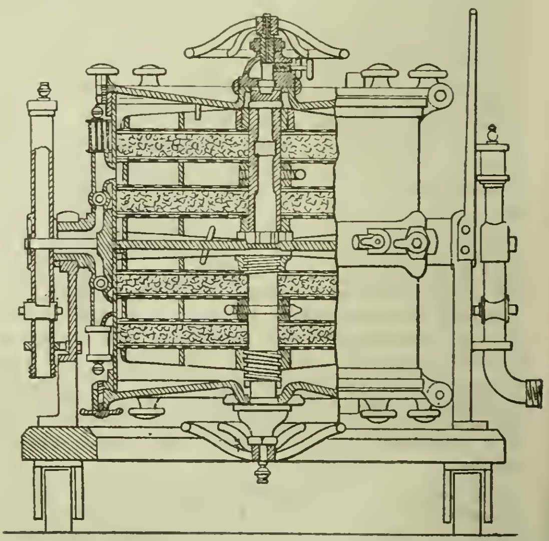
The improvements relate to the arrangement of machinery employed for the compression and liquefaction of carbonic acid, nitrous oxide, and other like substances, and consist in the combination and amalgamation in one machine of the compressing, cooling, and liquefying devices.

The compression cylinders are placed in an inverted position, like those of an ordinary marine engine, and are worked by the crank-shaft and rods from underneath. The framing which supports the cylinders is partly hollow, and made use of as a tank containing coils, and is further carried up to a height sufficient for forming a casing around the cylinders, the whole being filled with water for cooling. The condensing and liquefying coils within this water-tight casing have their outlets at the lowest point where they can be connected to the storing reservoirs for the liquefied gas.—B.

Improvements in or Relating to Filters. J. Sutton, Islip, U.S.A. Eng. Pat. 8266, May 2, 1892.

The object of this invention is to provide large filtering surfaces within a confined space, to give the power of increasing or diminishing the size of the pores through the filtering material, and to facilitate the packing and manipulation of the filter.

The accompanying Figure illustrates the application of the invention to one class of filters described in U.S. Pat. 406,603, July 9, 1889, the casing being supported on hollow trunnions, on which it can be swung into any desired position.



The cylindrical casing is shown in an upright position, and is divided into two separate compartments by a horizontal partition across its centre, each compartment being provided with a hinged cover which can be made water-tight. The fluid enters through one of the trunnions, from which channels are taken to both compartments, each capable of regulation by a suitable cock. Similar channels and cocks are provided for the exit of the filtered water through the opposite trunnion, and there are also other independent passages and cocks for cleaning the filter by passing a current of clean water through it in either direction.

The filtering material is retained in each department between two pairs of perforated concentric plates just fitting the casing, these plates being threaded on central hollow spindles, one for each compartment, which are provided with right- and left-handed screw threads. Upon turning either of the spindles by means of the hand wheels shown, in one or the other direction, the perforated plates are caused to either approach to or recede from one another, with the result of either compressing or relieving the filtering substance between them, and thereby diminishing or increasing the size of the pores. In order to examine or clean either of the compartments the end cover need only be unscrewed and hinged back, the opposite compartment meantime remaining in undisturbed action.—B.

Improvements in Hollow Filtering-Cylinders for Use in Filtering-Vessels. H. Nordtmeyer, Celle, Germany. Eng. Pat. 3464, February 22, 1892.

This invention consists in strengthening the cylinder by means of a stiffening tube, or rod, or a tightened wire, chain, or cord passed lengthwise through the cylinder. If a tube be used, it serves as an outlet for the filtered liquid. The tube or rod may also be used as a spindle for journaling the filtering cylinder.—J. C. C.

Improvements in Methods and Apparatus for Evaporating Liquids. C. W. Cooper, New York, U.S.A. Eng. Pat. 16,403, September 13, 1892.

The object of this invention is to ensure a rapid and equable rate of evaporation and concentration of a liquid throughout the whole apparatus. This is sought to be accomplished by a repeated and rapid circulation of the liquid through the tubes of the apparatus, combined with the simultaneous replacing of the evaporated liquid in a continuous stream. In one arrangement several clusters of tubes are employed within one casing, and are so placed that the heated liquor from the first set, after parting with some of the vapour, comes into contact with the stream of fresh liquid and, combining therewith, enters the second set, and so forth, thereby conducting fresh liquor to each set and equalising the concentration. In another arrangement where only one set of tubes is employed, the circulation is repeated and accelerated by means of a pump.—B.

II.—FUEL, GAS, AND LIGHT.

Experiments in the Formation of Sulphuric Acid and of Ammonium Sulphate in the Burning of Coal-Gas. E. Priwoznik. Ber. 1892, **25**, 2676—2680.

The sulphuric acid formed by the burning of coal-gas is, according to the author's experiments not in the free state, but combined with ammonia as neutral ammonium sulphate. By the evaporation of water in platinum vessels over a Bunsen burner, a residue of ammonium sulphate remains; in two experiments the residue left from 5 litres of water weighed 0·0121 grms. and 0·0094 grms. respectively. A similar result is obtained when porcelain or metal vessels are used, the only difference being that in the case of platinum a small quantity of free sulphuric acid is formed, at first, as a product of combustion of the gas and appears on the side of the vessel in the form of a finely-divided dew.—C. A. K.

Waste Water from a Water-Gas Scrubber. J. Klaudy. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 290—291.

The water passed through a coke-tower used for scrubbing water-gas, gave a white deposit free from sulphur and, on standing, an odour of hydrogen cyanide. On analysis the water was found to contain formic acid and traces of trioxymethylene but no ammonia or nitric acid. The dried residue from a litre weighed 0·3521 grm. and the water contained in grms. per litre:—

KCl	$CaCO_3$	$CaSO_4$	$Ca(HCO_2)_2$	$MgCl_2$
0·0141	0·0613	0·1072	0·0366	0·0034

$Mg(HCO_2)_2$	HCN	SH_2	FeS	CO_2
0·1101	0·0366	0·0078	0·0147	0·0270

One volume of water was used to wash about 40 volumes of gas. The addition of ferrous sulphate and chalk rendered the water harmless to health by converting the hydrogen cyanide into calcium ferrocyanide.—W. J. P.

Valuation of Coals. F. M. Horn. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 296—298.

The author gives a table showing the composition, calorific value, and evaporation coefficients of 14 samples of German coal.—W. J. P.

The Calculation of Flame-Temperatures. E. Blass. Stahl und Eisen, 1892, 893; Proc. Inst. Civil Eng. 1892—3, **111** (1), 56—60.

The author has been induced to undertake experiments on the large scale, upon the heat attainable by gas-flames, from the circumstance that platinum can be brought to the welding point, but cannot be melted in a crucible furnace, by the combustion of cold gas with cold air, which should, according to the old formulæ, give a sensible temperature of 2,650° C., or far above the melting-point of the metal (1,775° according to Violle). This difference is due to the assumption that the specific heats of the products of combustion, water, and carbon dioxide, are constant; whereas these values actually change very rapidly with increased temperature in both gases, the expressions for their mean value being, according to Le Chatelier (Ann. des Mines, **4**, 1883), as follows:—

$$CO_2 : c^p = 0{\cdot}188 + 0{\cdot}000273\,t - 0{\cdot}0000000537\,t^2$$

$$H_2O : c^p = 0{\cdot}420 + 0{\cdot}000364\,t$$

Calculated in this manner, the temperature attainable by burning water-gas with air is approximately 1,700°, a result sufficiently near to the value obtained by Violle's direct experiment to establish the probable correctness of the La Chatelier formula; but in order to test the point more completely, a set of experiments have been carried out at the joint cost of the German Iron Smelters' Society and the European Water-Gas Company, with water-gas supplied by Messrs. Schulz, Knaudt and Co., a fuel selected as being of simple and uniform composition. The apparatus consisted of a four-twyer crucible melting furnace, containing an empty steel melting crucible, with four tubes perforating the side at right angles to each other. Three of these tubes contained pyrometers, while the fourth took off a portion of the products of combustion to a condenser and gas-meter, in order to determine the amount of water and other constituents, formed by the combustion. The gas supply was measured by two gas-meters of 50 and 100 cubic metres capacity per hour respectively, and the air supplied by Root's blowers, driven by variable speed pulleys, each step corresponding to a difference of 100 cubic metres per hour. The composition of the furnace gases was deduced at short intervals by analyses of samples taken directly from the furnace, as well as from the portion poured through the meter. These, although conducted with extreme care, showed that the relative proportion of water to carbon dioxide was subject to variation within rather wide limits, and that gases do not mix as rapidly and uniformly as they are generally supposed to do.

The supposed instruments used for direct measurement were :—

1. Wiborgh's air-thermometer, which can be used up to 1,200° C.

2. Le Chatelier's electric pyrometer, available nearly up to the melting point of platinum.

3. Hartmann and Braun's telephone pyrometer.

Besides these, Siemens calorimeter pyrometer, Seeger's normal cones of clay and quartz, Ducretel's optical pyrometer, and Prinsep's pyrometric alloys of gold and platinum, supplied by the Frankfort Gold and Silver Refinery, were used on different occasions. The air-thermometer, though most exact in principle, was not very satisfactory, two different instruments giving dissimilar indications, without its being possible to discover the cause of the difference. The telephone pyrometer was found to be very convenient in work, but unfortunately it was destroyed at an early period of the investigation by a quantity of molten copper falling upon the platinum case. It is an excellent instrument, the only defects being the high price (20*l.*) and the difficulty of using it in a noisy place.

The Le Chatelier pyrometer is also a very handy instrument, but the thermo-couple alters tolerably rapidly, so that the scale indications cannot be relied upon for any great length of time, and the recording galvanometer is so sensitive to vibrations that it can scarcely be used in any place where machinery is at work.

The Ducretel polariscope is scarcely to be regarded as a pyrometer, as no correct measure of temperature can be obtained from it, although in experienced hands it may be of value in comparing different sources of heat. Considerable experience and sensitiveness of the observer to slight changes of colour are essential for its successful use.

The Prinsep alloys in all cases gave results agreeing very well with those obtained from the Wiborgh and Le Chatelier pyrometers.

After overcoming a variety of preliminary difficulties, the apparatus was brought into regular working order, and numerous experiments were made, each extending over a period of from eight to ten hours. The data and methods of computation are given in detail, together with the results obtained from five experiments, each representing a different condition of combustion, two being with gas in excess, two with air in excess in variable proportions, and the fifth with gas and air in the theoretical proportions required to produce the highest calorific effect. The results are tabulated as follows :—

Temperature.	Gas in Excess.		Air in Excess.		Gas and Air in Theoretical Proportions.	
	I. Gas : Air 1 : 0·18	II. Gas : Air 1 : 0·714	III. Gas : Air 1 : 9·79	IV. Gas : Air 1 : 4·18	V. Gas and Air cold.	VI. Gas cold, Air 840°
Observed..........................	425	1,170	655	1,218	$>$ 1,775	$<$ 1,775
Calculated by new formula	409	1,173	688	1,235	1,690	1,947
Calculated by old formula	521	1,560	747	1,890	2,630	2,916

In the fifth experiment with gas and air in proportion for theoretically perfect combustion, the loop of the thermopile in platinum rhodium alloy was twice melted, but a platinum wire of 1 mm. diameter, and the gold platinum alloy No. 24, whose reputed melting point is 1,690°, showed only superficial fusion.

The experiment in the sixth column was made by Mr. Dicke at Mr. Pintsch's works, the gas being burnt with air heated to 840 C°., as determined by a Wiborgh pyrometer. In this case platinum was completely melted, the temperature realised being more than sufficient for the fusion of the best Dahlhausen fire-bricks, and could only be resisted by a magnesite lining to the furnace.

A point of interest in Experiment II. is the circumstance that both copper and iron were oxidised in the flame, although the latter contained about 40 per cent. of reducing gases (carbonic oxide and hydrogen). It is evident, therefore, that to obtain a flame in which iron will not oxidise, the gas excess must be much larger, as in Experiment I., where, however, the heat realised is too low for any but very limited uses. The author suggests that possibly a non-oxidising white heat, or 1,400°, might be realised by the conditions of Experiment I. if both gas and air were brought to a temperature of 1,000° before combination.

In order to form an idea of the temperatures attainable by the combustion of different mixtures of gases, the author has compiled the following table of theoretical temperatures, the fuel being supposed to be chemically pure :—

——	Gas and Air Cold.	Gas, Cold. Air 1,000°	Gas 1,°000° Air 1,000°
Producer gas..........	..	..	..
$\frac{1}{3}$ Vol. Co + $\frac{2}{3}$ Vol N ...	..	..	..
Water-gas...........	1,450	1,750	2,160
$\frac{1}{2}$ Vol CO + $\frac{1}{2}$ Vol H ...	1,875	2,270	2,400
Hydrogen...........	1,650	1,970	2,140
Carbonic oxide	1,955	2,390	2,570

When the above value for theoretical water-gas, 1,875°, is compared with the 1,690° found by experiment, the difference is seen to be only 185°, or about 10 per cent., whereas the difference between the 2,160° calculated for producer-gas and 1,500° observed by Le Chatelier as the maximum heat of the Siemens furnace, or 660°, represents nearly 30 per cent. The reason for this is to be sought, not in the non-development of the calorific value of the fuel in practice, but in retarded combustion, owing to the gradual mixture of the air and gas, so that the heat is distributed over a large area, with a corresponding diminution of maximum intensity, whereas when gas and air are burnt under the conditions of the experiments, both being supplied under pressure, combination is rapidly effected, with the result of producing a focus of intense temperature.

In the final part of the paper the author, after quoting calculations from Campbell's paper on "The Physical and Chemical Equations of the Open-Hearth Furnace," in the Proceedings of the American Institute of Mining Engineers, June 1890, which show how small a proportion of the heat developed in the Siemens furnace is actually devoted to melting the charge, suggests that this might be improved if the gas and air could be supplied as a blowpipe flame of sufficient intensity to displace the surface covering of slag and penetrate to the bath, which would readily take up heat by reason of its high conductivity.

As a means of simplifying the calculations of flame temperatures, the author has computed the specific heat of water and carbonic acid by the Le Chatelier formula for different temperatures, as given in the following table :—

Temperature	0	290	400	600	800	1,000	1,200
Carbonic acid .	0·188	0·240	0·288	0·332	0·372	0·407	0·438
Water vapour.	0·420	0·493	0·565	0·637	0·711	0·783	0·856

Temperature.	1,400	1,600	1,800	2,000	2,500	3,000
Carbonic acid.	0·465	0·488	0·507	0·520	0·534	0·524
Water vapour.	0·929	1·002	1·075	1·148	1·340	1·512

The specific heat of oxygen (0·217°), nitrogen (0·244°), hydrogen (3·409°), and carbonic oxide (0·245°), although not perfectly constant with increase of temperature, are sufficiently so for practical purposes of calculation.

The effect of dissociation may also be disregarded, as, according to Mallard and Le Chatelier, it does not affect water vapour below 3,000°, and in carbonic acid it only begins at 1,800° or 2,000°, the amount of decomposition being about 4 per cent. at between 2,640°, 17 per cent. at 2,646°, and 61 per cent. at 3,130°, the temperature of complete dissociation being probably at 3,400°.

PATENTS.

Improvements in Heating Retorts or Furnaces for the Distillation of Coal or other Analogous Purposes. J. A. Yeadon and W. Adgie, Leeds. Eng. Pat. 22,292, December 21, 1891.

The principal novelty in this patent lies in the application of crude or purified coal-gas, or water-gas, to the heating of retorts employed for the carbonisation of coal; either fixed or revolving retorts may be used and coke fires may be employed as an additional source of heat.—F. S. K.

Improvements in Gas Purifying Apparatus. H. Williams, Stockport. Eng. Pat. 24, January 1, 1892.

In the purification of coal-gas by means of lime or oxide the charging and emptying of the purifiers involves a great deal of labour. According to this patent a cylindrical shell or case is fitted with a revolving spiral, or with propeller blades and employed as a purifier. The lime or oxide is fed into the purifier continuously from a hopper, the spent lime being discharged at the other end; the coal-gas is passed through the purifier in an opposite direction. —F. S. K.

Solidifying Petroleum and the Hydrocarbons contained in same for Facilitating Transportation and Use as Fuel, also Reliquefying same. C. Allina, Wiener, Neustadt, Austria. Eng. Pat. 964, January 18, 1892.

Petroleum, and the liquid saturated fatty hydrocarbons, have the property of forming a solid mass with from half to five per cent. of the potassium, sodium, magnesium, or aluminium salts of margaric, stearic, palmitic, and oleïc acids; the salt is dissolved in the hot petroleum, which solidifies on cooling, the mixture being much more suitable for transportation and for use as fuel than the liquid hydrocarbon. The solid mass can be liquefied if desired by warming it with a small quantity of oleïc acid.—F. S. K.

A Combined Refuse Furnace and Gas Manufacturing Apparatus. W. J. Lomax and C. J. Lomax, Bolton. Eng. Pat. 1181, January 21, 1892.

The apparatus described in this patent consists of a horizontal furnace, into which town refuse, previously treated in a drying chamber if necessary, is fed by means of a hopper; this furnace is provided with moveable fire-bars on the self-carrying principle so that the refuse is carried through the furnace and delivered through a door at the opposite end. The gaseous products of combustion or distillation of the refuse pass through openings into a retort chamber and are there utilised for heating ordinary gas retorts; the latter are employed for carbonising cannel, coal, sewage sludge, or other material in the ordinary manner.—F. S. K.

Improvements in the Treatment of Oils for Rendering them Capable of Transport or Storage, and of Use as Fuel or as Illuminants, with Greater Safety and Convenience than hitherto. I. S. McDougall and J. T. McDougall, London. Eng. Pat. 1437, January 25, 1892.

The animal, vegetable, or mineral oil, or mixture of oils, is converted into a solid or semi-solid mass by mixing it with 25 per cent. by weight of infusorial earth, resin, or other suitable material being added in small quantity if desired to promote greater adhesiveness. Such a mixture can still be used as fuel or for illuminating purposes, and can be stored, transported and used with greater safety than the liquid oil. —F. S. K.

Improvements in the Manufacture of Illuminating and Heating Gas and in Apparatus therefor. A. Klönne, Dortmund, Germany. Eng. Pat. 1575, January 26, 1892.

In purifying coal-gas in the ordinary way the gas is first cooled by means of air or water condensers which present large tar-wetted surfaces; the consequence is that the tar, which is at a lower temperature than the gas, absorbs some of the heavier illuminants and a considerable loss in illuminating power is incurred; the object of this invention is to remove the tar while the gas is still at such a temperature that the condensation or absorption of the heavier illuminants is prevented.

The gas from the retorts or producers, having passed the exhauster, is led through a friction, air, or water surface condenser so that it is freed from solid impurities and its temperature lowered to 75°—100° F. It then enters a cooling washer, consisting of several compartments containing ammoniacal liquor: the gas, being forced successively through the several layers of liquor is completely freed from tar before the latter has the chance of absorbing any of the heavy hydrocarbons; in this process the gas is cooled to 60°—70°, entirely freed from carbon dioxide, and a considerable proportion of its sulphuretted hydrogen is eliminated. From the cooling washer it is led into a compensator, the sole object of which is to keep the gas as nearly as possible at a constant temperature of 60°, and then into a plunger ammonia extractor consisting of several compartments; in the latter it is washed with liquor, which becomes weaker and weaker as the gas passes forwards, and finally with fresh water, so that the whole of the ammonia is removed.

The liquor from the last compartment of the ammonia extractor is run, together with other liquor from a storage tank, through the various compartments of the cooling washer; from the latter it runs to a separator where the tar and light oil are separated and flow to the tar well, the liquor passing through a water cooler into a distributing tank. A quantity of liquor equal to that of the fresh water admitted to the ammonia extractor is then discharged into the ammonia well, the rest being pumped into the storage tank for use in the cooling washer.

If it be desired to completely purify the gas without the aid of oxide or lime this can be done by admitting a sufficient quantity of weak caustic ammonia into the cooling washer or ammonia extractor.—F. S. K.

An Improved Method of and Apparatus for Making and Storing a Mixture of Inflammable Gas and Air. W. H. Beck, London. From B. de Lissa, Melbourne, Australia. Eng. Pat. 15,122, August 22, 1892.

Gas and air in suitable proportions are drawn from separate gasometers into a single chamber by means of a water-blast or spray which produces a vacuum; the mixture is then passed into a small gas holder and finally into a specially contrived gasometer. The water-blast, and consequently the amounts of gas and air drawn into the apparatus, are regulated automatically.—F. S. K.

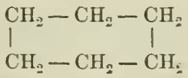
III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Place of the Naphthenes and their Derivatives in the General System of Organic Substances. W. Markownikow. Jour. Russ. Phys. Chem. Soc. 1892, **24**, 141.

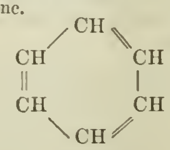
The chemical properties of the naphthenes which Markownikow recognised first to form a new class of hydrocarbons seem to place them in a systematic classification of the hydrocarbons as an intermediate link between the paraffins and the aromatic hydrocarbons of the benzene series. A glance at the three formulæ—

$$CH_3.CH_2.CH_2.CH_2.CH_2.CH_3$$

Normal Hexane.



Hexanaphthene.



Benzene.

reveals the relationship at once.

The author proposes therefore to comprise all derivatives of the naphthenes into one group, which he calls the naphthene group. Many substances belonging to this group have been known for some time, but are only now having assigned to them their proper place in the system of organic chemistry.

The creation of this new class is justified on the one hand by the possible transformations of the naphthenes into paraffins and aromatic hydrocarbons, and on the other hand by a number of analogies found on comparing the properties of the three classes of hydrocarbons.

The change of naphthenes into aromatic substances is effected by heating the former in sealed tubes with sulphur, at 200° C. Thus, *e.g.*, octonaphthene yields a large quantity of trinitro-*m*-xylene. More elegant still is Konowalow's method: bromination in presence of aluminium bromide, by means of which it has become possible to prepare tribromo-ψ-cumene from mononaphthene, pentabromotoluene from heptanaphthene and tetrabromo-*p*-xylene from octonaphthene. On reducing the nitro derivatives of the naphthenes, ketones and amides are obtained. The naphthenes are oxidised by the oxygen of the atmosphere, when neutral substances are obtained. The main points of difference between the paraffins and the naphthenes is that the latter have a higher specific gravity, and that they cannot be brought to crystallisation; even the naphthenes boiling above 300° C. do not crystallise.

The subjoined table contains a few well-characterised naphthenes; there are many isomerides, the number and structure of which has to be determined in the same way as in the case of the benzene derivatives; therefore the same nomenclature, *e.g.*, *o-m-p-* derivatives, will hold good for them:—

Formula.	Formation and Occurrence.	Boiling Point.	Sp. Gr. $\frac{0^\circ}{0^\circ}$
C_6H_{12} ..	Hexahydrobenzene .... (Kishner)	69°	0·7539
	Russian naphtha		
C_7H_{14} ..	Hexahydrotoluene ..... (Lossen)	97°	0·772
	Russian naphtha		
	From the products of dry distillation of colophony. (Renard)	95°—98°	$0{\cdot}742\ \frac{20^\circ}{20^\circ}$
C_8H_{16} ..	Hexahydro-*m*-xylene... (Wreden)	115°—120°	0·777
	Russian naphtha ...... (Wreden)	122°—124°	0·7835
	From colophony	120°—123°	$0{\cdot}764\ \frac{19^\circ}{19^\circ}$
C_9H_{18} ..	Hexahydro mesitylene . (Baeyer)	135°—138°	..
	Hexahydro-ψ-cumene .. (Konowalow)	135°—138°	0·7812
	From naphtha.........	135°—136°	0·7808
	Hexahydropropylbenzene. (Tschitschibabin)	140°—142°	0·7811
$C_{10}H_{20}$.	Dodekahydronaphthalene. (Wreden)	153°—158°	0·802
	From naphtha.........	160°—162°	$0{\cdot}7808\ \frac{17{\cdot}4^\circ}{4^\circ}$
	From naphtha.........	168°—170°	$0{\cdot}8073$—$0{\cdot}814\ \frac{15^\circ}{15^\circ}$
	From menthene........	168·5°—170°	$0{\cdot}797\ \frac{15^\circ}{15^\circ}$
	From terpinehydrate ..	168·5°—170°	$0{\cdot}797\ \frac{15^\circ}{15^\circ}$
	From camphor......... (Starodubsky)	167°—169°	$0{\cdot}8114\ \frac{0^\circ}{0^\circ}$
	Tetrahydroterpene..... (Orlow)	162°—167°	$0{\cdot}806\ \frac{0^\circ}{0^\circ}$
$C_{11}H_{22}$ ..	From naphtha.........	179°—181°	$0{\cdot}8019\ \frac{16{\cdot}2^\circ}{4^\circ}$
$C_{12}H_{24}$ ..	From naphtha.........	197°	$0{\cdot}8120\ \frac{18{\cdot}4^\circ}{4^\circ}$
$C_{14}H_{28}$ ..	..	240°—241°	$0{\cdot}8215\ \frac{18{\cdot}6^\circ}{4^\circ}$
$C_{15}H_{30}$ ..	..	246°—248°	$0{\cdot}8210\ \frac{18{\cdot}8^\circ}{4^\circ}$

Markownikow considers as naphthene derivatives Wallach's tetrabromides of the terpenes. Starting from monohalogen derivatives of the naphthenes it has been possible to prepare the corresponding alcohols and their acetates. Thus, Konowalow obtained the mononaphthene alcohol $C_6H_8\genfrac{}{}{0pt}{}{OH}{(CH_3)_3}$ and Shukowsky prepared the octonaphthene alcohol $C_6H_9\genfrac{}{}{0pt}{}{OH}{(CH_3)_2}$ Menthol, menthene, and menthylamine find here their places in the chemical system. Monobasic acids of the naphthenes seem to be represented by well characterised individuals, amongst which have to be reckoned in the first instance the so-called petroleum acids. The higher homologues do not crystallise, whilst the lowest acid—obtained from benzoïc acid—does crystallise. (See Aschan, this Journal, 1891, 997, Zaloziecki *ibid*, 1891, 824, 1892, 2). The author proposes for these acids, the general formula $C_nH_{2n-2}O_2$, the name of naphthenic acids, and adopting the nomenclature used for the fatty acids, he names $C_{17}H_{12}O_2$ heptanaphthenic, acid, $C_{11}H_{20}O_2$ endekanaphthenic acid, &c. Quininic acid belongs to these monobasic acids, and has to be considered as a tetrahydroxyheptanaphthenic acid, $C_6H_7(OH)_4COOH$, which on boiling with hydriodic acid is easily transformed into benzoic acid. The author finally claims the hexahydrogenated acids which Baeyer has prepared from phthalic, terephthalic, and mellithic acids and also the succinylsuccinic acid, as dibasic acids of the naphthene series.—J. L.

Petroleum Acids. R. Zaloziecki. Chem. Zeit. 1892, 16, 905—907.

This somewhat lengthy article consists for the greatest part of a polemic against Aschan's views (this Journal, 1891, 997) on the constitution of the so-called petroleum acids, the author maintaining his former views that these acid substances have to be looked upon as lacto-alcohols (this Journal, 1891, 824). Fresh material for substantiating this opinion is, however, not adduced. The author has now prepared these lacto-alcohols from the waste sulphuric acid of petroleum refineries by extraction with caustic soda. Continuing his experiments on the formation of acid compounds in petroleum (this Journal, 1891, 997) the author has now oxidised the lacto-alcohol $C_{10}H_{22}O_2$ with potassium bichromate and sulphuric acid and obtained a mixture of volatile acids which presumably contain amongst others acetic acid and nonylic acid.—J. L.

Peruvian Petroleum. L. Weinstein. Chem. Zeit. 1892, 16, 795—798.

Peruvian petroleum, although for a long time known to occur in many places near the Pacific coast, has only recently been brought into prominence by the action of several English companies. The author has examined a crude oil occurring at Zorritos, near Tumbez, in the northern part of Peru.

The crude petroleum has the sp. gr. 0·810—0·840; it possesses an agreeable aromatic smell and is exceedingly rich in easily volatile hydrocarbons. An elementary analysis (by Dr. Salathé, Titusville) gave C = 84·9 per cent.; H = 13·7 per cent.: O = 1·4 per cent. On cooling to −30° C. no solid substance separated from the petroleum. The heat of combustion found was 10,672 calories.

A fractional distillation of three samples of crude petroleum gave the following result:—

Zorritos Oil.	I.	II.	III.
Specific gravity.............	0·815	0·820	0·835
° C.	Per Cent.	Per Cent.	Per Cent.
0—130.....................	25·75	26·50	17·0
130—150.....................	11·5	8·0	6·0
150—170.....................	6·0	6·0	5·5
170—190.....................	6·0	6·0	5·0
190—210.....................	5·0	4·5	5·0
210—230.....................	5·5	5·5	4·5
230—250.....................	4·25	4·0	5·5
250—270.....................	5·75	5·0	4·25
270—290.....................	3·50	4·0	4·0
Residue.....................	26·0	30·0	33·0
Light oils.....................	37·25	34·5	23·0
150°—290°.....................	36·0	35·0	33·75

Judging from these figures one might proclaim superiority of this oil over Pennsylvanian oil. But this is not borne out by practice and therefore the author adopted for the technical examination of the crude oil the method proposed by Bourgognon. 300 cc. of the oil are distilled from a spacious retort and the receiving vessel is changed whenever 15 cc. = 5 per cent. have passed over. The temperature is noted when another fraction is collected. The distillation of the 300 cc. requires three hours. In the subjoined table the result of such a distillation, carried out with Zorritos oil, is given; for the sake of comparison some North American oils were examined simultaneously.

—		Zorritos.	Lima (Ohio).	California.	—	Pennsylvania.	
						Parker.	Brad-ford.
Sp. Gr.........		0·835	0·835	0·835	..	0·801	0·815
Fraction No.					Fraction No.		
1	Sp. Gr.	0·709	0·704	0·706			
	° C....	70	71	71	1	0·699	0·702
2	Sp. Gr.	0·726	0·733	0·716			
	° C....	76	93	84			
3	Sp. Gr.	0·740	0·737	0·735			
	° C....	82	99	93	2	0·736	0·744
4	Sp. Gr.	0·749	0·752	0·746			
	° C....	86	121	104			
5	Sp. Gr.	0·758	0·767	0·761			
	° C....	93	128	106	3	0·755	0·769
6	Sp. Gr.	0·765	0·778	0·769			
	° C....	97	136	104			
7	Sp. Gr.	0·774	0·793	0·777			
	° C....	103	176	112	4	0·771	0·788
8	Sp. Gr.	0·768	0·806	0·791			
	° C....	107·5	179	124			
9	Sp. Gr.	0·803	0·814	0·808			
	° C....	125	188	153	5	0·788	0·806
10	Sp. Gr.	0·823	0·824	0·818			
	° C....	139	204	158			
11	Sp. Gr.	0·837	0·831	0·834			
	° C....	159	219	179	6	0·801	0·824
12	Sp. Gr.	0·852	0·830	0·850			
	° C....	180	232	218			
13	Sp. Gr.	0·864	0·831	0·860			
	° C....	190	247	221	7	0·819	0·829
14	Sp. Gr.	0·878	0·835	0·874			
	° C....	200	252	254			
15	Sp. Gr.	0·890	0·834	0·877			
	° C....	212	254	254	8	0·824	0·824
16	Sp. Gr.	0·892	0·830	0·858			
	° C....	226	252	251			
17	Sp. Gr.	0·876	0·825	0·853			
	° C....	235	241	260	9	0·819	0·819
18	Sp. Gr.	..	0·826	0·846			
	° C....	..	232	252			

The first eight fractions of Zorritos oil = 40 per cent. were colourless, and remained so for some time; fractions No. 9 and 10 had a violet tint, whilst fraction No. 11 was of a violet-blue colour.

The following table shows the percentages and specific gravities of under-fractions into which the fractions mentioned in the first column may be broken up by fractional distillation.

In order to determine the amount of non-saturated hydrocarbons and of those belonging to the aromatic series two fractions were washed with concentrated sulphuric acid, containing 20 per cent. fuming acid. The acid absorbed from the fraction 100°—150° C., 7·10 per cent.; and from the fraction 150°—200° C., 15·4 per cent. The remaining parts had the following sp. gr. 0·739 and 0·777.

Specific Gravity of Analysed Part.	0·731	0·745	0·758	0·770	0·790	0·809	0·824	0·841	
Fraction. 0—100° C.	59	43	12	..	..	..	..	..	Vols. Per Cent.
	0·707	0·728	0·728	..	..	..	..	..	Sp. Gr.
100°—120° C.	22	28	43	32	..	..	..	..	Vols. Per Cent.
	0·741	0·745	0·745	0·750	..	..	..	..	Sp. Gr.
120°—140° C.	10	15	21·5	30·5	19	..	..	..	Vols. Per Cent.
	0·757	0·759	0·761	0·761	0·766	..	..	..	Sp. Gr.
140°—160° C.	..	..	12·5	17·5	13·5	25	..	..	Vols. Per Cent.
	..	..	0·778	0·777	0·777	0·783	..	..	Sp. Gr.
160°—180° C.	..	..	..	9·25	18	30·25	29	..	Vols. Per Cent.
	..	..	..	0·788	0·793	0·795	0·797	..	Sp. Gr.
180°—200° C.	..	..	..	..	11·25	15·25	25	37	Vols. Per Cent.
	..	..	..	..	0·808	0·813	0·815	0·818	Sp. Gr,
200°—220° C.	..	..	..	..	7	8	17·5	26·5	Vols. Per Cent.
	..	..	..	..	0·827	0·826	0·828	0·831	Sp. Gr.
220°—240° C.	..	..	..	..	..	3·5	11·5	18·5	Vols. Per Cent.
	..	..	..	..	..	0·837	0·836	0·847	Sp. Gr.
240°—260° C.	..	..	..	..	..	..	95	13	Vols. Per Cent.
	..	..	..	..	..	..	0·848	0·851	Sp. Gr.
260°—280° C.	..	..	..	..	..	..	..	7	Vols. Per Cent.
	..	..	..	..	..	..	..	0·862	Sp. Gr.

The working of the crude oil for burning oil (kerosene) is easy: the residue yields a lubricating oil of high viscosity and high specific gravity, and of an appearance similar to that of "valvoline." The kerosene had a sp. gr. 0·824 and showed the following boiling point:—

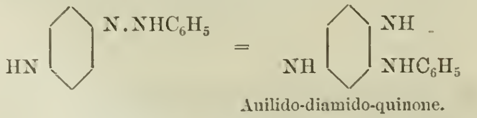
0°—150° C.	9·5 per cent.
150°—210° C.	46·5 per cent.
210°—280° C.	36·0 per cent.
Residue	6·75 per cent.

Flash point (Abel's test) 93° F. = 33·9° C.—J. L.

IV.—COLOURING MATTERS AND DYES.

On the Formation of Indulines. O. Fischer and E. Hepp. Ber. 1892, **25**, 2731—2734.

The authors have previously shown that the intermediate products formed during the production of indulines are paraquinone anilides. Although the conversion of the latter into indulines offers no theoretical difficulty, the formation of these quinone derivatives from amidoazo compounds has not been satisfactorily explained. If it be assumed that the amidoazo-compounds are hydrazones — as assumed by Goldschmidt—their conversion into the quinone derivatives can be explained by the following equation:—



Anilido-diamido-quinone.

It is known that such intramolecular changes occur on the reduction of azo-compounds, and the authors have found that a similar change may be effected by means of glacial acetic acid. When benzene-azo-α-phenylnaphthylamine is heated at 130° with 80 per cent. acetic acid, anilidonaphthaquinone is obtained as the chief product, and anilidonaphthaquinone-anil in smaller quantity. Similarly, when benzene-azo-α-naphthol is boiled for 8—10 hours with 20—25 parts of glacial acetic acid, the chief product obtained is anilidonaphthaquinone.—A. K. M.

β-Dinaphthylamine Monosulphonic Acids. F. Schiff. Mittheil k.k. Techn. Gewerbe Museums, 1892, 283—287.

The β-dinaphthylamine obtained as a by-product in the preparation of β-naphthylamine has hitherto found no application as a source of dyestuffs. The author finds that it yields two isomeric monosulphonic acids by the following treatment:—Finely-powdered β-dinaphthylamine (50 grms.) is stirred into monohydrated sulphuric acid (150 grms.), cooled till complete crystallisation has occurred. On keeping the mass at the ordinary temperature for 60 hours, with frequent agitation, complete solution is brought about; ice (500 grms.) is then added, and the brownish separation filtered off. The filtrate contains principally higher sulphonation products, but when evaporated on the water-bath yields small quantities of the monosulphonic acid. The greater portion of these, however, remains in the residue, and is extracted by heating with water or caustic alkalis, but preferably with 90 per cent. alcohol. The alcoholic extract is evaporated and the residue taken up with hot caustic soda; the solution on cooling deposits white needles of pure sodium salt. 20 per cent. of the amine employed is recovered unchanged and 60 per cent. of the theoretical yield of monosulphonic acid is obtained. The two isomeric sodium salts $C_{20}H_{14}N(SO_3Na)$ are separated by reason of their different solubilities in water; the so-called α-acid yields the less soluble salt, the β-acid the more soluble.

The α-acid is separated from its aqueous solution by hydrochloric acid, but not by acetic acid, as a white amorphous precipitate; solutions of the salt turn red on boiling. The sodium salt dissolves in 96 per cent. alcohol giving a solution showing intense bluish-green fluorescence. The barium and calcium salts form insoluble yellowish precipitates. The silver salt is easily reduced on warming with water. The salts of the β-acid resemble those of the α-acid, but are more soluble in water.

Both acids give poor azo-colours; the azo-compounds with α- or β-naphthylamine are green metallic powders, which dye silk a beautiful red colour in a 3 per cent. soap bath. With metamidobenzoic acid a dirty yellow azo-compound is obtained; the tolidine and benzidine compounds are fixed on cotton by sodium sulphate, or phosphate, borax, or caustic soda. The compounds obtained with amido-azobenzene mono- and di-sulphonic acids give black colours, lacking, however, in intensity. These latter, together with the dis-azo colours obtained with sulphanilic acid-azonaphthylamine are very unstable towards acids and are changed by boiling with sodium sulphide.

On heating the azo-compounds obtained with β-naphthylamine in aqueous solution, with concentrated hydrochloric acid, subsequently adding caustic soda, filtering off the separated naphthylamine, and adding hydrochloric acid to the filtrate, an orange-yellow precipitate of β-naphthazine monosulphonic acid, $C_{20}H_{12}NSO_3$, is obtained. It is readily soluble in alkalis or sodium carbonate solution, and is re-precipitated by acetic acid. The sodium salt forms sulphur-yellow needles soluble in alcohol or warm water, and does not dye animal fibres. The barium and silver salts form sparingly-soluble yellowish precipitates; the copper salt is more soluble. No precipitate is obtained with lead acetate, but ferrous sulphate gives a green precipitate.
—W. J. P.

Preparation of Nitro-β-Naphthoquinone. Th. Zincke Annalen, **268**, 273—276.

The preparation of nitro-β-naphthoquinone in good yield is far more difficult than the directions given by Stenhouse and Groves (Annalen, **194**, 203) would lead one to suppose. It is necessary to start with a pure quinone, as the presence of diquinone often hinders nitration. Naphthoquinone is most readily prepared from its hydroquinone, which is now manufactured on the large scale by the Badische Anilin und Sodafabrik. On account of the sparing solubility of the hydroquinone a large bulk of water has to be employed to effect solution, 20 grms. requiring a litre of water. The mixture is heated on the water-bath, and when the substance is almost completely dissolved, some sulphurous acid is added, the solution cooled to 40°, and filtered into a solution containing an excess of ferric chloride.

For the nitration of the quinone, the author recommends a nitric acid of higher specific gravity (1·38—1·4) than that (1·2) used by Stenhouse and Groves. The air-dried quinone (10—15) grms. is treated with four to five times its weight of nitric acid in a large test-tube; this is dipped into hot water (80°—90°) when the quinone should quickly dissolve with deep red coloration. If the heat be continued too long, red fumes are abundantly evolved and the yield of nitro-product is diminished. As soon as the quinone is dissolved the tubes are placed in cold water, when the nitro-product soon separates. It is filtered through glass wool and washed first with nitric acid, then with glacial acetic acid. and finally with alcohol. A further purification, if necessary, may be effected by crystallisation from acetic acid. Nitro-β-naphthoquinone thus obtained melts at 158°.
—A. K. M.

Hydroxyketone Colouring Matters. C. Graebe and A. Eichengrün. Annalen, **269**, 295—317. (See also this Journal, 1891, 536.)

I. *Trihydroxybenzophenone* [2 : 3 : 4 or 3 : 4 : 5] (Alizarin-yellow A) $C_{13}H_{10}O_4 + H_2O$ is prepared from pyrogallol and benzoic acid, or, in the place of the latter, benzoyl chloride, benzoic anhydride, or benzotrichloride; the last of these is now employed on the large scale. *Alizarin-yellow A* is used in cotton printing and produces pure yellow shades; its lakes are golden yellow and are fast to light, air, and soap.

Trihydroxybenzophenone crystallises in yellow needles and melts (dehydrated) at 140°—141°. Several metallic and other derivatives are described.

II. *Tetrahydroxybenzophenone* [2 : 3 : 4 : 2′]

$$C_{13}H_{10}O_5 + H_2O$$

is prepared from salicylic acid and pyrogallol and is obtained in greenish-yellow plates which melt at 100°, whilst the dehydrated substance melts at 149°. Its sodium derivative $C_{13}H_9O_5Na + H_2O$, and acetyl derivative $C_{13}H_6O_5(C_2H_3O)_4$ are described.

III. *Tetrahydroxynaphthylphenylketone*, $C_{17}H_{12}O_5 + H_2O$, is obtained from gallic acid and α-naphthol, and the positions of the OH groups are probably 4 : 3′ : 4′ : 5′. It crystallises from alcohol in greenish-yellow prisms or needles which melt at 246°. A few of its derivatives are described.—A. K. M.

The Artificial Colouring Matters Discovered by R. Bohn. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1892, 331—338.

The following is a list of the colouring matters discovered or introduced into practice by René Bohn:—

Alizarin maroon (discovered in 1885).—This is an amido-alizarin the constitution of which is yet undetermined. It crystallises in brown needles, which dissolve in sulphuric acid with a red, and in alkalis with a purple colour. With the alumina mordant it yields chocolate-red lakes; with chrome dark purple. It is employed in wool-dyeing, as well as in cotton-printing and dyeing.

Galloflavin (1886, Eng. Pat. 6413; this Journal, 1887, 285, 437, 722).—The constitution of this colouring matter is not definitely known. Its empirical formula is $C_{13}H_6O_9$. It yields on the chrome mordant a lake of exceeding fastness to soap, light, and air, and is chiefly employed in wool-dyeing.

Anthracene brown or *Anthragallol* (1886; this Journal, 1884, 141) is 1 . 2 . 3-trihydroxyanthraquinone. It was discovered in 1877 by Seuberlich, but was first manufactured commercially in the year named. It is one of the fastest of the alizarin colouring-matters.

Alizarin black or *Napthazarin* (1887, Eng. Pat. 7833; this Journal, 1888, 431), although known since 1861, has been commercially available only since 1887. It is manufactured by a different method from that by which Roussin first prepared it, the latter being technically valueless. The compound of this colouring matter with sodium sulphite or bisulphite is employed in calico-printing for grey shades.

Alizarin green and *Alizarin indigo-blue* (1888, Eng. Pats. 14,353 and 15,121; this Journal, 1889, 770). These important derivatives of alizarin blue are obtained by the following process:—10 kilos. of dry alizarin blue are added by degrees to 100 of fuming sulphuric acid containing 70 per cent. of anhydride, and the mixture heated to 50° for five hours. An unstable, intermediate product, devoid of tinctorial properties, is produced, which is transformed into alizarin green by heating it with 10 parts of sulphuric acid of 60° B. at a temperature not exceeding 130°. Alizarin indigo-blue is obtained by raising the temperature to 210°. In practice, the intermediate compounds are not isolated, the final compounds being obtained by diluting the product of the first reaction with two parts of sulphuric acid at 66° B. and heating at 130° or 210°, according to the compound it is desired to manufacture. After heating for eight hours, the mass is poured into water and filtered. Alizarin green forms microscopic blue-grey needles, insoluble in water, but soluble in alkalis with a green, and in alkaline carbonate solutions with a blue colour. Alizarin indigo-blue crystallises in small black needles; it dissolves in both alkaline hydrate and carbonate solutions with a blue colour, and, like alizarin green, is precipitated from such solutions by an excess of alkali. Both colouring matters yield easily-soluble compounds with sodium bisulphite, in which form they are sent into commerce. Alizarin green gives a dark blue-green and alizarin indigo-blue a dark blue shade with the chromium mordant, both colour-lakes being of the highest degree of fastness. The colouring matters are oxidation products of alizarin blue.

Carbazole yellow (1888, Eng. Pats. 14,478 and 14,479; this Journal, 1889, 771) is prepared from salicylic acid and the tetrazo derivative of diamido-carbazole. It is easily soluble in water and dyes unmordanted cotton in a neutral bath a fast golden yellow. It also dyes wool from a neutral or acid bath a yellow, fast to milling.

Alizarin yellow A (1889, Eng. Pats. 8373 and 9428; this Journal, 1890, 497) is a trihydroxybenzophenone, obtained by the condensation of pyrogallol with benzoic acid. It forms yellow crystals, containing 1 H_2O, and melting at 138°. In cold water it is only slightly soluble, but it dissolves readily in boiling water, alcohol, ether, acetone, and glacial acetic acid. Its alkaline solution has at first a yellow colour, but on exposure to air turns green, a precipitate of the same colour eventually separating. The colouring matter is polygenetic, yielding the following colours: with chromic oxide, brown; with ferric oxide, dark olive; with alumina, orange-yellow, which is changed to orange by calcium salts; with a mixture of alumina and tin oxide, a fine yellow. All the colours obtained are very fast.

Alizarin yellow C (1889, Eng. Pat. 9429; this Journal, 1890, 500) is gallacetophenone. It was prepared by Nencki by condensing pyrogallol with glacial acetic acid. Its lakes are of a more greenish hue than those of trihydroxybenzophenone.

Anthracene blue (1891) is a new colouring matter which seems likely to find very extensive employment in wool-dyeing. It is obtained by a new reaction, the publication of which its discoverer for the present reserves.—E. B.

A Reaction of Aldehydes and Ketones with Aromatic Nitro-Compounds. B. v. Bittó. Annalen, **267**, 377.

See under XXIII., *page* 66.

PATENTS.

Manufacture of New Colouring Matters. C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 277, January 6, 1892.

The base employed in the production of these new colouring matters is *p*-amidobenzene-azo-amido-*α*-naphthalene represented by the formula—

$$NH_2—C_6H_4—N=N—C_{10}H_6—NH_2.$$

It was first prepared by Meldola (J. Chem. Soc. (Trans.) 1883, 432) by combining diazotised *p*-nitraniline with *α*-naphthylamine and reducing the nitro-azoamido compound obtained with ammonium sulphide. On diazotisation this base gives a tetrazo compound which may be combined with amines, phenols, or their derivatives in the well known manner, giving various shades, which are generally of a darker colour than the corresponding dyestuffs hitherto obtained from para diamines. They all dye cotton from an alkaline or salt bath, and wool from a salt bath, and are tolerably fast to light and washing. The claims except the combinations of the tetrazo compound with phenol, resorcinol and the naphthols, and Schaeffer's *β*-naphthol mono-sulphonic acid, as these bodies had already been prepared.—T. A. L.

Improvement in the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt and Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 1390, January 23, 1892.

By the action of nitrous acid in an acid solution on dimethyl-*m*-amidocresol a dinitroso-cresorcinol is produced, which does not react with aromatic amines to form colouring matters. If, however, cold solutions of equal molecules of sodium nitrite and of dimethyl-*m*-amidocresol hydrochloride are mixed and allowed to stand, a red precipitate separates out which is the mononitroso-derivative of dimethyl-*m*-amido-cresol. It can also be produced by mixing cold alcoholic solutions of amyl nitrite and of the sodium salt of dimethyl-*m*-amidocresol, filtering off the sodium salt which separates out, dissolving it in cold water and precipitating with acetic acid. The new substance can be purified by crystallisation from toluene and melts at 105° C. It combines with aromatic amines to form basic blue colouring matters, the following being a typical example; 13 kilos. of benzyl-*m*-amidodimethyl-*p*-toluidine, 11 kilos. of nitroso-dimethyl-*m*-amidocresol hydrochloride and 90 litres of spirit are heated until the nitroso compound has disappeared. The melt is diluted with hot water, 20 kilos. of sodium acetate are added to remove impurities, the solution is filtered and the colouring matter precipitated by the addition of salt and zinc chloride. Other amines mentioned are *α*-naphthylamine, its mono- and di-alkyl derivatives and certain meta and para diamines such as *m*-amido-dimethyl-aniline, ethyl-*m*-amido-dimethyl-aniline, *m*-amido-diethyl-*p*-toluidine, dibenzyl-*m*-toluylene diamine, tetramethyl-*m*-phenylene diamine, *p*-phenylene diamine, 1·4 naphthylene diamine, &c.—T. A. L.

Erratum.—This Journal, December 1892, page 998, 2nd col., 5th line from the top, after "*β*-naphthylamine" add the word "nitrate."

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Carbonisation of Wool with Aluminium and Magnesium Chlorides. F. Breinl and C. Hanofsky. Mitt. k.k. Techn.Gewerbe-Museums, 1892, 203—217.

Magnesium and aluminium chlorides, while completely effective in the destruction of vegetable substances, are distinguished among the various chemical agents used for extracting vegetable matters from woollen materials, by their comparatively slight action on dyed colours. The action of these salts has been variously explained. It has been attributed to the hydrochloric acid liberated on heating textile fabrics which have been impregnated with them (Wagner's Jahresbericht, 1877; Frank, *ibid.* 1878, 1024); to the crystallisation of the salts in the vegetable fibres (Delong); to the destructive action of aluminium chloride itself (Joly); and, again, to the condensing action of the latter salt (R. Meyer). The authors have made a number of experiments with the object of elucidating the action, with bleached calico, pure woollen cashmere, and a union fabric composed of 60 per cent. of cotton and 40 per cent. of wool.

Carbonisation with Magnesium Chloride.—To detect and estimate any hydrochloric acid disengaged from the materials treated, samples of the fabrics named were impregnated with magnesium chloride by steeping for an hour in a solution at 9° B., dried in the air, and heated in an air-bath in flasks, through which a continuous stream of air, washed by silver nitrate, was passed. As a preliminary test made with pure wool showed that a solution of silver nitrate became discoloured by the hydrogen sulphide evolved from the heated wool, the air, after passing through the flasks, was washed with a decinormal solution of sodium hydrate.

Five samples of white cashmere were taken, saturated with magnesium chloride and dried as above described, and severally heated at temperatures varying from 130° to 150° for one to three hours. No alkalinity was perceptible in any of the samples after this treatment, and no neutralisation of the alkali could be observed, using methyl orange as indicator. Even in a test made with wool dyed with acid magenta in a bath containing 2·5 per cent. of sulphuric acid, and which had a marked acid reaction towards litmus, evolution of hydrochloric acid could not be detected, the wool after heating being still acid. The results obtained with samples of pure cotton, and mixed cotton and wool tissues, are given in the following table:—

Material.	Time of Heating and Temperature.	Percentage of Hydrochloric Acid Evolved.	Condition of Material after Treatment.
Cotton	1 hour : 130°—140°	0·10	Completely charred and alkaline.
„	1 hour : 130°—140°	0·11	„ „
„	3 hours : 140°	0·57	„ „
„	$2\frac{1}{2}$ hours : 140°—150°	0·65	„ „
„	$1\frac{1}{2}$ hours : 140°—155°	0·70	„ „
Mixed tissue.	$2\frac{1}{2}$ hours : 140°—150°	0·17	Cotton charred and alkaline; wool coloured faint yellow, but otherwise unaffected.
„	3 hours : 150°	0·20	

It is noticeable in these results that the quantity of acid disengaged from the mixed tissue (consisting of 60 per cent. of cotton) is not proportional to the cotton contained in the same. As regards the influence of the process on dyed colours, it was found that colours darkened with logwood and copper sulphate became paler and lost their blue tone; colours saddened with logwood or sumac and ferrous sulphate were less changed; anthracene brown on an iron mordant was rendered rather redder, and cochineal scarlet much bluer.

Other experiments were made at different temperatures to the above. At 120°—130° the impregnated cotton became disintegrated but not charred, and very little acid was disengaged. At 160°—180° the wool was left in an alkaline condition, and such colours as are affected by alkalis became changed, Brilliant green, for example, turning orange, and Magenta, Acid magenta, and Acid green being almost decolorised, and only restored on rinsing in dilute acid. The general conclusions are:—

1. A solution of magnesium chloride at 9° B. is efficacious in the removal of all vegetable matters from wool, seeing that it readily destroys cotton, which is the most resistant of them.

2. The material moistened with such a solution should be dried at a low temperature, to avoid the dissociation of the salt and, as far as possible, the production of steam in the carbonising chamber, which is liable to cause damage to the colours through drops of condensed water falling on them.

2. A temperature of 140°—150° is sufficient for the carbonisation. A higher temperature affects not only the colours but the wool fibre as well.

3. Whether a passage of the carbonised materials through dilute acid is advisable cannot be generally decided. This must depend upon particular circumstances: for instance, the amounts of vegetable matters present in the wool, the fastness of the colours to alkaline bodies (magnesia), and to acids, &c.

Carbonisation with Aluminium Chloride.—A commercial preparation of this salt, neutral to logwood decoction, was employed at a density of 7° B., the various textile materials experimented upon being thoroughly imbued with the solution, dried in the air and enclosed in flasks as described. The results obtained are tabulated below.

Material.	Time of Heating and Temperature.	Percentage of Hydrochloric Acid Evolved.	Condition of Material after Treatment.
Cotton	2 hours: 110°—120°	1·56	Completely charred.
"	3 hours: 120°	1·70	" "
"	2 hours: 100°—105°	0·64	Quite decomposed, but only coloured yellow.
"	1⅓ hours: 100°	0·07	" "
Mixed tissue.	1 hour: 118°—120°	0·55	Cotton destroyed; wool coloured pale yellow.
"	2 hours: 118°—120°	0·80	" "
"	2 hours: 120°	0·89	" "
Wool	3 hours: 120°	0·12	Coloured pale yellow.
"	2 hours: 120°—122°	0·13	" "
"	2½ hours: 120°—124°	0·14	" "
"	1½ hours: 120°—135°	0·14	" "

The evolution of acid from the pure wool was discovered to be due to the presence of free acid in the aluminium chloride solution. With a solution prepared from 6 equivalents of common salt and 1 equivalent of alum, and diluted so as to contain the same quantity of alumina as the above solution at 7° B., the amounts of hydrochloric acid obtained on repeating the last two experiments mentioned in the table, were respectively 0·007 and 0·011 per cent. The cotton samples, also, although disintegrated, remained uncharred with this solution. The dyed colours were found to be in almost all cases greatly affected; the copper-logwood lake perhaps most so, and far more than the iron log-wood colour. The conclusions deduced from this research are:—

1. Aluminium chloride solution at 7° B. completely eliminates vegetable matters from wool.

2. Dyed materials which are to be carbonised with this salt must be quite free from acid.

3. Unless steam-heated drying cylinders are used, the carbonising chamber must be well ventilated to remove the steam, which is very liable to indirectly damage the colours.

4. The destruction of the vegetable matters takes place slowly at 100°. This temperature should be exceeded as little as possible to avoid rendering the wool yellow.

5. After carbonising, the wool may be washed free from acid by water alone (without alkali), but a large quantity is required.—E. B.

PATENTS.

An Improved Compound of India-Rubber and Fibre, and Processes and Apparatus for Producing the same. W. Golding, Manchester. Eng. Pat. 18,851, October 31, 1891.

See under XIII., *page* 52.

An Improved Substitute for Whalebone. T. J. Haslam, Dublin. Eng. Pat. 21,587, December 10, 1891.

Alternate layers of celluloid or other suitable cement in a plastic condition, and straight hair or vegetable fibres (previously washed with alkali) are placed in a rectangular iron mould and submitted to pressure by means of a plunger, the mould is then dried under pressure, the material removed and split into lengths and polished. The layers of hair should preferably be only one hair thick, and the layers of cementing material just sufficient to cover them.—A. G. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications of some New Dyes. H. von. Perger. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 236—272.

Triphenylmethane Derivatives.

Patent blues A and AJ 1 belong to a series of dyes obtained by oxidation of the sulphonic acids of *m*-hydroxy-, amido-, and chloro derivatives of tetralkyldiamidotriphenylcarbinols (Eng. Pats. 12,796 and 14,822 of 1888, 9530 of 1890; this Journal, 1889, 701 and 930; 1891, 538). The first dye is greener in shade than ordinary patent blue (this Journal, 1890, 53). The second yields dark shades of blue and for such shades and compound colours is an excellent substitute for indigo carmine. Both dyes are even faster to washing, milling, and stoving than the older patent blue, but their resistance to light is only moderate. They are applied in an acid bath which with 0·5 to 5·0 per cent. of dye becomes nearly exhausted.

Dyes of the magenta group are obtained by simultaneously oxidising (by ferric salts in chromic acid) primary aromatic amines and diamidodiphenyl- or diamidoditolylmethane, which are prepared by heating anhydroformaldehyde-aniline with aniline and *o*-toluidine respectively. Thus, triamidotri-*o*-tolylcarbinol, a magenta probably identical with that obtained by Rosenstiehl and Gerber from *as*-metaxylidine and 2 mols. of *o*-toluidine, is prepared by oxidising either a mixture of *o*-diamidoditolylmethane and *o*-toluidine or (by the nitrobenzene process) of anhydroformaldehyde-*o*-toluidine with *o*-toluidine and excess of *o*-toluidine hydrochloride or, again, by heating *o*-toluidine hydrochloride with diamidodiphenylmethane the (phenyl residues in the latter being replaced by tolyl groups), and subsequently oxidising. Similarly, instead of anhydroformaldehyde-*o*-toluidine, the analogous compounds of aniline, *p*-toluidine, xylidine, and naphthylamine can and be used, instead of nitrobenzene other aromatic nitro compounds can be employed to effect the condensation and oxidation, a number of magentas, hitherto not technically available, being thus readily produced. The ordinary magenta of commerce is a mixture of several triamidotriphenyl derivatives; its hydrochloric acid solution gives a green coloration with potassium chlorate. The above homologues of pararosaniline do not give this reaction.

Acid violet dyes closely related to Formyl violet are formed by sulphonating ethylbenzylaniline and condensing it with formaldehyde into diethyldibenzyldiamido-diphenylmethanedisulphonic acid, oxidising the latter and condensing the resulting hydrol base with tertiary aromatic bases and again oxidising. *Acid violet* 4 *BN* of the Badische Anilin und Soda Fabrik is the sodium salt of benzylpentamethylpararosaniline sulphonic acid (Eng. Pat. 21,284, 1890; this Journal, 1891, 1033), and apparently identical with *Acid violet* 6 *B* of the Farbenfabriken vormals Fr. Bayer and Co., which, however, is prepared by a different method. The *Acid violet* 6 *B* of the Berlin Actiengesellschaft is obtained by oxidation of the condensation product of dimethyl-*p*-amidobenzaldehyde and ethylbenzylaniline sulphonic acid. *Formyl violet* 4 *SB* of the firm of Cassella and Co. is dibenzyltetra-ethyltriamidotriphenylcarbinoldisulphonic acid. While its fastness to light is similar to that of the above acid violets, it is superior to these in its resistance to alkalis and milling. It dyes very evenly and can, therefore, be advantageously used for pale shades in wool dyeing or printing. In concentrated sulphuric acid this dye dissolves with a brown-orange colour, which becomes blue-violet on addition of water; alkalis decolorise the aqueous solution. *Acid violet* 6 *BN* of the Badische Co. yields shades resembling those of Acid violet 7 B, and is as fast to light as Formyl violet. It dyes wool slowly, best at a temperature of 72°—75°. Sulphuric acid dissolves it with a red-brown colour, which becomes successively blue and violet on dilution with water. The *Acid violet* 5 *B* of the Elberfeld Farbenfabriken dyes very well, like all the other acid dyes, in a bath containing sodium bisulphate, the baths being exhausted at 67°. The dyed colour is moderately stable to milling and light. The *Fast acid violet* 10 *B* of the same firm, dyes wool bright violet-blue colours and is very suitable for dyeing compound shades along with phenolic and other acid dyes. It is best applied at 75°—80°. It possesses a considerable degree of fastness to light and milling. In sulphuric acid this dye dissolves with a yellow colour which on the addition of water becomes first green and then blue. The *Fast acid violets A*, 2 *R*, *R*, and *B*, of the Farbwerke vormals Meister, Lucius, and Brüning, are sodium salts of sulphophenylated and -tolylated rhodamines. They may be applied either substantively (in an acid bath) or on chrome-mordanted wool, yielding bright colours which are fairly fast to light, stoving, alkalis, &c. *Victoria violet* 4 *BS*, of the same firm, is a moderately bright blue-violet, which is applied on wool in an acid bath. The shades it yields do not lose much in milling but possess little resistance towards light.

An interesting group of hydroxy- and carboxy- amido derivatives of triphenylmethane is obtained by condensing tetramethyldiamidobenzhydrol with resorcinol, pyrogallol, α- and β-naphthol, dihydroxynaphthalene, &c., and oxidising the products (Eng. Pat. 14,621, 1890; this Journal, 1891, 761). The dyes thus formed have an affinity for the chrome mordant and are suitable for wool dyeing but more especially for calico printing. *Chrome-violet*, one of the group, is sent into commerce as a bronzy-blue paste, which dissolves in sulphuric acid with a yellow-brown colour, turning dark red on dilution; in acetic acid with a brilliant green colour. In the case of wool, it is best applied in a bath containing acetic acid on material mordanted with potassium bichromate and oxalic acid, 2·5 per cent. of the dye giving a pale, and 10 per cent. a rich mauve shade. *Chrome-blue* forms a bronzy-blue paste which is dissolved with a chocolate colour by sulphuric acid, the blue colour being reproduced on the addition of water. It is slowly decolorised by zinc dust and ammonia, but is reoxidised on exposure to the air. On chrome-mordanted wool or cotton it yields pure blue shades. The fastness of these two dyes to soaping or milling is scarcely satisfactory, but they resist light fairly well. *Chrome-green*, obtained by condensing the above hydrol base with benzoic acid and oxidising, is faster to light than the basic green dyes, and is recommended for shading cœrulëin and other dyestuffs fixable on the chromium mordant, in calico-printing. *Chrome-yellow* is supplied in the form of paste. It is very fast to light and soaping, and withstands a moderate treatment with bleaching powder solution, and can be used in calico printing as a substitute for Persian berries and other phenolic yellow colouring matters. All the above "chrome" colours are printed on calico with acetate of chrome, and are steamed and soaped as usual.

DIPHENYLMETHANE DERIVATIVES.

The so-called *Acridine reds*, 3 *B*, 2 *B*, and *B*, are *scarlets*. 3 R, 2 R, and R, are diphenylmethane compounds. They are suitable for dyeing silk, wool, or cotton, mordanted with tannic acid, and for printing cotton in conjunction with the same mordant. They are bright but not very fast. *Acridine orange*, obtained by molecular transformation of tetramethyltetramidodiphenylmethane (Eng. Pat. 8243 of 1890; this Journal, 1891, 537) is an acridine derivative.

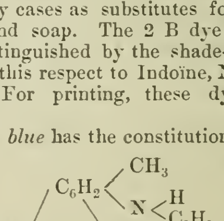
MISCELLANEOUS COMPOUNDS.

Capri blues GON, *GN*, and *VN*, are produced by the action of nitrosamines on the compounds which result from treating dimethyl-*m*-amidocresol with dichlorimidoquinone. Sulphuric acid dissolves them with a green colour which becomes red and then blue on the addition of water. They are fixed on cotton by the tannic acid mordant and are tolerably fast to soap. They can also be used for dyeing silk, wool, jute and leather, but have the drawback of possessing comparatively little colouring power.

Fast Neutral-violet B is a basic dye, formed by the action of nitrosodimethylaniline on diethyl-*m*-phenylenediamine. It may serve as a substitute for Methyl violet which it somewhat surpasses in fastness to light. It is applied in the same way as the latter, 6 per cent. of the commercial 40 per cent. paste giving deep shades. Sulphuric acid dissolves it with a brown colour.

Metaphenylene blue 2 *B* is prepared from nitrosodimethylaniline and di-*o*-tolyl-*m*-phenylenediamine (Eng. Pat. 5852, 1888; this Journal, 1889, 281) and is a valuable dye for cotton. The colours it gives on the tannic acid mordant may serve in many cases as substitutes for indigo, so fast are they to light and soap. The 2 B dye is faster to light than the dyes distinguished by the shade-marks R and B, and is superior in this respect to Indoïne, New blue, and the indazine blues. For printing, these dyes are of little importance.

New Methylene blue has the constitution—



It gives pure blue shades like those of Toluidine blue (this Journal, 1892, 31). For calico printing it possesses the advantage, as compared with Methylene blue, of combining less readily with the tannic acid of the printing-mixture before printing. Its fastness is similar to that of Methylene blue 2 B. It dissolves in concentrated sulphuric acid with a greener colour than the latter dye. Hypochlorites render its aqueous solution brown-red, whereas they do not affect Methylene blue.

Chromines G and *R* are obtained by heating dehydrothiotoluidine with sulphur and sulphonating the product, the more-highly sulphonated compound having the redder shade. Chromine G closely resembles Thioflavine S. It forms a brown-yellow powder which dissolves readily in water, and colours sulphuric acid a brown yellow. Cotton is best dyed with it in a bath containing sodium phosphate, although good results are obtained with common salt, sodium sulphate and borax, a pure yellow being produced which is very fast to soap but only slightly so to light. With silk, borax forms the best addition to the dyebath, sodium acetate yielding a greenish yellow. As this dye withstands the actions of chlorine and stannous chloride it may be useful in calico printing for the production of discharge effects.

Azindone blues R and *G* are soluble dyes, prepared by the action of *p*-phenylenediamine on insoluble indulines. Cotton is dyed with them, either after mordanting with tannic acid, in which case 1 to 3 per cent. of alum is added to the dyebath, or directly in a bath containing sodium acetate and acetic acid. The first method yields a moderately bright-blue which may be darkened by passing through a dilute boiling solution of potassium bichromate. The second method yields shades which may be rendered greener and brighter by soaping. The shades obtained are very fast.—E. B.

A Method of Discharge-Printing on Indigo. Sealed note No. 407: dated November 14, 1884. Storck and Pfeiffer. Bull. Soc. Ind. Mulhouse, 1892, 387—390.

A THICKENED solution of aluminium chlorate when printed on indigo-dyed calico and passed through the steam-ageing apparatus, effects a slight discharge of the blue. This action is increased by adding a small quantity of vanadium chloride to the printing-mixture, as it is also by steaming under pressure for a short time. A mixture of aluminium chlorate and a certain proportion of a sulphocyanide, more especially the ammonium salt, has the power of oxidising indigo even at the ordinary temperature, but this mixture is very difficult to thicken suitably for printing. The difficulty may be avoided, however, by preparing the cloth with the sulphocyanide, and printing a thickened solution of the chlorate, a very effective discharge being produced, and alumina deposited on the fibre which may subsequently be dyed. Ammonium chlorate, again, when steamed, destroys indigo, thus rendering it possible to obtain white patterns simultaneously with colour-effects on the alumina mordant. But all these processes have the serious drawback of impairing the tenacity of the fibre. The authors accordingly turned their attention to aluminium bromate, which they found when dissociated did not injure the cotton fibre to the same extent as did the chlorate of the same base, and were thus led to devise an economical method of manufacturing barium bromate, from which the aluminium salt is most conveniently prepared. This method consists in converting the whole of the bromine in combination with calcium, as obtained by boiling the product of the action of bromine on calcium hydrate, into calcium bromate, and then decomposing the latter by interaction with barium chloride as indicated in the equations:—

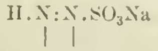
$$1.\ Ca(BrO_3)_2 + 5\ CaBr_2 + 30\ CaOCl_2 = 6\ Ca(BrO_3)_2 + 30\ CaCl_2$$

$$2.\ 6\ Ca(BrO_3)_2 + 30\ CaCl_2 + 6\ BaCl_2 = 6\ Ba(BrO_3)_2 + 36\ CaCl_2$$

the barium bromate, owing to its sparing solubility being readily isolated. In order to obtain aluminium bromate from it, it is necessary to heat the mixture of it and aluminium sulphate solution almost to boiling, as the decomposition is exceedingly slow at the ordinary temperature. A concentrated solution of the aluminium salt may be obtained without difficulty, and merely requires mixing with starch paste to prepare the printing-mixture. Additions to the latter of vanadium chloride and of sulphocyanides are of no advantage, but additions of alkaline or alkaline-earth chlorides produce a marked improvement in the results. The discharge is effected by steaming, and the alumina which simultaneously becomes fixed is afterwards dyed with alizarin, &c. The process has been tried on the large scale with entirely satisfactory results (see also this Journal, 1892, 812 and 813).

The Change of Shade during Steaming of Printed Azo-Colours on Wool. F. Binder. Bull. Soc. Ind. Mulhouse, 1892, 382—386.

THE change of colour of azo-dyes printed on woollen tissues which sometimes takes place during the steaming operation, is due to the action of sulphurous acid which has been absorbed by the fibre in the process of bleaching, and which has escaped oxidation in the subsequent chlorination of the material. To remove the whole of this acid it is necessary to carry on the chlorination to an excessive degree, thus causing the wool to take an objectionable permanent yellow hue, which is intensified by steaming. Hydrogen dioxide readily oxidises the acid without injuring the wool, but is too expensive for use for this purpose. The dyes under the influence of sulphurous acid become transformed into bisulphite compounds of the type—



$H.N:N.SO_3Na$

which, when fixed on wool, resist the ordinary operations of steaming and washing, The author finds that such compounds may, as a general rule, be readily decomposed by re-steaming the printed tissues for a few minutes between folds of cloth moistened with an ammoniacal solution of sodium chlorate, the primitive shades of the dyes being thus restored. Certain dis- and tris-azo dyes, however, behave exceptionally, Naphthol black, for example, which is changed to a dull puce by sulphurous acid, not being so restored. In applying the latter class of dyes the addition of an alkaline chlorate to the printing mixture is sometimes made. This protects the dyes in large surfaces of colour, but is ineffective with small patterns, which are changed in colour by the sulphur dioxide evolved in the steaming from the unprinted parts of the cloth. A better plan with such dyes is to employ steaming cloths moistened with an ammoniacal solution of sodium chlorate, the change being then prevented from taking place. The cloths can be employed several times, being moistened with dilute ammonia before re-use.

A passage through dilute ammonia solution or hypochlorous acid will also restore the altered shades of monazo dyes. but the above method is more practicable.—E. B.

Employment of some Induline Dyestuffs. G. Ulrich. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 292—295.

THE induline sulphonic acids of the benzene series have been but little employed in wool dyeing owing to a lack of fastness, and the irregularity with which the colour is deposited. Loose wool may be dyed, however, by placing it in 20 parts by weight of a cold bath containing 2—4 grms. of the colour and 0·5 grm. of ammonium oxalate per litre, and boiling for 2—3 hours; the material is then withdrawn, washed, and placed in a solution of sodium sulphate and sulphuric acid or tartar preparation. Worsted gives good results when steeped for $1\frac{1}{4}$—2 hours in a boiling bath containing 50—80 per cent. of ammonium oxalate and 3 per cent. by weight of the yarn of Wool Induline B; after washing and drying, the deep blue colour shows no irregularities, and is unaffected by rubbing or light. The colour withstands fulling if the operation be carefully performed, and the yarn dried as soon as possible.

The rosindulines may be applied to wool in the same manner as the preceding. Naphthyl blue gives a very pure violet blue, and Naphthyl violet a very full reddish violet; the colours are stable towards fulling and light. The sparing solubility of the rosinduline dyes, which has proved a hindrance to their application to wool printing, may be avoided by adding ammonia to the printing colour in place of sulphuric or tartaric acid. After $\frac{1}{2}$—1 hour steaming, the print resists washing. Medium deep shades only can be obtained in this way, but by the addition of tannin to the usual acid rosinduline printing colour, the dyestuff is either held in solution or is in so fine a state of division as to work satisfactorily. The application of a printing colour composed of 20 grms. of Rosinduline G, 20 grms. of tartaric acid, 100 grms. of tin salts, and 600 grms. of starch-tragacanth thickener per 1,000 grms., to woollen fabrics dyed with sulphone-azurine, and steaming forone hour, completely discharges the latter colour and gives very good results. Rosinduline 2 G requires the addition of one-eighth part of tannin, for printing, a quarter part should be used; the fixation is incomplete without further addition of acid. Tartaric acid gives bluer shades than sulphuric acid; half a part of tannin should be added to the dye in preparing discharge-printing colours. Rosinduline B and G require half a part of tannin. Rosinduline 2 B requires a quarter part, and the blue shade one-third part of tannin; the latter colour loses in intensity on washing, if not steamed for an hour. Excess of tannin should be avoided, and sulphuric acid is the most suitable to use.—W. J. P.

Preservative against the Discharge of Indigo by Potassium Bichromate. A. Kertész. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 298—299.

As a preservative against the discharge of indigo in printing fabrics with a discharge colour containing potassium bichromate the author recommends the following mixture:—2½ litres soda ley (24° B.); 1 litre sodium bisulphite solution (35° B.); 2 litres of water, 3 litres of gum tragacanth solution, 2½ kilos. of dextrin, and 2 litres of potassium thiocyanate solution (35° B.).—W. J. P.

The Steaming of Printed Fabrics. E. Jaquet. Bull. Soc. Ind. Mulhouse, April—May 1892, 288.

The author has studied the "marking off" during steaming of printing colours and the means of avoiding such damage.

This may arise in some cases from the hygroscopic character of the colour, the "marking off" being due to simple contact; but in the more frequent and important instances it is caused by a sublimation of the colouring matter and its transportation by the vapour to the unprinted parts of the cloth. Colours made from alizarin are subject in particular to such marking off, and these have been specially studied. An alizarin-red printed on a non-oiled calico marks off much less than one on oiled cloth; an alizarin red, or claret, or purple marks off the more readily the more acid the mordant is, particularly if the acid is a strong one, as in the case of a sulphate of alumina or of chrome incompletely converted into acetate. It may, therefore, be concluded that the tendency to mark off diminishes in proportion to the rapidity with which the colour-lake is produced. As, however, a too rapid reaction in many cases injures the solidity of the resulting colour, it is not always advisable to use a neutral mordant.

To determine the cause of the marking off of an alizarin-red colour, a fent printed with an alizarin-red blotch was steamed in contact with calico prepared in the following ways and subsequently soaped.

With white unoiled cloth the marking off was nil: with oiled cloth it was scarcely perceptible; with cloth prepared in alumina it was exceedingly strong.

A second trial was then made with the same white cloths, but first printing them with an alizarin-red colour, using an open sprig pattern so as to leave as much white as possible. On steaming these in contact with the alizarin blotch, the whole of the fents showed strong marking off, the alumina-prepared cloth being worse than the others. It is evident from this that the alumina is the cause of the marking off, this fixing the alizarin that is sublimed from the printing colour; and in the case of the fents printed with the open pattern the smooth part of the roller has furnished sufficient alumina to fix the alizarin. This conclusion was confirmed by printing on unoiled cloth an alizarin-red colour in the one case by roller and in the other by block, and then steaming as in the previous trials. The former showed distinct marking off, the latter hardly a trace. The remedy for such marking off is therefore to be found in preparing the tissue with a resist which shall prevent the fixation upon it of alumina, and this is best effected by adding a little citric acid to the alizarin oil used in preparing the cloth. Such an addition has been used in certain Mulhouse works for many years with excellent results.—W. E. K.

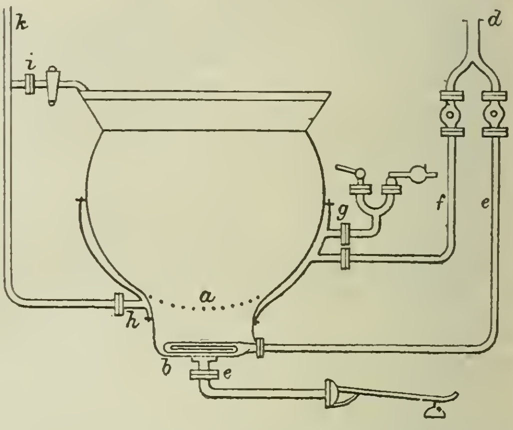
Note on the Turkey-Red Oils of MM. Schmitz and Toenges. P. Werner. Bull. Soc. Ind. Mulhouse, April—May 1892, 291.

These are a new class of Turkey-red oils patented and sold by Schmitz and Toenges, of Heerdt, near Düsseldorf, and placed on the market under the name of "oxyoleates." In their preparation, the usual course of treatment of the oil with sulphuric acid is followed, but the salted-out fat is subsequently heated in open vessels to from 105° to 120° C. In this operation the whole of the sulphur is eliminated as sulphurous and sulphuric acids, and a new product is obtained, considered by the inventors to be an "oxyoleic" acid.

The author has examined a number of these products, and finds that they possess in certain cases advantages over the usual Turkey-red oils, whilst at the same time they are not higher in price.—W. E. K.

A New Boiler System in Wool-Dyeing. F. Fritze. Lehne's Färber Zeit. 1892, 257—259.

An apparatus is described for the purpose of dyeing wool without damaging the fibre. The annexed sketch will be easily understood. The jacketed pan is provided with a perforated steam coil fixed on the bottom of the apparatus. To prevent contact of the steam with the wool a copper sieve *a* is fixed in the lower part of the pan. A similar sieve *b* prevents any solid particles from stopping up the outlet *c*. The condensed water collecting in the jacket is led away by means of *h* and *k*, and may be used for filling the pan by opening the tap *i*.—J. L.



Report upon New Researches on Turkey-Red Oil. Lehne's Färber Zeit. 1892, 241, 259, 293.

These papers contain a report on the work of Juillard (this Journal, 1892, 355) and J. A. Wilson (this Journal, 1891, 26).—J. L.

Valuation of Tin Crystals and of Zinc Dust. A. Fränkel. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 223.

See under XXIII., *page* 65.

PATENTS.

Improvements in Dyeing Vats. A. Dreze, Liège, Belgium. Eng. Pat. 148, January 4, 1892.

A central pipe in the form of an inverted truncated cone is fixed to a perforated false bottom in the vat. In the annular space between this pipe and the sides of the vat the goods are placed. An upper perforated plate is placed above the goods. Steam is introduced by means of a pipe having its orifice below the truncated cone. This acts as an injector, and a rapid circulation of the dye-liquor (upwards through the cone, and downwards through the material contained in the annular space around the cone) is effected.—W. E. K.

Improvements in Bleaching. H. Thies, Laaken, Germany, and E. Herzig, Mulhouse, Alsace. Eng. Pat. 4278, March 4, 1892.

This invention relates to a preparatory treatment of fibrous materials in bleaching (prior to scalding the same) for the purpose of expelling the air from the fibres. The process consists in subjecting to pressure the materials to be bleached contained in a scalding-vessel filled with alkaline liquid, which thereby absorbs the air adhering to the fibres, and driving thereafter the alkaline liquid into an accessory reservoir where it is freed from the absorbed air by reducing the pressure. These two operations are carried out in a continuous manner, the alkaline liquor circulating through the two vessels. In order to complete the removal of air from the fibres a sulphite is added to the alkaline liquor. After this preparatory treatment the goods are bleached by means of the circulation of caustic soda lye through the vessels. It is claimed that by the preparatory treatment the fibrous materials are protected from shrinkage and oxidation and a better and quicker bleach effected.

—W. E. K.

An Improved Process for the Production and Fixation of Colours in Conjunction with Aniline Black upon Woven Fabrics. F. F. Grafton, Manchester, and W. Browning, Accrington. Eng. Pat. 11,416, June 18, 1892. (Second Edition.)

The specification describes a method for the production of coloured designs on a background of aniline black on calicoes and other woven fabrics by means of the following operations: The cloth is first impregnated with tannic acid or tartar emetic or other suitable mordant and is then padded with aniline oil and other materials for the production of aniline black by ordinary methods. After drying, the design is printed with Methylene blue or other colouring matter which is mixed with sodium acetate and a gum to act as a "resist." The aniline black is then developed by steaming or ageing, when only those parts not protected by the design will develope, whilst at the same time the printed colouring matter will become fixed and prevent the formation of aniline black upon those parts of the fabric which have been printed.—T. A. L.

VII.—ACIDS, ALKALIS, AND SALTS.

The Action of Aluminium on Mercury Salts. J. Klaudy. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 217—222.

The interaction of aluminium and mercury salts cannot be properly investigated with aqueous solutions of the latter, as the amalgam which is first formed decomposes water and secondary changes occur. The action of aluminium on a saturated alcoholic solution of mercuric chloride was, therefore, studied. A thin sheet of aluminium, on being immersed in such a solution, quickly becomes covered with a film of mercury, and thereupon commences to dissolve. The action then proceeds at an accelerated rate, with the evolution of so much heat that the alcohol is caused to boil vigorously. After a time the action slackens, and a small quantity of gas, presumably hydrogen, is evolved. Finally, towards the end of the reaction, if an excess of aluminium has been used, a separation of basic aluminium chloride, containing Al and Cl in the ratio 1:1, takes place. If, however, the mercuric salt and aluminium are taken in the proportion of $Al_2:3\,HgCl_2$, the aluminium dissolves completely, and the solution on evaporation leaves a residue of aluminium chloride. When a still larger proportion of mercuric chloride is used, the mercury which separates becomes acted upon and mercurous chloride is formed. Only when the amount of aluminium greatly exceeds the above proportion, does the action cease at the formation of the amalgam. The quantity of mercury which is required to produce the latter body is exceedingly minute, the amount deposited in an experiment in which the amalgam was weighed under alcohol and then immersed in water to oxidise the aluminium in it, being found to be 0·0353 grm. in 2·8567 grms. of the amalgam, of which 1·5834 grms. were unaffected by the water. This gives the ratio of Hg : "active" Al as 1:267, and proves that the metals do not chemically combine, but merely form a galvanic couple. Other mercury salts than mercuric chloride can be used to prepare the amalgam, but the latter salt acts best. Amalgamated aluminium has an intense affinity for oxygen. Exposed to the air it is slowly oxidised, whilst so much heat is evolved that the mass becomes heated to 80°. It also readily decomposes water and steam, liberating hydrogen, and reduces potassium permanganate and bichromate, and alkaline potassium ferricyanide, as well as organic oxygen compounds, such as nitrobenzene, indigo, &c. It displaces from solutions of their salts all the metals which are precipitable by zinc, and in addition to the latter metal, iron, manganese, &c. Acids and potassium and sodium hydrates easily dissolve it. Hydrocarbons and absolute alcohol are without action upon it.—E. B.

The Water of Crystallisation of Barium Thiocyanate (Sulphocyanide). J. Tcherniac. Ber. 1892, **25**, 2627—2629.

Barium thiocyanate contains 3 and not 2 mols. of water of crystallisation, as has been previously thought, and has therefore the formula $Ba(SCN)_2\ 3\,H_2O$. The salt also forms alcholates with methyl and with ethyl alcohol, which contain 2 mols. of alcohol of crystallisation. The methyl alcohol compound $Ba(SCN)_2.2\,CH_3.OH$ forms glittering prismatic needles, as does the ethyl compound; the latter effloresces readily.—C. A. K.

The Partial Substitution of Sodium Cyanide by Potassium Cyanide in Commercial Cyanides. T. B. Stillman. Jour. Anal. and Applied Chem. **6**, 1892, 467—469.

The author has discovered that a mixture of sodium and potassium cyanide is cheaper, and for many purposes superior to the 98 per cent. potassium cyanide, since it contains a higher percentage of cyanogen. The mixture can be made at a less cost than the potassium cyanide alone, as may be seen from the formula for its manufacture—

$$2\,K_4Fe(CN)_6 = 8\,KCN + 2\,FeC_2 + N_4$$
$$2\,Na_4Fe(CN)_6 = 8\,NaCN + 2\,FeC_2 + N_4$$

The method adopted by the author to determine the proportions of potassium and sodium was as follows:—

The cyanides were converted into sulphates by evaporating their solution in water in presence of an excess of sulphuric acid. After ignition and weighing the sulphates, they were dissolved in water, and the sulphuric acid was determined in the ordinary way by precipitation with barium chloride. From these data were calculated the percentages of potassium and sodium respectively in the cyanide. To these results is added the percentage of cyanogen, as determined by titration with semi-normal silver solution.

A commercial sample of "98 per cent." potassium cyanide gave the following result:—

	Per Cent.
Sodium	7·90
Potassium	49·70
Cyanogen	42·33
Undetermined	0·07
Total	100·00

or

	Per Cent.
Sodium cyanide	16·90
Potassium cyanide	82·83
Difference	0·20
Undetermined	0·07
Total	100·00

—K. E. M.

New Process for the Manufacture of Potash. D. Sidersky. Le Génie Civil, 21, 1892, 410; Proc. Inst. Civil Eng. 1892–3, **111**, (1) 116.

The production of potash from the Stassfurt salts, which consist of variable compounds of sulphates and chlorides of potassium, sodium, and magnesium, has hitherto been effected by the Leblanc process, a method which is not only expensive, but gives a large amount of waste products, whilst the finished article is not easily obtained in a pure state; so that these minerals are almost entirely sold for agricultural purposes. In the new method described by the author, and patented by the Buckau Chemical Company, the whole of the constituents are utilised with the production of potash, soda, calcined magnesia, crystalline sulphate of lime, hydrochloric acid, and sulphuric acid.

The material best suited for the process is the mineral kainite, the average composition of which is—

	Per Cent.
Magnesium sulphate	16 to 18
Potassium sulphate	22 „ 24
Sodium chloride	30 „ 40

This is first converted into sulphates by treatment with sulphuric acid, the hydrochloric acid being condensed, as in the Leblanc process. The magnesium sulphate is next decomposed by the addition of lime, which produces calcium sulphate and magnesia, both of which are insoluble. This operation is effected by adding the necessary quantity of concentrated milk of lime to the boiling solution of kainite sulphates of a density of about 20° B. At first the lime dissolves in the hot solution; but when left at rest for some days after slow cooling, the calcium sulphate separates as a heavy crystalline powder covered with a lighter deposit of magnesia. These, after removal of the saline solution, are washed and separated by decantation, and finally collected in the filter-press.

The solution of potassium and sodium sulphates is next treated with barium sulphide, giving insoluble barium sulphate and solutions of the alkaline sulphides, which after filtration, are boiled down to a strength of 20° B. and subjected to the action of pure concentrated carbonic acid gas obtained from the decomposition of alkaline bicarbonates. This decomposes the sulphides, producing sulphuretted hydrogen, which is burned and converted into sulphuric acid and bicarbonates of sodium and potassium. The former salt, being almost insoluble in the cold solution, is separated by filtration, and the potassium salt is obtained by boiling down the filtered liquid. Lastly, the bicarbonates are transformed by calcination into neutral carbonates, the carbonic acid gas driven off being employed in the decomposition of the alkaline sulphides. This is said to be the first industrial application of pure carbonic acid, and to be essential to the success of the operation, which cannot be carried out with limekiln gases, on account of the presence of free oxygen in the latter, whereby a certain proportion of the sulphides are invariably changed into sulphates.

The order of operations given above may be varied by separating the magnesia with lime before the conversion into sulphates. The mixed sulphates may also be converted into sulphides by calcination with coal, which completely decomposes the magnesian sulphate, and converts the alkaline sulphates into sulphides. The product when lixiviated in Shank's apparatus, gives a precipitate of magnesia and alkaline sulphide liquors for the carbonic acid treatment. The conversion of potassium and sodium sulphates into sulphides by carbon alone has not been found to be practicable, owing to their ready fusibility and corrosive action upon the furnace-bottom when melted. The presence of magnesium sulphate, however, alters the conditions, as the mass becomes fritted with an infusible substance, caustic magnesia, and the conversion takes place at a temperature below that necessary to develop the corrosive action of the material.

PATENTS.

Improvements in the Manufacture of Caustic Alkalis. J. E. Bott, Stockport. Eng. Pat. 18,482, October 27, 1891.

The invention relates to the concentration or evaporation of caustic lye. It consists in principle of blowing heated air through the lye contained in a vessel hung on trunnions. The bottom of the vessel is perforated to allow of the passage of tuyers through which the hot air is forced through the lye contained in the vessel, the air and water-vapour passing away from the upper part of the vessel above the suface of the lye. In the apparatus, drawings of which accompany the specification, the trunnions are hollow, the hot air being led to the apparatus by one trunnion and the air and vapour being passed away by the other. When the lye is sufficiently concentrated or dried, the vessel is tipped over, the air-blast cut off, and the contents of the vessel removed through a suitable aperture in the top. Instead of air, carbonic acid may be blown into the lye when desired.—H. S. P.

Improvements in the Preparation of Acetate of Ammonia for Use in the Manufacture of White Lead by the Acetate of Ammonia Process. W. Smith, London. Eng. Pat. 18,693, October 29, 1891.

The object of this invention is the economical production of pure ammonium acetate, suitable for the preparation of white-lead (this Journal, 1892, 45 and 360). This end is obtained by a series of operations (1) for the production of pure calcium acetate from the commercial crude acetate of lime; (2) for the conversion of the same into ammonium acetate.

Crude grey acetate of lime is dissolved in a little water, settled, and the strong solution treated with an excess of strong sodium sulphate solution for conversion into sodium acetate; part of the pyroligneous matter is hereby carried down with the simultaneously-formed gypsum. The solution is now concentrated, and the crystallised sodium acetate so obtained distilled with sulphuric acid of 140° Tw.; the remainder of the tarry matters is thus destroyed and sufficiently pure acetic acid distils over. This is now neutralised with lime, boiled down, the calcium acetate salted out and redissolved in water.

The decomposition with ammonium sulphate proceeds best at 60°—80° C., and the resulting ammonium acetate solution may be used for the treatment of litharge.

The residue from distilling with sulphuric acid may be dissolved, filtered, and boiled down for the recovery of sodium sulphate.—H. A.

Improvements in Distilling Apparatus suitable for the Treatment of Ammoniacal Liquors. A. Feldman, Bremen, Germany. Eng. Pat. 18,959, November 3, 1891.

The apparatus consists of an inner cylindrical vessel for decomposing the ammonium compound with lime, and of an outer annular vessel for steaming off the volatile ammonia contained in the liquor both before and after treatment with lime. The annular vessel is provided with shelves; the liquor enters on the top, and passing by means of luted tubes over some of the shelves meets in its downward course a current of steam, which rises through luted bell-jars. The steamed liquor is discharged in the lime vessel, preferably by means of a tube reaching to the bottom of the same. The well-agitated mixture overflows on to another series of shelves, where the last traces of ammonia are liberated. The gaseous ammonia is taken off from the top of the annular vessel, and the spent liquor from the bottom of the same.—H. A.

Improvements in and relating to the Manufacture of Chlorine. C. Hoepfner, Giessen, Germany. Eng. Pat. 19,375, November 9, 1891.

This is an electrolytic process. Instead of electrolysing common salt, the inventor obtains chlorine by electrolysing

hydrochloric acid. The solution of acid is caused to circulate, being returned to the electrolysing cells at a constant strength by an addition of aqueous hydrochloric acid or by blowing into it the gaseous acid. Instead of hydrochloric acid a solution of a chloride mixed with sulphuric acid may be used. The process is especially applicable to recovering chlorine from solutions of chloride of calcium such as are obtained in the ammonia soda process, in the Weldon process, &c., by decomposing these solutions with sulphuric acid and electrolysing the solution of hydrochloric acid obtained. Membranes are used in the cells to prevent diffusion. To enclose the anodes a diaphragm of nitro-parchment is used which is not acted on by chlorine, but does not resist the reducing action of the reducing or alkaline substances that are formed at the cathode. A second diaphragm is therefore used next the cathode, formed of ordinary parchment-paper, not nitrated. What the electrodes are made of is not stated.
—H. S. P.

Improved Electrolytic Apparatus, more particularly Applicable for Manufacturing Caustic Soda and other Products from Salt, but also Applicable to other Purposes. G. Bamberg, London. Eng. Pat. 20,413, November 24, 1891.

See under XI., *page* 49.

Improvements in the Manufacture of Nitric Acid. A. Vogt, London. Eng. Pat. 22,018, December 16, 1891.

In this process an admixture of sodium nitrate and burnt lime (or other refractory material) is subjected to the action of previously heated carbonic acid gas at about 350° C., whereby sodium carbonate is formed and nitrous fumes are given off. The presence of steam and heated air may be useful in oxidising the simultaneously-formed lower oxides of nitrogen. In carrying out the process, equal parts of the raw materials are preferably well incorporated with water, dried, and charged into retorts. After the evolution of nitric acid ceases, the residue is lixiviated and treated for the production of alkali.—H. A.

A New or Improved Process for the Manufacture of Carbonic Acid Gas and Hydrogen Gas, and for the Separation of the two Gases, and Apparatus therefor. J. Pullman, London, and H. S. Elworthy, Stratford. Eng. Pat. 22,340, December 21, 1891.

Hydrogen and carbonic acid gases are generated by passing superheated steam in excess over red hot coke or charcoal contained in a cast-iron retort, and the mixed gases after cooling are led through a number of porous pipes made of plaster of Paris or unglazed earthenware, or other suitable material, where they are separated to a great extent by diffusion, the hydrogen passing more rapidly through the porous walls of the pipes than the carbonic acid. The diffusing apparatus containing the porous pipes is so arranged that it has two outer chambers, one at each end, and an inner one. The porous pipes open into each end chambers, and the mixed gases passing into one of the end chambers, then enter the porous pipes, where diffusion takes place, the carbonic acid freed from a considerable quantity of the hydrogen passing on to the other end chamber, whence it is drawn away for further treatment, whilst the hydrogen that has diffused through the pipes into the middle chamber of the apparatus is drawn away by a pipe opening into that chamber. Other forms of diffusing apparatus are also indicated. After leaving the diffusing apparatus the nearly pure hydrogen is compressed into suitable vessels partially filled with water, whereby most of the remaining carbonic acid is absorbed. On opening the valves of the vessels the hydrogen rapidly escapes, and may be collected in a suitable holder and thence taken for final purification, either by washing with water in a scrubber or by passing it over some absorbent for carbonic acid, such as damp hydrate of lime or through milk of lime. The pure hydrogen is then compressed in suitable vessels for sale or use.

The carbonic acid gas after leaving the diffusing apparatus is passed over copper oxide heated to redness, which converts the admixed hydrogen into water and any carbonic oxide that may be present into carbonic acid. It is then compressed and utilised in the manufacture of mineral waters, or for other purposes. Instead of separating the mixed gases by diffusion, they may be taken from the cooling apparatus direct and compressed in strong metal vessels partially filled with water, as before mentioned. The carbonic acid being much the more soluble, on opening the vessels hydrogen at first escapes rapidly and may be collected, the carbonic acid being afterwards collected in a separate receiver. The gases may be submitted to this operation several times over, and finally purified as above. Or instead of using water, glycerin or hydrocarbon oil, which absorb more gas and part with it more slowly, may be used.—H. S. P.

Improvements in the Method of and in Means for Recovering Salts from Brine and Solutions, and for Concentrating Solutions. H. Williams, Stockport. Eng Pat. 22,655, December 29, 1891.

The chief object of the invention is to recover salt from brine, but it may be used in the manufacture of alkali or of alum and other salts. The principle of the invention consists in allowing a spray of brine to fall from the top of a tower where it comes in contact with an ascending current of hot air, which causes evaporation of more or less of the water, depending upon the size of the tower, the supply of brine and of air and the heat of the air. It is intended that the salt shall fall to the bottom of the tower, whence it is removed, whilst the water passes away as vapour at the top. Drawings of the plant are given.
—H. S. P.

Improvements in Apparatus for Use in the Concentration of Sulphuric Acid. H. H. Lake, London. From V. Hannetelle, Paris. Eng. Pat. 22,704, December 29, 1891.

The apparatus consists of four platinum cylinders placed side by side and resting at each end on iron bed-plates, and heated from below by a fireplace or furnace. The four cylinders are so arranged that looked at in a transverse section one is at a lower level than the other, whilst in longitudinal sections they are inclined in opposite directions to each other. The sulphuric acid to be concentrated is admitted into the cylinder which is at the highest level, and flowing down to the bottom of this one it is admitted by a connecting pipe to the next cylinder, down which it flows, and so on through the series, leaving the last cylinder sufficiently concentrated. The cylinders are connected in pairs by pipes at their upper parts for conducting away the vapours that are generated during the concentration.—H. S. P.

Process for obtaining Alkali Phosphates from Neutral or Acid Alkali Sulphates. J. Wetter, London. From H. & E. Albert, Biebrich, Germany. Eng. Pat. 2415, February 8, 1892.

The invention relates to the manufacture of biphosphates of potash, soda or ammonia. The reaction depends upon the decomposition of the alkaline sulphate by phosphoric acid in the presence of carbonate of lime, by which means calcium sulphate, and the alkaline biphosphate and carbonic acid are formed. The operation is conducted in lead-lined tanks, provided with agitators. The strength of the acid liquid used is said to vary from 9°—24° B. which corresponds to from 6—19 per cent. of P_2O_5. The calculated quantity of alkaline sulphate is dissolved in this solution and the finely pulverised material containing calcium carbonate gradually added. The process is specially applicable to the utilisation of French and Belgian phosphates containing a considerable quantity of carbonate of lime, for the carbonate becomes converted into sulphate at the expense of the alkaline sulphate used, and the residue may be then worked up with sulphuric acid, to recover phosphoric acid from the insoluble lime phosphates it contains, and the acid solution thus obtained may be used for dissolving alkaline sulphate for decomposition by this process.

As soon as the reaction is complete, the soluble alkaline phosphate is separated by filtration, or by a centrifugal machine, &c., and evaporated to a paste, when on cooling it forms a hard substance that may be pulverised by disintegrators. It contains about 35 per cent. P_2O_5 soluble in water, 26—30 per cent. of K_2O or about 12 per cent. NH_3 and usually about 2—4 per cent. SO_3.—H. S. P.

Process and Apparatus for the Production of Neutral Sulphate of Soda and Sulphuric Acid, from Bisulphate of Soda. E. J. Barbier, Paris, France. Eng. Pat. 10,450, June 1, 1892.

This process is based on the observation that an 80°—100° Tw. solution of sodium bisulphate when cooled down to 10° C., deposits neutral sodium sulphate containing ten equivalents of water, whilst sulphuric acid of 64°—91° Tw. remains in solution. The refrigerated liquid is run into a centrifugal machine where the crystals are separated and washed. The wash-waters are available for dissolving fresh quantities of sodium bisulphate. The mother-liquor contains a certain quantity of undecomposed sodium bisulphate which may be separated by the addition of about 35—40 per cent. of 160° Tw. acid. A smaller quantity of bisulphate may be deposited by simple evaporation to 106° Tw.

The apparatus consists of a refrigerating tank of cast-iron or lead, divided into compartments which can be refrigerated in rotation. For the treatment of five tons of bisulphate per day, four compartments with a capacity of seven cubic feet each, or eight compartments of half this capacity are required.—H. A.

Improved Process for Producing Pure Carbonic Acid Gas. E. Luhmann, Andernach-on-the-Rhine, Germany. Eng. Pat. 10,599, June 3, 1892.

This process is based on the property of a cold solution of alkaline phosphate to absorb carbonic acid from gaseous mixtures, with formation of alkaline biphosphate and alkaline bicarbonate. This solution, on heating, parts with the carbonic acid and sodium phosphate is re-formed. As an example, a solution containing 10 parts of sodium phosphate in 100 parts of water may be used for absorbing carbonic acid from previously cooled flue gases; the carbonic acid is afterwards liberated by means of enclosed steam at about 212° F.—H. A.

Manufacture and Treatment of Soda. E. Solvay, Brussels, Belgium. Eng. Pat. 2387, June 16, 1879. (Second Edition.)

The improvements described in this specification refer to various phases in the ammonia-soda process.

1. For distilling ammoniacal liquors it is proposed to employ lime which has been previously slaked with a calcium chloride solution. The hydrate of lime so produced possesses a granular form, presenting a large acting surface. The process may be varied by charging quicklime into a closed cylinder, forcing in ammonium chloride solution on the bottom and passing out the decomposed solution on the top. The granular lime is also applicable for causticising soda solutions.

2. Brine often contains magnesia, which may be separated from the ammoniacal brine by the addition of an excess of sodium carbonate, dissolved in brine.

3. An important point is the continuous absorption of ammonia by the brine and a continuous introduction of the requisite proportionate quantities of ammonia in the brine. Irregularities in the process may be compensated by the following plan. The ammonia is absorbed in a large reservoir containing brine. The ammoniacal brine, along with any precipitate contained in it, overflows from thence into another large reservoir for settling out the sludge,—which can be removed through valves on the bottom of the settler. The settled liquor overflows into a third large tank, by means of a vertical perforated pipe dipping into the same, thus producing an even distribution of all the liquors. Owing to the large volume of the liquid the variations in the composition of the ammoniacal brine will be but slight.

4. The sodium bicarbonate is to be calcined in a closed cylindrical iron vessel, heated by means of a furnace. The cylinder is provided with hinged scrapers for removing and forwarding the bicarbonate, which is fed in at one end of the furnace; carbonic acid and ammonia escape on the top, and sodium carbonate is delivered at the other end of the cylinder.

5. The still-liquors, after being distilled with lime, contain calcium chloride and sodium chloride which may be recovered economically by concentrating the solutions in boilers and using the steam evolved for driving machinery. An alternate method consists in boiling down in pans, partly V-shaped, partly semi-cylindrical, provided with a rotating shaft and hinged blades for removing the salt formed,—the calcium chloride remaining in solution.

6. The fished salts from the former process may be systematically washed in a series of tanks, provided with shafts and scrapers for forwarding the salt from one tank to the other,—the water flowing in opposite direction.

—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Discrimination of the Suitability of Glass Vessels for Chemical Use, and the Action of Water on Glass. F. Mylius and F. Foerster. Zeit. Anal. Chem. **31**, 241—282.

In this paper the authors give the results they have obtained by estimating the quantity of alkali dissolved by water when allowed to remain in contact with the surfaces of glass vessels, made of various kinds of glass, for various periods of time, from one hour to several days, and at various temperatures. By alkali is understood soda, potash, lime, magnesia, &c., and the amounts dissolved are expressed in terms of milligrammes of soda per 100 square centimetres of glass surface. The methods adopted for determining small quantities of alkali dissolved are (*a*) titrating with milli-normal solutions of acid and caustic soda, when the amount of alkali dissolved by 100 cc. of water is equal to 0·1 mg. Na_2O or more; (*b*) for smaller quantities than this, a colorimetric method. In both methods an ethereal solution of iodeosin is used as indicator. Commercial iodeosin contains a small quantity of foreign substance that gives a violet-blue colour in alkaline solution. It is purified from this impurity by recrystallising its sodium salt from alcohol and precipitating the iodeosin from the solution of the sodium salt with hydrochloric acid. Iodeosin thus purified is lighter coloured than the commercial preparation. It is soluble in dilute solutions of alkali, giving a rose colour. It is almost insoluble in absolute ether, benzene, petroleum spirit, chloroform; more soluble in acetone, in alcohol, and in aqueous ether. It is a bad indicator when used in the ordinary way in titrations with normal or decinormal solutions, the change on addition of acid to the alkaline solution from rose to orange-yellow being very slow, and requiring a considerable excess of acid to produce it. But when ether is used and shaken up with the solution to be titrated, the smallest excess of acid liberates the minute quantity of eosine present, and it at once passes from the aqueous solution to ethereal, leaving the aqueous solution colourless.

When titrating with milli-normal solutions of hydrochloric acid and caustic soda, water which is quite neutral must be used. In good glass vessels such solutions can be kept some time, but they gradually take up alkali from the glass. The titration is effected in a stoppered glass flask or bottle. 50—100 cc. of the liquid to be tested is put in the bottle and shaken up with 10—20 cc. of an ethereal solution of iodeosin containing not more than 2 mg. of iodeosin per litre. If free alkali be present, the lower layer of liquid shows a rose colour, and on addition of acid it becomes colourless. The titration can be made in the presence of carbonic acid, and the method is therefore applicable to the estimation of the alkalinity of spring waters.

The colorimetric method is based upon the comparison of the intensity of the rose colour produced in an aqueous solution of an alkali when shaken up with an ethereal solution of iodeosin, containing iodeosin in excess of that required to combine with all the alkali present. The intensity of the colour produced is proportional to the alkali present. By equalising the depth of tint obtained from the sample to be tested to that obtained by diluting an alkaline iodeosin solution of known strength, the authors have been able to estimate with accuracy 0·005 mg. of alkali. Certain precautions must be taken. The water used for diluting the solutions must be free from fixed alkalis and ammonia, and from acids. This may be done by distilling in a platinum vessel and then redistilling with a little sulphuric acid to retain the ammonia, or the water may be neutralised by addition of sulphuric acid. The ether must also be free from acid, which may be effected by shaking with dilute caustic soda solution. It must be noted also that the neutral alkaline salt seems not to be quite stable in water, but a small quantity of liberated iodeosin is dissolved from the aqueous solution when shaken with ether, so that alkaline aqueous solutions do not abstract from an ethereal solution of iodeosin exactly the amount of the iodeosin required to form a neutral alkaline salt of the colouring matter, but rather less. Thus 100 mg. of Na_2O produce a colour corresponding to a quantity of the standard alkaline iodeosin solution containing only 72·4 mg. of Na_2O. The correct result is obtained by multiplying the number of cc. of standard solution by a factor determined by experiment. A correction has further to be made for the fact that water itself when purified in the way specified produces a colour with ethereal iodeosin equal to about 5·6 cc. of the standard solution of iodeosin used (1 cc. = 0·00074 mg. Na_2O).

At the conclusion of the paper the authors summarise the facts with regard to the action of water on glass that they consider proved by their own and Pfeiffer and Kohlrausch's experiments, as follows :—

(1.) The solubility of glass in water is produced by a decomposition, by which in the first place alkali is set free.

(2.) The silica of the glass is next brought into solution by the free alkali.

(3.) The composition of the solution changes according to the condition of the digestions.

(4.) The quantity of alkali brought into solution from a given surface under given conditions, is a measure of the action on the glass under these conditions.

(5.) The action on glass surfaces by cold water falls at first very quickly with the length of time of digestion, but afterwards approaches a constant value.

(6.) Different kinds of glass show a different resisting capacity to solution.

(7.) The action on glass increases very quickly with the temperature.

(8.) The relative vulnerability of several kinds of glass is dependent upon the temperature.

(9.) From glasses of equal vulnerability unequal quantities of substance may go into solution.

(10.) The vulnerability of good glass is appreciably decreased by previous treatment with water.

(11.) The worse a glass is, the less is its vulnerability reduced by treatment with water.

(12.) The vulnerability of glass surfaces is altered by "weathering."

(13.) After treatment with water glass surfaces have the property of fixing alkali from the solutions formed, and on a fresh treatment with water to give it up again.

(14.) Potash glass is much more soluble than soda glass; but the difference vanishes as the proportion of lime in the glass is increased.

(15.) In glass vessels that are only slightly attacked by hot and cold water, lime, alkalis, and silica must exist in a definite ratio to one another.

(16.) Of all kinds of glass, lead flint glass is least soluble, but the surface of this kind of glass is corroded and easily attacked by acids.—H. S. P.

The Influence of the Composition of the Glass used for Microscope Slides and Cover Glasses on the Preservation of Microscopic Objects. R. Weber. Ber. 1892, 25, 2374—2377.

The gradual disappearance of mounted microscopic objects after being kept for a time, led the author to investigate the action of the glass, both of the slide and of the cover glass on the contained specimens, and also the composition and properties of the glass employed for these purposes. On exposure to air for a long period the glass becomes covered in some cases with a thin film, whilst in others it remains perfectly clear and bright. The former occurrence is specially observed in cases of glass in which the proportion of alkali (potash and soda) to lime is relatively great; such samples are affected on exposure, especially in moist places, with the result that small quantities of the caustic alkalis result, and to their action on the contained microscopic objects, the gradual destruction of the latter is traced. Analyses given show that in the case of English-made cover glasses which keep clear and bright the proportion of $SiO_2 : CaO : K_2O + Na_2O$ is 4·7 : 1 : 0·9, whilst in other cases with a proportion of 6·6 : 1 : 1·1 the glass is attacked on exposure. This points to the necessity of employing glass containing a relatively large proportion of lime. To test the durability of such glass the action of hydrochloric acid vapours on it for 24 hours is recommended, the extent to which the glass is attacked being indicative of its stability.
—C. A. K.

Composition of Glass suitable for Chemical Apparatus. R. Weber and E. Sauer. Ber. 1892, 25, 1814—1818.

The glasses commented on in this Journal, 1892, 267, are nearly of the same composition as those operated on by the authors, and reported upon in a previous joint publication. The authors expose flasks of the various glasses to the action of A, water; B, 25 per cent. sulphuric acid; C, 12 per cent. hydrochloric acid; D, 10 per cent. ammonia; E, 2 per cent. sodium phosphate; F, 2 per cent. sodium carbonate; the exposure lasting for five hours in the case of water, and for three hours in that of the other experiments. These glasses of the composition given below yielded results indicated.

Glass.	Percentage of						Ratio $SiO_2 : CaO : \left\{ \begin{matrix} K_2O \\ Na_2O \end{matrix} \right.$
	SiO_2	$Al_2O_3 + Fe_3O_3$	CaO	MgO	K_2O	Na_2O	
11	61·78	6·00	16·05	4·00	..	12·17	2·8 : 1 : 0·5
12	71·22	1·50	15·00	..	..	12·28	4·4 : 1 : 0·74
13	79·82	0·40	6·50	..	13·28	..	11·5 : 1 : 1·20

Glass.	Loss in Weight of a 100 cc. Flask in Milligrammes.					
	A.	B.	C.	D.	E.	F.
11	3·5	2·0	3·5	6·0	10	10·0
12	1·0	0·5	0·5	3·5	15	30·5
13	0·5	0·25	0·5	4·0	5	22·5

The resistance of these glasses shows a considerable increase in comparison with the samples previously examined by the authors. It is observed that the attack on glass is more vigorous the higher the temperature; that glass vessels lose more weight when heated over a bare flame than when heated in a water-bath; that as regards action on glass, water is more active than acids, but alkalis are the most vigorous, especially when warm, though even their activity diminishes the nearer the proportions of lime to the alkalis in the glass approaches the ratio 1:1·3 to 1·5. Although the method of experiment adopted by the authors is both more acurate and more convenient than Pelouze's method, nevertheless the authors have boiled for equal periods in a platinum crucible equal weights of some of their glasses in the form of powder, with the following results:—

Ratio $SiO_2 : CaO : \left\{ \begin{array}{l} K_2O \\ Na_2O \end{array} \right.$ of Glass.	Percentage of Dissolved Matter in Solution.	Percentage of Silica in the Dissolved Matter.
11:1:2·6	6·0	13·0
9·6:1:3·2	2·5	15·0
9·5:1:2	1·1	28·4
8·8:1:1·5	0·4	23·3

For general chemical purposes a glass of the percentage composition, SiO_2, 74·40; Al_2O_3, 0·70; CaO, 8·85; K_2O, 4·40; Na_2O, 11·65; and a silica-lime-alkali ratio of 8:1:1—5 is recommended by the authors, and is now being adopted in manufacture for special purposes. For the Kjeldahl process, for instance, glass 13 is suitable, but is not sufficiently fusible for many other purposes.—D. A. L.

PATENTS.

Improvements in the Manufacture of Plate and other Glass, and Apparatus therefor. L. West, St. Helens, November 24, 1891. Eng. Pat. 20,415.

Usually in the manufacture of plate glass the material is both fused and refined in pots. This invention effects the fusion and part of the refining in a tank, the molten metal being then transferred by gravity to pots arranged on the periphery of a turn-table, in which pots the refining is completed.—V. C.

An Improvement in the Manufacture of Mineral Wool. C. H. Hubbell, London. Eng. Pat. 17,928, October 7, 1892.

The improvement consists in the use of granite one part, limestone or other suitable substance, two parts, which are fused together in a cupola or other suitable furnace. The molten mass is converted into mineral wool by the action of a jet of steam in the ordinary way.—J. H. C.

Process and Means for Manufacturing Glass Pipes, P. Silvert, Dochlen, near Dresden. Eng. Pat. 18,448 October 14, 1892.

Molten glass is poured on to a table provided with rims, fillets, or borders by which the thickness, size, and form of the sheet of glass is determined. On the sheet of glass while still plastic, a core, preferably a hollow roller, is placed. The diameter of the core is slightly less than the interior diameter of the pipe required. The sides of the plastic sheet of glass are bent up round the core by means of shovel-shaped tools, so that the edges meet or overlap. The welding is effected by rubbing on the edge. The core with the glass covering is then put into a mould or box in which it is pressed and turned, by which means the marks on the surface of the glass are obliterated. Subsequently the core is made to rotate within the glass covering, by which means the internal diameter of the glass pipe is slightly enlarged and the removal of the core thereby facilitated.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in Plaster for Building Purposes. T. Jones, Chicago, U.S.A. Eng. Pat. 18,145, October 11, 1892.

Common lime mortar is unsatisfactory as a covering for wood surfaces. The inventor formerly patented a plaster (U.S. Patent, 451,560, May 5, 1891), of which granite is an ingredient. The present invention is a plaster made by digesting aluminous shale, containing not less than six per cent. of potash, with oil of vitriol diluted with four or five times its bulk of water, and subsequently mixing the 15 to 20 parts of the shale so treated with 100 parts of gypsum, which has been calcined at a bright red heat. For use, the plaster is mixed with an equal bulk of sand and sufficient water to make it plastic.—V. C.

X.—METALLURGY.

Aluminium. Balland. Compt. Rend. **114**, 1536—1538.

Lubbert and Roscher have asserted that aluminium is attacked by wine, brandy, coffee, tea, &c., and is hence unfit for use in the manufacture of domestic utensils, preserving cans, canteens, &c. The author has made experiments which lead him to draw the conclusion that aluminium may be employed with safety and advantage for all these purposes, and is specially advantageous where weight is a consideration, as, for instance, in military fittings, &c. In these experiments French sheet aluminium of commerce 1 mm. thick and containing 3 per cent. of impurities (iron and silicon) was employed in strips weighing 5 grms., and presenting approximately a surface of 38 sq. cm. The vessels and metal were thoroughly cleansed before the experiments, and the latter was brushed with a nail brush washed with plenty of water and dried before weighing, at the close of the experiment. The experiment lasted several months, and it was found that air, water, wine, beer, cider, coffee, milk, oil, butter, fat, &c.; urine, saliva, earth, &c., have less action on aluminium than on the ordinary metals (iron, copper, lead, zinc, tin); vinegar and salt, however, attack aluminium, but not to any extent sufficient to interfere with its use for the purposes specified; in fact, during four months in vinegar, the loss only amounted to 0·349 grm. per square decimetre, and to only 0·045 grm. in a 5 per cent. salt solution during the same period.—D. A. L.

Notes on a New Crystalline Ferro-Nickel Alloy. D. H. Browne. Jour. Anal. and Applied Chem. **6**, (1892), 150—152.

In breaking a pot of copper-nickel matte at the works of the Canadian Copper Company, Ontario, a cavity lined with brilliant tin-white crystals, which penetrated into the surrounding matte was revealed. These crystals, some of which were twinned, were of the form of a right-angled isosceles triangle, and varied in size from a few lines to perhaps half an inch along the longest edge; they were very highly magnetic, exceedingly tough and flexible, and insoluble, or only very sparingly soluble in hydrochloric acid and in sulphuric acid, but readily soluble in hot dilute nitric acid, leaving no siliceous or carbonaceous residue.

Analyses of two samples of the crystals gave the following results:—

—	I.	II.
Copper	4·89	3·64
Iron	43·3	44·0
Nickel	52·1	52·0

From the variation in the percentage of copper, and from the fact that crystals of pure copper were observed on the surface of the crystals of the ferro-nickel, this element would seem to be simply an impurity, in which case the composition of the pure crystals would correspond very closely with the formula, Ni_9Fe_8.—F. S. K.

The Action of Aluminium on Mercury Salts. P. Klaudy. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 217.

See under VII. *page* 41.

Estimation of Antimony: The Gooch Crucible. T. Paul. Zeits. f. Anal. Chem. 1892, 537.

See under XXIII., *page* 64.

PATENTS.

A New Method of Preparing Iron for Alloying with other Metals generally, and particularly with Copper and Zinc. H. Pidot, Paris. Eng. Pat. 13,796, August 15, 1891.

This patent relates to the production of a series of alloys from a red-yellow to a silver-white colour, and designated Pidot's "Iron-Silver" and "Ferro-Bronze." Cast iron in the form of drillings is immersed in a bath of hydrochloric acid and a current of steam pass through the liquid for half an hour, and after this a current of carbonic acid gas for the same period of time. The object of the latter is to prevent the formation of definite protochlorides and perchlorides of iron, and is repeated once a day. When the mixture has stood about three days variable proportions of copper or copper and zinc are introduced, and these "soon become amalgamated with the iron." After standing five days longer the metals become reduced to a pulverulent mass, or in less time if sawdust is added. The mixture is then roasted on a hearth and smelted in a crucible or other suitable furnace, at which time the other metals, such as lead, tin, aluminium, nickel, manganese, &c., according to the desired alloy, are added. The composition of "iron-silver" is given as copper, 40 per cent.; zinc, 25 per cent.; and iron, 35 per cent.—A. W.

Improvements in the Manufacture of Iron, Steel, or Copper, and a Material to be used in the said Manufacture. A. Figge, Hameln, Germany, and P. Wood, Halifax. Eng. Pat. 19,928, November 17, 1891.

The improvement consists in the use of a mixture or flux consisting of micaceous mineral, lime or limestone, emery or corundum, and manganese ore in stated proportions, varying according to the character of the ore and the product desired. The mixture is introduced into the smelting or reduction furnace with the ore or metal to be treated, and is reduced therewith in the ordinary way with coke.—J. H. C.

An Improved Method and Means of Treating Ores. D. A. Louis, London. Eng. Pat. 20,284, November 21, 1891.

This patent relates to improvements in the apparatus used for separating the valuable material from the gangue after the ore has been agitated and digested with a solvent in the ordinary manner. The materials may be digested in a vat with a perforated false bottom and provided with an agitator. The leaching is performed in a vessel provided with a perforated false bottom covered with a filtering cloth, and in which revolving brushes, scrapers, or rubbers are arranged to sweep the filtering surface and so keep it free from the accumulation of mud, this appliance being specially constructed according as the vessel is cylindrical or rectangular. The leaching may also be carried out without the aid of a false bottom vessel by suspending in the mixture a perforated hollow shallow cylinder covered externally with a filtering cloth and connected internally with a suction system. The liquor is drawn through the filter into closed collecting vessels connected with a vacuum reservoir or other suction apparatus, whence it is passed through revolving cylinders, mounted on hollow trunnions, which contain the precipitating material. The advantage of this is that the gold adheres only slightly to the precipitating material. The mixture is then filtered by a suction arrangement somewhat similar to the above, or it is passed into a revolving centrifugal machine where the suspended matter collects at the periphery which may or may not be perforated and furnished with a filtering cloth.—A. W.

Improvements in Apparatus for Treating Ores. H. H. Wallace, Colchester. Eng. Pat. 21,255, December 5, 1891.

On a revolving vertical shaft is fixed a feed-hopper with side spouts, which revolves and distributes a quantity of ore on to a circular amalgamated copper plate which is fixed about three inches below it, and which is slightly conical. Beneath the outer edge of this plate revolves a tray so placed that particles falling off the circular plate would be carried over into an outer circular trough. After the tray has passed the particles fall direct into another trough. The ore is fed through the hopper on to the circular plate, to the outer and lower edge of which it is washed by jets of water. The lighter particles reach the edge first and the appliance is so timed that the revolving tray is in the right position at the right moment to carry over the particles into the first mentioned trough. After the tray has passed by the heavier particles reach the edge of the plate and fall direct into the other trough.—A. W.

Improvements in the Manufacture of Iron and Steel. W. Hutchinson, Wolverhampton. Eng. Pat. 1273, January 22, 1892.

In making iron and steel by the basic Bessemer process tap-cinder is added to the molten cast iron either while it is in the transferring ladle or after it has been placed in the converter. It may be employed either cold or hot, in lumps or in a molten state; roll-scale, tube-scale, and lime may be added with it when desired.—J. H. C.

Improvements in the Manufacture of Steel and Iron. T. Twynam, Chiswick, and J. Colley, Bilston. Eng. Pat. 1341, January 23, 1892.

The improvement is more especially applicable to the basic Bessemer process, and consists in the addition of an oxidiser to the molten metal for the purpose of oxidising the phosphorus, and a subsequent deoxidation by the addition of solid carbon.

The oxidiser may be oxide of iron alone, in the form of forge scale, ferruginous cinder, or "pottery mine." When obtainable a large proportion of protoxide is preferred, admixture with lime is often advantageous, and so is the presence of manganese. It is preferable to add this oxidiser before the pig iron is run into the converter, but good results can be obtained by adding it even after the carbon flame has dropped.

The carbon may be either ground coke, wood-charcoal, anthracite or tar, and is best added by encasing it in a thin sheet-iron or wooden receptacle weighted with ferro-manganese, spiegel, hematite, or scrap.—J. H. C.

An Improvement or Improvements in Coating Sheets or Plates of Iron and Steel with Lead. R. B. Thomas, Lydney. Eng. Pat. 1443, January 25, 1892.

The difficulty of coating iron with lead is overcome by first coating it with a thin layer of terne metal (an alloy of tin and lead) after which the lead will form an adherent coating, either with or without the use of a flux or oil. The apparatus used is the same as in the ordinary tin plate manufacture. Terne metal containing less tin than usual is preferably used, a convenient proportion being one part of tin to three or four parts of lead by weight.—A. W.

Improvements in the Process of Recovering Precious Metals from their Ores. C. Moldenhauer, Frankfort-on-the-Maine, Germany. Eng. Pat. 1467, January 25, 1892.

The inventor states that in extracting gold by means of cyanide solution, the simultaneous oxidation of the gold is necessary, and hitherto has been effected by the action of the air. This oxidation is expedited by the use of ferricyanide of potassium or other alkali or alkaline earth, employed in an alkaline solution. A great saving of the cyanide is said to be the result, to the extent even of 80 per cent. The proportions preferred are from one-half to two parts of ferricyanide to one part of cyanide. Other oxidising agents can be employed instead of ferricyanide, such for instance as permanganate of potash, hypochlorite, peroxide of lead, &c.—A. W.

Improvements relating to the Extraction of Silver. C. Hoepfner, Giessen, Germany. Eng. Pat. 1654, January 27, 1892.

The silver is extracted from the copper matte, in which it exists as sulphide, by means of a liquid containing cuprous chloride, which liquid should be neutral, free from iron, and preferably kept in a warm place. The following is given as the reaction—$Cu_2Cl_2 + Ag_2S = Cu_2S + Ag_2Cl_2$. The solution is separated from the matte and the silver precipitated by any suitable means.—A. W.

Improvements in the Manufacture of Iron and Steel. W. Hutchinson, Wolverhampton. Eng. Pat. 1776, January 29, 1892.

Carbon or carbonaceous matter in a fine state of division is carried by the blast of air or reducing gas into the molten mixture of pig or cast iron and oxide of iron while under treatment in the basic Bessemer converter or the Siemens furnace, so as to increase the quantity of oxide of iron, which can be advantageously used. In some cases molten oxide of iron is treated alone in a Siemens basic or neutral-lined furnace by a similar carbon-charged blast.
—J. H. C.

A New or Improved Furnace for the Reduction or Smelting of Zinc, Lead, Silver, Gold, and other Ores. W. Smethers, London. Eng. Pat. 17,908, October 7, 1892.

The furnace consists of a closed chamber, heated indirectly by means of a surrounding heat chamber, or directly by the flames of a mixture of gas and air directed upon the materials under treatment through holes formed in the walls of the chamber.

The ores to be treated are placed upon channeled fireproof trays, resting upon the sole of the closed chamber. The molten metal collects in these channels, and thence flows into suitable moulds or receptacles. Special arrangements are made for continuous working by introducing new charges through openings formed in the front and rear walls of the chamber, and also for condensing the vapours which pass away with the products of combustion.—J. H. C.

Process for the Removal of Manganese from Pig-Iron, Ingot Iron, and Steel. C. D. Abel, London. From Hoerder Bergwerks und Hütten-Verein, Westphalia. Eng. Pat. 18,082, October 10, 1892.

The manganese is reduced to the extent of one per cent. in cast iron which contains too much of it for convenient working in the converter by treating the molten metal with a small quantity of iron pyrites, about 100 kilos. for every 10 tons of iron. Analyses are given showing reductions from 1·90 and 2·79 per cent. to 1·29 and 1·77 per cent. respectively. The manganese sulphide slag collects on the surface of the iron and can be removed after solidification. No sulphur gets into the iron unless too small a proportion of manganese is present.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Utilisation of the Electric Light Current for Quantitative Chemical Electrolysis. J. S. Stillwell and P. T. Austen. Journ. Anal. and Applied Chem. (1892), **6**, 129—140.

The authors describe a simple means of adapting the electric light current to electro-plating and quantitative chemical electrolysis. For this purpose the current strength is reduced by introducing blackened incandescent lamps of various resistances into the main current; side-currents of various strengths are then formed by connecting points in the circuit and introducing further resistances. In this way a current of any desired strength, from 75 ampères down to $\frac{1}{100}$ cc. of electrolytic gas, can be obtained at a small cost.—F. S. K.

On the Employment of Manganin for Resistance Coils. Milthaler. Ann. der Physik und Chem. 1892, 297; Proc. Inst. Civil Eng. 1892—3, **111** (1), 104.

On account of its high specific resistance, and small negative temperature-coefficient, manganin,[*] composed of copper, 83 per cent.; nickel, 4 per cent.; and manganese, 13 per cent., may be advantageously employed in the manufacture of resistance-coils. The author found that after such a coil had been heated to about 100° C., its resistance was diminished by from 0·4 to 0·8 per cent.; but on repeating the process the alteration became less and less, until it amounted to no more than $\frac{1}{20000}$ of the whole.

He recommends, therefore, that the coils should be heated to 110°, and kept at that temperature for some hours every day for a month, in order to get rid of the molecular disturbances due to the processes of manufacture, and that they should be well paraffined to preserve the alloy from air and moisture.

PATENTS.

A Method of Extracting Chromium by the Aid of Electrolytic Baths with a Base of Salts of Chromium. E. Placet and J. Bonnet, Paris, France. Eng. Pat. 22,855, July 17, 1891.

Two types of baths are given, acid and alkali. The acid bath preferred is composed as follows:—10 to 15 grms. chrome alum; 10 to 15 grms. sulphate of soda or potash; 5 grms. oxalic acid or other organic acid; 100 grms. water.

This solution, which is green, is heated until it turns violet.

Two alkaline baths are given as follows:—10 to 15 grms. of alkaline chromate or bichromate: 15 to 20 grms. of chrome alum; 100 grms. of water; or 10 to 15 grms. chrome alum or fluosilicate of chromium; 10 to 15 grms. fluosilicate of soda, potash, or ammonia; 5 to 10 grms. hydrofluosilicate or any other acid; 100 grms. water.

The shade of colour of the chromium deposited can be varied by altering the nature and the quantity of the acid used in the preparation. Alloys of chromium with other metals may often be obtained by mixing with any of the baths given a solution of the salts of the metal which it is desired to alloy.—G. H. R.

Improvements in and relating to the Manufacture of Chlorine. C. Hoepfner, Giessen, Germany. Eng. Pat. 19,375, November 9, 1891.

See under VII., *page* 42.

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[*] Feussner, Electrotechnische Zeitschrift, 1892, Vol. XIII., p. 99. *See also* Feussner und Lindeck, Zeitschrift für Instrumentenkunde, 1889, Vol. IX., p 233, and L'Électricien, 1892, p. 357.

Improved Electrolytic Apparatus, more particularly Applicable for Manufacturing Caustic Soda and other Products from Salt, but also applicable to other Purposes. G. Bamberg, London. Eng. Pat. 20,413, November 24, 1891.

To obviate the disadvantages arising from porous partitions, the electrolytic tank is divided into two separate compartments, while passages are made to extend down each side of the dividing partition so as to make communication through it at the bottom. These passages are so arranged that their upper ends are below the level of the liquid, thus, while there is free communication through the liquid, the gases given off are kept separate. It is preferred to construct the partition with its communicating passages by forming on each side of the central partition, which extends down from the top of the tank nearly to the bottom, two side partitions extending from the bottom of the tank to a certain height below the level of the electrolyte, a space being left between the central and the two side partitions to form the passage.—G. H. R.

Improvements in Secondary Batteries. N. Wladimiroff, St. Petersburg, Russia. Eng. Pat. 22,339, December 21, 1891.

The invention consists chiefly in making each of the electrodes of the same chemical nature on both sides, so that it acts simultaneously as a positive pole in one of the cells, and as a negative pole in the adjoining cell. The battery is constructed of a series of frames of annular or other suitable form, and of any suitable non-conducting material. Between each of the frames is inserted an electrode, preferably a circular plate with concentric grooves on both sides to enable it to better retain the active material. The two electrodes are provided with lugs for connecting them to terminals. Each of the frames is provided with two apertures in which are inserted funnel-shaped tubes of glass or other suitable material for pouring in the acid.
—G. H. R.

Improvements in Dry Electrical Elements. C. Vogt, Posen, Germany. Eng. Pat. 1141, January 20, 1892.

A manganese element is divided into an upper and lower compartment. The lower chamber contains a manganese cylinder, the elongation of which is formed by a carbon bar extending outwards beyond the upper chamber, and having at the top a pole-screw for the composition conducting wire. At a suitable distance a zinc cylinder is placed round the manganese cylinder at the height of the lower compartment. To the zinc cylinder is soldered a pole wire which extends outward from the element and is insulated by an acid-proof substance to protect it from the phosphoric acid contained in the upper chamber. The remaining free space of the lower chamber is filled with a substance capable of absorbing and retaining moisture. This substance is then saturated with chloride of ammonium. The element proper producing the current being now finished is closed by means of a suitable number of perforated pieces of pasteboard which separate the upper from the lower chamber. The upper chamber is filled with any suitable substance with a sufficient quantity of phosphoric acid diluted with water. Subsequently the whole element is hermetically closed by means of melted asphaltos or similar material, so that only the two poles project.—G. H. R.

Improvements in Electrolytic Apparatus. T. Craney, South Bay City, U.S.A. Eng. Pat. 16,822, September 20, 1892.

The object of the invention is to make a carbon anode which shall not be disintegrated by the chemical action of the products of electrolysis, and for this purpose the carbon is encased in a cell or cells formed of non-porous and non-conducting material, thereby confining the electrolytic action on the anode to a certain portion or portions of that body. The cell is made of stoneware, glass, or other like substance unaffected by the products of electrolysis, and the exposed portions of the carbon are enclosed or contained in vertical, or substantially vertical, interstices formed in the walls of the cell, or between the walls of two or more superimposed cells or sections.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Manufacture of Vegetable Oils. Consul Trail. Reports from the Consuls of U.S.A. 142, July 1892, 475—494.

The report treats the very considerable import trade in oil-seeds to Marseilles during the year 1890, the methods followed in extracting the oil from these various seeds, the cost of their importation, the prices of the seeds, as well as the value and use of the extracted oils.

The following summary deals with the importation of oil-seeds to Marseilles during the year 1890:—

	Met. quintals.
Sesame, from the Levant	118,420
„ from India and Africa	653,850
Pea-nuts, in the husk	208,640
„ shelled	1,030,600
Linseed	99,830
Cotton-seed	211,710
Cocoa-nuts and palm-nuts	706,790
Rape-seed, cultivated and wild	142,610
Other seeds	310,930
Total	3,483,510

During 1890 there has been an increase of importation as compared with 1889 of sesame from the Levant, shelled, and whole pea-nuts, linseed, cultivated and wild rape-seed, cotton-seed, poppies, palm-nuts, and a few other kinds, principally Niger, while a falling off has taken place in sesame from India and Africa, castor peas, pulgheria, cocoa-nuts, mowrahs, and a few other kinds. The net increase of importation in 1890 over that in 1889 amounts to 232,550 quintals.

In order to facilitate the extraction of oil the seeds are thoroughly triturated with a small quantity of water by means of two upright rollers. The crushed seed is then filled into bags made of esparto grass and horsehair ("scourtins") and placed in a press, the bags being separated by iron plates. Care must be taken not to exceed a pressure of about 250 kilos. per square centimetre (about 31¾ cwt. per square inch) to prevent bursting the scourtins. Results in every way superior to those obtained by this system of pressing are obtained by the use of the "Estrayer cylinder," which is described in full detail. This apparatus dispenses with the "scourtins" or horse-hair sacks by substituting screens made of the same substance, whereby an economy of 80—90 per cent. on the cost of the "scourtins" is effected. The yield of oil in quality and quantity is much better than that obtained by other systems of pressing in vogue. The apparatus consists of two cylinders, one inside the other, of which the outer acts upon the inner by means of a series of inclined planes, the inner cylinder being composed of eight segments, which either close up tightly or separate slightly, according as pressure is exercised or removed by the position of the outer cylinder. The resistance of the apparatus is calculated for a pressure of 500 kilos. per square centimetre, which is fully a third higher than the other presses can stand without some part of the mechanism being strained. An interior movement allows of the cylinder being enlarged in diameter, so that the oilcakes may be removed easily. The cylinder holding 80—100 kilos. of seeds can be discharged and refilled in 7—8 minutes, the pressing occupying 30—35 minutes.

An oil factory with 30 presses of the ordinary type used at Marseilles can treat 22,500 kilos. of seed (pressed twice) in 24 hours, while the same number of Estrayer cylinders will treat 30—33,000 kilos. of seed. The cost of Estrayer's cylinder and press is 6,000 francs.

Description of Seed.	Method of Extracting the Oil from the Seeds Imported to Marseilles.		Percentage of Oil Pressed (on Original Seeds).	Value of 100 kilos. Oil.	Value of 100 kilos. Cake.	Oil Used for	Cost of Import per 1,000 kilos. Seed.
				Frs.	Frs.		Frs.
Sesame, Levant	1st pressing.	cold	30—32	96—100	..	Food	10—15
	2nd „		9—10	70—73	..	„	
	3rd „	at 70° C.	10—11	49—51	12—13	Soap	
„ Indian and African	1st „	cold	27—28	62—75	..	Food; burning	30—35
	2nd „		9—10	60—62	..	„	
	3rd „	at 70°—80° C.	8—9	49—51	11—12	Soap	
Shelled peanuts	1st „	„	50	50	..	„	
	2nd „						
Poppy seed	1st „	cold	22	72	..	Food; paints	30—35
	2nd „		10	60	..	Food; painting, burning.	
	3rd „	at 70°—80° C.	7	50	11—11·5	Soap	
Linseed	1st „	cold	22	62—63	..	Food	30—35
	2nd „	70°—80° C.	10	..	16—17	Soap	
Cultivated rape seed	1st „	cold	22	65	..	Burning	30—35
	2nd „	70°—80° C.	12—13	50	10	Soap	
Wild „ „	1st „	„	14	53—54	..	Mixing	20—25
	2nd „		8	50	..	Soap	
Castor beans	1st „	cold	30	65	..	Medicine	30—35
	2nd „		8—10	58	9—9·5	Lubricating	
Egyptian cotton seed	1st „	„	10—12	80—90	..	Food; mixing with olive.	10—11
	2nd „	warm	8—10	50	10	Soap	
Niger	1st „	cold	18	65	..	Mixing	
	2nd „	warm	14	50	9·5	Soap	
Pulgheria	1st „	„	20	53	..	„	
	2nd „		10—12	52—53	..	„	
Cocoanuts	1st „	„	62—64	45—48	11—13	..	
	2nd „						
Palm nuts	1st „	„	38—42	50	..	Soap	
	2nd „						
Mowrah	1st „	„	37—41	55—60	3—4	..	
	2nd „						

Comparative results :—

With presses in use at Marseilles seeds have to be subjected to three pressings, twice cold and once hot. Yield for 100 kilos. white Bombay sesame :—

Description.	Yield.	Price per kilo.	Value.
	Kilos.	Centimes.	Francs.
Oil :			
First pressing (cold)	30	75	22·50
Second „ „	8	62	4·96
Third „ (heated)	8	50	4·00
Oil-cake	54	12½	6·75
Total	100	..	38·21

The same amount of the same seed is subjected in Estrayer's process to two pressings, in the first of which the seed is pressed whole and cold, the second triturated and heated. The yield is as follows :—

Description.	Yield.	Price per Kilo.	Value.
Oil :	Kilos.	Centimes.	Francs.
First pressing (whole and cold)	40	78	31·20
Second „ (triturated and heated).	7	50	3·50
Oil-cake	53	12½	6·62
Total	100	..	41·32

100 kilos. of Egyptian cotton seed subjected in ordinary press :—

Description.	Yield.	Price per Kilo.	Value.
Oil :	Kilos.	Centimes.	Francs.
First pressing (cold and triturated).	13·35	90	12·01
Second pressing	5·85	50	2·92
Oilcake	80·8	10	8·08
Total	100	..	23·01

The same quantity of Egyptian cotton seed treated with A. Estrayer's system results as follows:—

Description.	Yield.	Price per Kilo.	Value.
	Kilos.	Centimes.	Francs.
Oil, sole pressing (cold and slightly triturated).	17·7	90	15·93
Oilcake	82·3	10	8·23
	100	..	24·16

—K. E. M.

On Horse Fat and Hazel-Nut Oil. F. Filsinger. Chem. Zeit. 1892, **46**, 792.

The author has determined the following physical constants of horse fat and hazel-nut oil.

——	Horse Fat.	Hazelnut Oil.
Specific Gravity at 15° C.	0·9189	0·9146
Iodine absorption	84·0	88·5
Saponification value	197·1	193·4
Acid value	1·7	3·2

—J. L.

Contribution to the Solidification and so-called "Saponification" of Petroleum. E. Donath. Chem. Zeit. 1892, **16**, 795.

The author finds in a publication of R. Haack a confirmation of his assertions that soaps containing large quantities of mineral oil are not soluble in water, and that any acids formed by oxidation of mineral oil can only owe their existence to the oxidation of naphthenes.—J. L.

Baudouin's Reaction for Sesame Oil. V. Villaveechia and G. Fabis. Zeits. ang. Chem. 1892, 509.

See under XXIII., *page* 67.

Note on the Turkey Red Oil of M. M. Schmitz and Toenges. P. Werner. Bull. Soc. Ind. de Mulhouse, April—May 1892, 291.

See under VI., *page* 40.

Report upon New Researches on Turkey Red Oil. Lehnes, Farber. Zeit. 1892, 241, 259, 293.

See under VI., *page* 40.

Analysis of Lard. C. Amthor and J. Zink. Zeits. f. Anal. Chem. 1892, 534.

See under XXIII., *page* 67.

A New Method for the Determination of Soda in Soap, together with a few Notes on Methods generally Employed. W. H. Low. J. Anal. and Applied Chem. **6**, 423.

See under XXIII., *page* 68.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

New Method of Producing Gutta Percha for Insulating Purposes. Jungfleisch. L'Industrie Electrique, 1892, 302; Proc. Inst. Civil Eng. 1892—3, **111** (1), 104—105.

The increasing scarcity of gutta-percha, and the rise in its price, has caused much attention to be given to the methods of its production. Mr. Serullas and Mr. Seligmann-Lui have been to the East Indies on special missions for the purpose of studying the methods in use for collecting the gutta-percha. Although the botanical characters of the trees which produce gutta-percha were well-known, it was not understood which particular variety of tree gave the best quality of gutta-percha for insulation purposes. Mr. Serullas found, in 1888, that the Isonandra gutta gave the finest quality. The Malays could only obtain the raw product by their method from trees of twenty-eight to thirty years' growth, or from re-growths fourteen to fifteen years old. The author states that their custom was to cut the trees down, and that then they only obtained about 0·58 lb. of raw gutta-percha from each tree as a maximum, and this was largely charged with impurities. Mr. Serullas obtained by a more careful treatment only 0·48 lb. from a tree thirty years' growth, and he saw a tree of 47 inches diameter cut down which only gave 0·84 lb. of the raw product. As the exports in 1884 reached 3,145 tons, this meant a destruction of twelve million Isonandra-trees of thirty years' growth in that year alone, so that it was probable the supply of gutta-percha would soon cease altogether. The author arranged with Mr. Serullas that the latter should send home from the East Indies the leaves and shoots of the trees in order that experiments might be made to see if the gutta could not be obtained from these parts without the necessity for cutting the trees down. It was found that there were many solvents by which the gutta could be extracted, and at present the best results have been obtained with toluene; it dissolves the three compounds of which gutta-percha consists, and does not dissolve the other vegetable matters except chlorophyll. The process has been tried upon leaves sent to France dry, upon fresh leaves sent over in antiseptic solution, and dried on arrival; shoots dried and stripped of leaves, and upon wood of two years' growth, dry and stripped of leaves. All these parts gave approximately the same favourable result. The method of extraction is simple. The material is torn up small and digested at 212° F., then treated with toluene. A solution of gutta-percha coloured green by the chlorophyll is thus obtained; the toluene is then carried off by a current of steam at 212° F. as a maximum temperature. The results obtained gave 9·0 to 10·5 per cent. of gutta-percha from the material treated. It appears that the gutta-percha itself is colourless, and that the usual brown tint is due to other vegetable constituents. The author states that if the leaves are sent direct to Europe, it will be possible to obtain the best qualities of gutta-percha without adulteration, and that a tree of thirty years' growth would give each year easily 24·2 lb. of dried leaves, and therefore 2·2 lb. to 2·4 lb. of gutta-percha, instead of 0·58 as before by destruction of the tree. The author believes that in this way the electrical industry will be able to obtain at a low rate all that it requires.

Investigations on the Favourable or Injurious Influence of the Usual Admixtures to India-Rubber and Gutta-Percha upon the Technical Use of these Substances. C. Heinzerling and W. Pahl. Verhand. Ver. z. Beförd. des Gewerbefl. 1891, 351; Proc. Inst. Civil Eng. 1892—3, **111** (1), 105—106.

After sketching the history of india-rubber and gutta-percha, the authors give statistics of the trade in these articles, and then describe the process of manufacture. The raw india-rubber is first torn into pieces and washed by means of rollers, the loss in weight being from 12 to 30 per cent. The washed material is then carefully dried and ground between rollers revolving twenty times a minute.

In order to modify the colour of the india-rubber it is mixed with talc, zinc oxide, white lead, litharge, cinnabar, antimony sulphide, lampblack, &c., while barytes and chalk serve to increase the weight.

The vulcanising of india-rubber is effected by heating the substance with sulphur, or a sulphide such as lead or antimony sulphide; the latter for red goods. For ebonite the proportion of sulphur used is 20 to 35 per cent., while 10 per cent. is the proportion mixed with india-rubber which is to retain its elasticity. In the latter case, the mixture is heated to 280°—309° F. (120°—136° C.), and in the former to 316°—319·6° F. (140°—141° C.). During this process only part of the sulphur is chemically combined; the remainder is in a state of mechanical admixture, and sometimes effloresces on the surface of the goods. The substances mixed with ebonite, according to the uses for which it is intended, are gutta-percha, gum balata, resin, asphalt, magnesia, lime, &c.

The treatment of gutta-percha differs somewhat from that of india-rubber. The raw material is first cut into pieces by a cutting machine, and then immersed in water, in which most of the impurities sink, while the pure gutta-percha floats. The mass is then warmed and kneaded in a special machine, and substances similar to those used with ebonite may be added at this stage. In judging the quality of india-rubber and gutta-percha, the specific gravity and percentage of ash have hitherto been taken as guides; but the authors find that for some purposes the quality is much improved by the admixture of certain mineral substances, and the specific gravity may be modified by adding substances such as paraffin-wax or thickened oil, which may be even lighter than the pure material.

In procuring the samples with which their experiments were made, the authors either had them specially prepared according to their instructions, or the composition was communicated to them by the manufacturers.

Samples of different compositions were subjected to the action of various chemical substances, viz., sulphuric acid, acetic acid, soda solution, ammonia, refined colza-oil, mineral lubricating oil with the addition of tallow, illuminating gas. The test-pieces were carefully measured before and after exposure to the action of the different reagents, it having been found that the india-rubber swelled as soon as any injurious action commenced. Among the physical tests carried out were the determination of the limit of elasticity, the deformation under high pressure, deformation under percussion, and the determination of the insulating capacity.

The results of the different tests are given in numerous tables. Some of the commercial samples were stored for two and a half years, and it was found that certain substances, such as zinc oxide and chalk, although they increased the strength and insulating power of the fresh material, caused considerable deterioration after long storage. Soft rubber containing basic admixtures such as magnesia, zinc oxide, lead oxide, or chalk, was more easily acted upon by acids than pure rubber; but in some cases these admixtures increased the resistance to the action of mineral and vegetable oils. Alkalis and illuminating-gas had so little action upon all kinds of india-rubber that differences of practical importance could not be observed. Most of the organic admixtures, especially paraffin, resin, and pitch, preserved the insulating capacity in a high degree; but india-rubber containing them did not resist the action of high temperatures well.

The quality of hard rubber or ebonite was much deteriorated by the addition of resin-oil and resin; but asphalt increased both strength and elasticity. Hard rubber resists chemical action much better than the soft material. Among the general conclusions drawn by the authors from the results of their experiments, the following may be mentioned:—

All mineral and organic admixtures diminish the elasticity of soft rubber goods; 10 per cent. of sulphur was found to be the best proportion for vulcanisation. The elasticity of hard rubber may be increased by certain organic and mineral substances. The strength of both soft and hard india-rubber may be increased by the addition of some organic or inorganic substances, but is materially diminished by others. Numerous compounds were found to possess better insulating qualities than pure india-rubber mixed with sulphur alone. All organic admixtures produced vapours when heated to a high temperature. Most varieties of india-rubber containing mineral matter become hard and brittle if stored for several years; but the insulating power appears to remain constant.

A series of samples of gutta-percha with different admixtures was tested in the same way as the india-rubber, but special attention was directed to the insulating capacity. The resistence to chemical reagents was not appreciably influenced by the substances added. Pure gutta-percha and gum-balata were found to be the best insulators. Insulation was diminished by the addition of cinnabar, hydrate of lime, resin-oil and resin, while it was not affected by asphalt added in quantities not exceeding 30 per cent. The limit of elasticity was slightly increased by cinnabar and hydrate of lime, while the strength was increased by the former and diminished by the latter substance.

The paper is accompanied by tables and curves giving the results of the mechanical tests.

PATENTS.

Improvements in the Treatment of Lead Ores and the Production therefrom of White Lead Salts and Colours of Lead as also Simultaneously Zinc White. T. H. Cobley, Dunstable, Bedford. Eng. Pat. 18,709, October 30, 1891.

In this invention it is proposed to calcine in any convenient furnace at a dull red heat a very intimate mixture of galena, slaked lime, and nitrate of soda, which when thoroughly oxidised is passed through a washing or levigating mill until the lime compounds are removed and the pure oxide remains, which may then be employed like litharge. This oxide of lead may then be dissolved in a suitable acid and on decomposing this lead salt by means of zinc scraps, a metallic lead sponge and a zinc salt are obtained. This lead sponge is then converted into white lead by consecutively treating it with air, and carbonic acid and steam. The zinc salt is either converted into zinc sulphide, or into carbonate of zinc which may be again reduced to metallic zinc.
—C. O. W.

An Improved Compound of India-Rubber and Fibre, and Processes and Apparatus for Providing the Same. W. Golding, Manchester. Eng. Pat. 18,851, October 31, 1891.

This invention relates to the manufacture of a compound fabric of india-rubber and fibre in its woven state. The textile fabric is thoroughly cleansed and dried and then slowly passed through a weak solution of rubber, the speed being so arranged as to take advantage of the action of capillary attraction. The solvent is then evaporated and leaves each fibre coated with a very thin layer of rubber. This process is repeated until the fabric is coated thick enough.—C. O. W.

Improvements connected with the Manufacture of White Lead. E. V. Gardner, London. Eng. Pat. 19,545, November 11, 1891.

This invention refers to the production of blue lead sheets for use in the production of white lead, and has for its object to provide a large surface of metal on which the corroding gases and vapours may act with a minimum mass or weight. For this purpose lead sheets about $\frac{1}{16}$ of an inch thick are corrugated, by passing them through corrugated rolls and the corrugations may either run longitudinally, or laterally or crosswise.—C. O. W.

A New or Improved Material which may be used in Arts and Manufactures in the stead of India-Rubber, Gutta Percha, and other Similar Substances, and Process for Making the same, and for the Utilisation therefor of Waste Liquors from Tanneries. W. R. Earp, Preston Brook, Cheshire. Eng. Pat. 22,331, December 21, 1891.

The improved material is the precipitate thrown down from a solution of gelatin by the addition of tannin, worked and kneaded (with the addition of more gelatin) to the required consistency; to render it soft and elastic, linseed oil may be incorporated; ground glass, silica, or clays will similarly serve to harden it. It may be softened by the application of heat and worked like gutta-percha. The fleshings and waste tan liquors of the tanneries may be employed for the production of this material.—A. G. B.

An Improved Process and Apparatus for the Manufacture of White Lead and other Lead Pigments. G. D. Coleman, Chicago, U.S.A. Eng. Pat. 14,794, August 16, 1892.

The invention relates to the treatment of metallic lead in a finely-divided state, so as to corrode the same and produce at will either, lead suboxide, lead protoxide, or white lead. The process is carried out by first treating granulated lead in a sort of cylinder mill of special construction, in which at the same time the lead may be exposed to the corroding influences of air, water, and carbonic acid under varying conditions of pressure and temperature. The products of the corrosion are continuously removed from the rotating drum or cylinder by means of a current of water, and thus the granulated lead retains its bright surface throughout the process. The following formulæ are given:—

1. For the production of lead suboxide a temperature of from 150° to 210° F. and under ordinary atmospheric pressure.

2. For the production of white lead a temperature of from 75° to 150° F. and a pressure of 30 lb.

3. For the production of lead protoxide a temperature of from 75° to 150° F. and a pressure of 15 lb.—C. O. W.

Improvements in the Preparation of Acetate of Ammonia for Use in the Manufacture of White Lead by the Acetate of Ammonia Process. W. Smith, London. Eng. Pat. 18,693, October 29, 1891.

See under VII., *page* 42.

XV.—MANURES, Etc.

Estimation of Phosphoric Acid in Basic Slag. A. J. Jolles. Zeits. f. Anal. Chem. 1892, 516.

See under XXIII., *page* 64.

PATENT.

A Composition or Dressing for Vines and other Trees. E. J. A. Groe and E. P. Ramond, Paris. Eng. Pat. 3806, February 26, 1892.

The composition is intended to prevent the ravages of parasites on trees and especially for the prevention of phylloxera on vines. It consists of alum and heavy grey pepper, preferably in the proportion of three parts of alum to one of pepper, reduced to a fine powder. To apply the dressing, the foot of the stem is dressed with the composition after removal of the bark, the stem of the vine being previously laid bare down to the roots. The application of the dressing should be made from immediately after the grapes are gathered until the sap rises in June. In dry weather a little water may be added to the dressing.
—C. A. K.

XVI.—SUGAR, STARCH, GUM, Etc.

Experiments with Sugar Beets in 1891. H. W. Wiley and others. U.S. Depart. of Agriculture, 1892, Bulletin, 33.

The matter dealt with in this pamphlet covers 159 pages. From the outline given of the general *modus operandi* (*pp.* 7—11), may be cited the following:—The supply of seeds consisted of "*Kleinwanzlebener*" (two tons), "*Vilmorin's improved beet seed*" (two tons), and the varieties of *Desprez*, Lemaire, and Simon Legrand (1½ tons in all). It is computed that between 7,000 and 8,000 farmers received packages of seed which averaged in weight nearly 13 oz. each, together with full directions as to planting, taking samples for analysis, &c., and a blank form to be filled up and returned with the samples for analysis. It was, however, found impossible to secure exact compliance with the directions, and in several instances, inaccurate (mostly exaggerated) returns were sent in; a result exceeding 25 tons of roots per acre was regarded with suspicion. Inasmuch as most of the samples were received from distant States, and must therefore have dried considerably during their transit, the recorded yield of sugar is higher than the amount actually present in the freshly harvested roots. On account of the large influx of samples, the percentage of sugar in the beets was simply calculated from that found in the juice on the assumption that each root contained 95 per cent. of juice, and 5 per cent. of pulp. The work has aroused the interest of people in all parts of the country in the problem of beetroot sugar cultivation, but the Secretary of Agriculture has decided not to make so large a distribution of seed in future, but to concentrate his efforts to the development of a sugar-beet station in which practical illustration can be given of the best methods of cultivation and selection of seed.

Cultivation of Beets by Farmers in Thirty-six States and Counties (*pp.* 12—76). A tabulated summary of the results obtained, following which (*pp.* 77—99) are notes on the analyses of the samples.

Sugar Beet Experiments at the Agricultural Station, Wisconsin, and by certain Farmers, working under State Direction in the same Locality (*pp.* 90—112):—Tables showing the results obtained, and notes on the same.

Beets of fair quality have been grown as far south as Texas, and it is now believed that on most of the central western portion of the United States, beetroot cultivation can be carried on with profit, especially where irrigation is possible. The Department of Agriculture has thoroughly demonstrated possibility of sugar-beet cultivation in the United States and if farmers could be induced to take it up, a rapid development of the industry would ensue. There is abundant capital waiting to embark in the manufacturing part of the industry whenever a sufficient quantity of raw material for its operations can be assured.

Experiments conducted at the Beet-Sugar Experimental Station, Schuyler, Nebraska (*pp.* 112—151).

Process for the Production of Sugar-Beet Seed by Cuttings (*p.* 152):—A process patented in Germany by A. Nowoczek, which consists in cutting out the buds from the axis of the leaves with as little as possible of the flesh adhering thereto, treating them with powdered charcoal to prevent decay and protect them from ground worms, and planting them in beds. The beets produced are of average size, and can be planted for seed. It is claimed that all the properties of the mother beet from which they are taken are much better preserved than by the ordinary method of planting it directly for seed.—A. R. L.

Experiments with Sorghum in 1891. H. W. Wiley and others. U.S. Depart. of Agriculture, 1892, Bull. 34.

This record of experiments comprises 132 pages. The process employed for the extraction of the sugar, which is essentially that published by Joulie (*Etudes et experiences sur le sorghs á sucre, Paris*, 1864) involves the use of alcohol, and could not therefore be made use of commercially under the existing revenue laws.

W. H. Sylvester (p. 77) has measured the starch granules from sorghum juice, and finds them to be only $\frac{1}{8000}$—$\frac{1}{6000}$ of an inch in diameter.—A. R. L.

Dulcitol. E. O. von Lippmann. Ber. **25**, 1892, 3216—3218.

Some cane-sugar obtained from a certain source in India was found on analysis to contain 61·4 per cent. sugar, 2·29 water, 2·08 ash, and 34·25 per cent. other organic matter. It contained a considerable amount of reducing sugar, and this consisted almost exclusively of invert sugar. In order to ascertain whether Maumené's non-reducing and unfermentable sugar were present, the author fermented the product with yeast. The fermented solution was found to contain a substance which was not fermentable and which did not reduce Fehling's solution, but from an examination of its properties the author shows it to be dulcitol.—A. K. M.

Sorbitol in the Products of the Manufacture of Sugar. E. O. von. Lippmann. Ber. **25**, 1892, 3218—3220.

The author has succeeded in isolating sorbitol from molasses which had been treated with alcohol and acid in accordance with Margueritte's method for the recovery of sugar. The alcoholic liquors deposited a dark-coloured syrup which was dissolved in hot water, treated with baryta and further purified by means of lead acetate and animal charcoal: the solution was concentrated to a syrup and alcohol added. First mannitol and subsequently sorbitol, crystallised from the solution.—A. K. M.

The Behaviour of Sugar Solutions with Acetone. W. H. Krug and K. P. McElroy. Journ. Anal. and Applied Chem. **6**, 183.

See under XXIII., *page* 68.

XVII.—BREWING, WINES, SPIRITS, Etc.

PATENT.

Improvements in Means or Apparatus for Maturing and Improving Fermented Alcoholic Liquids, Applicable also for Oxidising Oleaginous and other Liquids. W. S. Martin, Paris, France. Eng. Pat. 22,413, December 22, 1891.

The apparatus forming the object of the invention is for the purpose of freeing alcoholic and oleaginous liquids by oxidation from the varying quantities of aldehydes, essential oils and other organic compounds which are present as impurities, and are difficult of removal by present processes. The essential parts of the apparatus are an injector, in which the current of oxygen coming from a reservoir of that gas is caused to arrive normally in the direction of the liquid, with the object of producing an intimate mixture of the two fluids, and of a spray diffuser for the liquid formed of two nipples placed facing each other so as to allow fine jets of a mixture of gas and liquid to escape, which, by meeting each other, cause the whole of the mixture to be turned into spray, thus forming an emulsion. It is claimed that the shock of meeting of the jets generates electricity, which converts a portion of the oxygen into ozone.

—G. H. R.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

The Determination of the "Soluble" Constituents of Cocoa and the Detection of an Admixture of Fixed Alkalis or Ammonia. A. Stutzer. Zeits. f. ang. Chem. 1892, 510—513.

With the object of rendering cocoa preparations rich in the so-called "soluble constituents" it is a common practice with manufacturers to add potassium, sodium, or ammonium carbonate to the ground cocoa. The author, however, finds that the increase in the proportion of soluble constituents, both organic and inorganic, bears no ratio to the quantity of alkali added, and consequently that nothing is to be gained by their addition. The presence of these bodies is indicated by the following considerations:—

Pure cocoa contains a small percentage of ash, which does not effervesce on the addition of acid; about one-third of the ash is soluble in water. More than two-thirds of the phosphoric acid contained in pure cocoa is soluble in water, whilst the nitrogen present as ammonia is less than 0·1 per cent. When ammonium carbonate is admixed with the cocoa the nitrogen present as ammonia is more than 0·25 per cent., considerably less of the phosphoric acid is contained in the aqueous extract than in the case of the pure product. The addition of potassium or of sodium carbonate increases the total ash, and the ash itself effervesces on the addition of acid; further, the proportion of ash contained in the aqueous extract of the preparation is greater than with pure cocoa. The solubility of the phosphoric acid is decreased, whilst the nitrogen present as ammonia is about the same as in the case of the pure substance.

To determine the nitrogen present as ammonia it is not necessary to remove the proteids present, as previously stated by the author. Ten grms. of the cocoa powder are simply heated with an excess of burnt magnesia and 200 cc. of water in an Erlenmeyer flask for 20 minutes and the evolved ammonia absorbed in titrated sulphuric acid. To determine the soluble phosphoric acid it is preferable to employ the direct aqueous extract of the cocoa rather than to extract the ash, as in the latter case the presence of alkali may lead to erroneous results.—C. A. K.

On Margarins. F. Wallenstein. Chem. Zeit. 1892, **16**, 883—884.

In the following table the results obtained in the examination of 16 samples of margarin are given:—

—		M.P. of the Fat.	M.P.	Sol. P.	Acid Value		Iodine Absorpt.	Saponif. Value of the Fatty Acids.
			Of the Fatty Acids.		Before Drying.	After Drying.		
				°				
American Margarins............	1	26·0	45·0	42·5	1·26	1·55	44·3	205·7
	2	17·3	43·7	41·0	0·85	1·22	47·0	201·8
	3	25·0	44·0	42·4	0·56	1·00	43·8	204·8
	4	27·0	44·2	41·5	0·99	1·29	44·3	205·3
	5	25·0	43·8	42·0	0·70	1·04	45·0	205·8
	6	25·5	44·5	42·0	0·85	1·20	44·6	206·4

—		M.P. of the Fat.	M.P. Of the Fatty Acids.	Sol. P. Of the Fatty Acids.	Acid Value Before Dyeing.	Acid Value After Dyeing.	Iodine Absorpt.	Saponif. Value of the Fatty Acid.
Austro-Hungarian Margarins.......	7	25·0	42·9	41·5	1·35	1·69	45·8	205·0
	8	26·0	43·0	41·0	0·85	1·01	47·2	205·7
	9	23·25	42·0	40·0	1·56	1·83	47·6	206·4
	10	26·5	44·0	41·7	0·83	1·24	45·5	205·4
	11	25·25	43·5	42·0	1·42	1·74	44·1	204·9
	12	24·0	43·8	41·25	1·28	1·69	46·5	205·5
	13	25·5	43·5	41·75	1·28	1·68	45·1	205·8
	14	25·5	44·25	42·0	1·35	1·58	44·0	205·5
	15	24·75	43·7	42·2	1·30	1·59	44·4	206·8
	16	23·0	43·7	42·2	1·40	1·66	44·2	205·5

Welmans' reaction for the detection of fatty oils (this Journal, 1892, 548) is valueless in the case of the margarins, as their natural colouring matter itself gives the colour reaction. Rancid margarins, the colour of which has been destroyed, no longer react with Welmans' reagent.

With the aid of the iodine and saponification values the author calculates the approximate percentages of oleïne, stearin, and palmitin in the above 16 samples.—J. L.

PATENTS.

Improvements in Apparatus for Drying Cacao, Coffee, Tea, Barks, Malt, and other Substances. R. White, London. Eng Pat. 1197, January 21, 1892.

The invention relates to an improved apparatus for drying in an efficient and rapid manner cacao, coffee, tea, barks, hops, corn, seeds, and similar produce. The drying is effected either by a current of hot air, or by desiccated cold air, passing under, through, and over the substances to be dried. These are placed in trays or shallow boxes, or shelves in the drying chamber. The admission of the air is controlled by two valves, and the arrangement is such that air passes to each of the trays separately, so that the vapour carried off from the contents of one tray cannot communicate with the contents of an adjacent one. When cold air is employed the apparatus must be fitted with an exhaust fan or blower.

The trays or sieves may be advantageously made of cane or bamboo, instead of wire, so as to prevent metallic contamination. (See also Eng. Pat. 18,038, November 10, 1890; this Journal, 1891, 940—941.)—L. de K.

A New or Improved Method of Treating and Roasting Malt and Blending the Same for Infusion together with Coffee. K. G. Krikorian, London. Eng. Pat. 1150, January 21, 1892.

The object of the invention is to provide a wholesome coffee mixture for persons who are precluded from taking coffee or its mixture with chicory.

Barley, which is undergoing the process of malting and has arrived at that stage at which it is ready for the kiln, is placed in an ordinary cylindrical coffee-roasting apparatus, and the malt well agitated and turned during the roasting. A little salad-oil or other aromatic or flavouring matter may be added during the roasting to prevent burning of the malt. The roasting should be continued until the malt assumes the colour of roasted coffee.

The malt is then blended thoroughly with coffee in the proportion of one to two, and the mixture ground in a coffee-mill.—L. de K.

Improvements in and connected with the Process of Extracting Cocoa, or Rendering it Soluble for the Preparation of Soluble Cocoa, or the Manufacture of Cocoa Powder, Chocolate, and the like Preparations. W. P. Thompson, Liverpool. From Moser and Co., Stuttgart, Germany. Eng. Pat. 20,436, November 24, 1891.

By the inventor's process a soluble cocoa may be prepared without the use of a fixed alkali.

About 100 lb. of shelled purified raw cocoa-beans are placed in a drum capable of being rotated, and moistened with two litres of water. The axis of the drum is hollow and provided with holes, and is connected by means of a pipe with a closed vessel containing 5—10 litres of cold water and ½—3 lb. of ammonium carbonate. The vessel is then cut off and heated by steam or other suitable means. The ammonium carbonate now volatilises and passes off with the steam which is then allowed to enter the pipe and pass into the vessel containing the cocoa-beans. After about three-quarters of an hour the cocoa is dissolved. The connection between the two vessels is then closed, rotation is stopped, and after standing for two or three hours, the mass is roasted in any suitable roasting apparatus at a temperature not exceeding 132° C. A portion of the fat (about 31—33 per cent.) is then removed by pressure from the still-warm cocoa. The excess of ammonium carbonate has of course been completely expelled during the roasting. A peculiar advantage of this new process is that the finished product does not lose its aroma and taste if kept a long time in stock.—L. de K.

Improvements and Apparatus and Appliances for Softening, Purifying, and Filtering Liquids. C. H. Fitzmaurice, Litterton, Shepperton, Middlesex. Eng. Pat, 20,904, December 1, 1891.

The impure water is first thoroughly mixed in a suitable vessel, provided with an agitator, with caustic lime or other softening material, and then pumped up through a vessel filled with irregular pieces of pottery tiles, wood, or other purifying material, which serves to arrest all flocculent matter suspended in the water. At the top of this latter vessel are two perforated plates, between which a thick layer of cocoa-nut fibre, yarn, or other purifying material is placed, through which the water passes. The appliance is adapted to house cisterns by employing a tray carrying a series of jars partially glazed, preferably in zigzag or V-shaped stripes, in which the softening material is placed. The object of partially glazing these jars is to allow the softening agent to be saturated and to mix gradually with the impure water. After passing into the tray and through the jars the water overflows either through the perforations or over the edge of the tray into the tank.—C. A. K.

(*B.*)—SANITARY CHEMISTRY.

The Poisonous Character of Expired Air. S. Merkel. Arch. Hyg. **15**, 1.

Air expired both from man and from animals, even in a good state of health, contains a minute quantity of a volatile organic base. This base is poisonous in the free state, but loses its toxic influence when combined with acids.

—C. A. K.

The Comparison of River Pollution. R. Baumeister. Deutsche Viertelj fur offent Gesundheitspfl, 1892, 467; Proc. Inst. Civil Eng. 1892–3, **111**, (1) 38—40.

It is pointed out by the author that though the degree of river-pollution may be indicated by means of chemical analysis, there is no method by which it is possible to set forth all the various factors which may influence the prevailing conditions in respect to any stream when it becomes necessary to compare one place with another. Something in the nature of a mathematical formula would therefore appear to be desirable for this purpose. The processes relied upon for the removal of pollutions caused by sewage are notably either copious dilution, or gradual self-purification. For the former ample volume suffices; for the latter, rapidity of flow in the river is also an essential. The minor elements are likewise noticed, among which are the presence of algæ, the existence of rapids or weirs, the chemical effect of rocks in the river-bed, and of certain kinds of trade-refuse; but as these latter matters are of purely local significance, they may here be omitted. The extent to which sewage must be diluted in order to render it harmless when discharged into a stream of given volume at dead low-water can readily be fixed by a proportion; and von Pettenkofer has laid down the rule that no harm can arise when the volume of the sewer-water is not more than one-fifteenth that of the river into which it passes. But this simple statement should, according to the author, be based upon the amount of impurities present in the sewage. This latter factor may remain constant, while the volume itself depends to some extent upon the weather, and upon the daily consumption of water. When the water-supply reaches 150 litres per head per day, the dry weather flow of sewage will be twice as great as when that supply is only 75 litres per head. The purifying power of the river does not change in the same proportions, and it would be better to set down the population contributing to the sewers as the figure to be taken into account when calculating the pollution.

Leaving out of consideration the mineral matters in suspension in the sewage, the author takes the suspended organic matters, and all substances in solution as pollutions, and from numerous analyses he assumes 190 grms. per head per diem, as representing the average amount of impurities discharged from water-carriage towns. The total pollution, however, varies widely, in accordance with the manner in which the excreta are dealt with; but even in towns worked wholly on the dry system, the dejections of a certain proportion of the inhabitants reach the river. Taking the proportions of the inhabitants whose excreta pass direct into the sewers as c, and indicating all other impurities by 1, the expression $(1 + c)$ will represent in a definite form the whole amount of impurities conveyed into the river. In a town entirely on the dry system, $c = 0$. If half the population used water-closets, $c = 0{\cdot}5$, and if the town was entirely dealt with on the water-carriage system, $c = 1$. With regard to the rapidity of the flow in the stream, it must at any rate suffice to carry away the sewage, and according to von Pettenkofer, it should, at least, be equal to the velocity of flow in the sewer, or not less than 0·6 metre per second. Without attempting to lay down any standards, it is pointed out that from the foregoing factors a simple equation may be framed which may be described as the "coefficient of pollution":—

$$\frac{Q\,v}{E\,(1 + c)}.$$

Here Q equals the daily flow in cubic metres, when the river is at its lowest level $= 86{,}400\ q$, where q is equal to the volume of water per second. v equals mean velocity in metres per second. E is the population, and c the proportion of the inhabitants who regularly contribute to the sewers. In accordance with the above formula, a table of coefficients has been constructed by the author for a few of the large towns on the Continent. The coefficient thus obtained for Breslau is 1·8; for Paris, 1·9; for Cassel, 3·2; for Stuttgart, 4·8; while for Basel it is 395; for Maintz, 420; and for Lintz, 617. These being the first four and the last three towns on the list. As the three first named cities have each of them to clarify their sewage before it is passed into the rivers, the author suggests that five as calculated by this formula, should be approximately the lowest coefficient to be attained by towns desirous of passing raw sewage into a stream. It is pointed out that these figures doubtless require correction for actual comparisons, and that probably the values v and c, instead of being simple numbers as here shown, may need to become complex figures or even powers. Further, for practical use, it is evident that accurate knowledge must be obtained respecting the length of river-flow needed for self-purification under various conditions; moreover, it is essential that the behaviour of bacteria of the nature of disease-germs should be studied, when exposed to the action of running water.

A New Disinfecting Apparatus. O. Krell. Gesundheits-Ingenieur, August 31, 1892, 521; Proc. Inst. Civil Eng. 1892–3, **111**, (1) 41—42.

The apparatus herein described was designed by the author in conjunction with Dr. Raptschefsky, at the instance of his Excellency Mr. v. Remmert, the inspector of the medical department of the Russian army. In the first instance all existing forms of disinfecting apparatus were procured and submitted to a searching trial. The conditions laid down for the apparatus to be constructed were:—

1. That it should destroy entirely not only the germs of all known pathogenic organisms, but even those bacilli found to be the most difficult to exterminate (the garden mould bacillus).

2. That the disinfection should be accomplished in the shortest possible space of time.

3. That the apparatus should be as simple as possible, both in construction and manipulation.

The various systems tested were: (1) by hot air; (2) by superheated steam; (3) by saturated steam-jets; (4) by saturated steam at rest at about atmospheric pressure, with means for producing a vacuum by condensation; (5) by saturated steam at rest, with means for creating high pressures during disinfection; (6) by saturated steam jets at high pressure, with superheating. The performances of the various classes of disinfecting apparatus based upon the above principles are discussed in detail; and the experiments led to the conclusion that the new apparatus must work by means of saturated steam as a jet at high pressure, with provisions for ventilation of disinfecting chamber, and with special air inlets also at the floor level; without special heating apparatus within the chamber, but furnished with heat accumulators. Diagrams are given of the apparatus as carried out to comply with these conditions. It is made of steel, and is cylindrical in form, being 0·915 metre in diameter, and 1·52 metre in length (3 ft. × 5 ft.). The cylinder is placed horizontally, and has doors at each end, fastened to bronze rings with six screw-bolts to each. The chamber is tested to a pressure of 10 atmospheres at the works, but the safety-valve is weighted to lift at three quarter atmosphere above normal.

The total weight of the apparatus is only about 20 centners (about 1 ton). It is distinguished from all others by its rapidity of working. The previous heating up of the chamber from the cold state takes two minutes; and in 15 minutes more a temperature of 100° C. is reached, even through a thickness of 32 blankets; while in five minutes more the temperature rises to 112°. It may therefore be asserted that the disinfection, even of the most difficult objects, can be completed in 22 minutes. The working speed is contrasted by the author with that of other forms of apparatus now in use, and the advantage of saturated steam at 100° over heated air even at 150°, as determined by Koch, is insisted upon.

PATENTS.

An Improved Method for Destroying Gases in Towns' Refuse Destructors or other Furnaces Generating Heat. H. Utley, Leeds. Eng. Pat. 21,170, December 4, 1891.

For the better combustion of furnace gases, more especially in the case of towns' refuse destructors, air cavities, or channels formed of cast steel or other suitable material, are placed at the sides of the furnace, the otherwise necessary firebrick being dispensed with. These air channels are provided with an opening near the back of the furnace grate, so that air or oxygen may be admitted in suitable quantities, regulated by inlet valves. The air channels are made reversible, so that they may be reversed when one end becomes damaged.—F. S. K.

A New or Improved Apparatus for Disinfecting or Odorising Purposes. C. C. Leathers, London. Eng. Pat. 22,258, December 19, 1891.

The invention relates to improved apparatus for disinfecting or odorising the foul air in hospital wards, sick rooms, theatres, and the like, and consists of a chamber enclosed by a perforated metal case, in which there is arranged a fan rotated by a small electro-motor or other power. The space round the perforated casing is packed with sawdust, cotton, or other filtering material, impregnated with any suitable odorising or disinfecting substance, through which the foul air is drawn; or the bottom of the chamber is fitted with a liquid disinfectant which is drawn up into the chamber by means of suitable wicks or fibres. Attached to the shaft of the fan and revolving within the perforated casing, is a small conical-shaped chamber, also made of perforated metal and containing some porous material impregnated with the disinfecting or odorising substance employed. A special advantage claimed for the apparatus is that it causes no draught.—C. A. K.

A Combined Refuse Furnace and Gas Manufacturing Apparatus. W. J. Lomax and C. J. Lomax, Bolton. Eng. Pat. 1181, January 21, 1892.

See under II., *page* 31.

XIX.—PAPER, PASTEBOARD, Etc.

Bisulphite Liquors for Wood "Boiling." A. Harpf. Papier Zeit. **17**, 1892, 53, 54, 56, 57.

The author has exhaustively investigated the relation of density of these liquors (Mitscherlich process) to composition, *i.e.*, to total SO_2, free SO_2, and combined SO_2, from the results of more than 300 analyses and gravity observations; the mean numbers are calculated and given in tabular form.

Table I. gives the results for tower liquors, *i.e.*, as freshly prepared; Table II. the results for liquors in the storage tanks. Columns 7, 8, 9 in each table give the following ratios respectively:—

$$a = \frac{\text{Per cent. total } SO_2}{°\text{B.}} \qquad b = \frac{\text{Per cent. free } SO_2}{°\text{B.}}$$

$$c = \frac{\text{Per cent. combined } SO_2}{°\text{B.}}$$

The *italic* figures are the successive differences between the numbers in the vertical columns.

Table II.—Liquors from Store Tank.

°B.	Total SO_2	Free SO_2	Combined SO_2	Per 100 of Total SO_2		Factors.		
				Free.	Combined.	*a.*	*b.*	*c.*
	Per Cent.	Per Cent.	Per Cent.					
3	1·826 *0·150*	1·128 *0·072*	0·698 *0·078*	62	38	0·609	0·376	0·233
3¼	1·976 *0·110*	1·200 *0·089*	0·776 *0·021*	61	39	0·608	0·369	0·239
3½	2·086 *0·255*	1·289 *0·137*	0·797 *0·118*	62	38	0·596	0·368	0·228
3¾	2·341 *0·063*	1·426 *0·031*	0·915 *0·032*	61	39	0·624	0·380	0·244
4	2·404 *0·226*	1·457 *0·167*	0·947 *0·059*	60·5	39·5	0·601	0·364	0·237
4¼	2·630 *0·162*	1·624 *0·131*	1·006 *0·031*	62	38	0·618	0·382	0·236
4½	2·792 *0·152*	1·755 *0·068*	1·037 *0·084*	63	37	0·620	0·390	0·230
4¾	2·994 *0·120*	1·823 *0·049*	1·121 *0·071*	62	38	0·619	0·383	0·236
5	3·064 *0·129*	1·872 *0·110*	1·192 *0·019*	61	39	0·612	0·374	0·238
5¼	3·193 *0·292*	1·982 *0·156*	1·211 *0·136*	62	38	0·608	0·377	0·231
5½	3·485 *0·131*	2·138 *0·006*	1·347 *0·125*	61	39	0·633	0·388	0·245
5¾	3·616 *0·200*	2·144 *0·107*	1·472 *0·093*	59	41	0·629	0·373	0·256
6	3·816	2·251	1·565	59	41	0·636	0·375	0·261
	Mean numbers............................			61	39	0·616	0·377	0·239

TABLE I.—TOWER-LIQUORS.

° B.	Total SO_2	Free SO_2	Combined SO_2	Per 100 of Total SO_2		Factors.		
				Free.	Combined.	*a.*	*b.*	*c.*
	Per Cent.	Per Cent.	Per Cent.					
3½	2·183 *0·105*	1·421 *0·069*	0·762 *0·036*	65	35	0·624	0·406	0·218
3¾	2·288 *0·195*	1·490 *0·082*	0·798 *0·113*	65	35	0·610	0·397	0·213
4	2·483 *0·151*	1·592 *0·096*	0·911 *0·055*	63	37	0·621	0·393	0·228
4¼	2·634 *0·173*	1·668 *0·066*	0·966 *0·107*	63·5	36·5	0·619	0·392	0 227
4½	2·807 *0·110*	1·734 *0·053*	1·073 *0·057*	62	38	0·623	0·385	0·238
4¾	2·917 *0·218*	1·787 *0·184*	1·130 *0·034*	61	39	0·614	0·376	0·238
5	3·135 *0·129*	1·971 *0·076*	1·164 *0·053*	63	37	0·627	0·394	0·233
5¼	3·264 *0·204*	2·047 *0·045*	1·217 *0·159*	63	37	0·622	0·390	0·232
5½	3·408 *0·123*	2·092 *0·030*	1·376 *0·093*	60	40	0·630	0·380	0·250
5¾	3·591 *0·193*	2·122 *0·184*	1·469 *0·009*	59	41	0·624	0·369	0·255
6	3·784 *0·175*	2·306 *0·062*	1·478 *0·143*	61	39	0·630	0·384	0·246
6¼	3·959 *0·237*	2·368 *0·208*	1·591 *0·019*	60	40	0·633	0·379	0·254
6½	4·186 *0·123*	2·576 *0·090*	1·610 *0·033*	61·5	38·5	0·644	0·396	0·248
6¾	4·309 *0·234*	2·666 *0·184*	1·643 *0·050*	62	38	0·638	0·395	0·243
7	4·543	2·850	1·693	63	37	0·649	0·407	0·242
Mean numbers........................				62	38	0·627	0·389	0·238

On plotting out the results for percentages of SO_2 (ordinates) and degrees Beaumé (abscissæ) the "curves" representing the relations are seen to be approximately straight lines.

The entire range of results is summed up in the following numbers representing the composition of the liquors:—

—	Of 100 Parts SO_2		Factors.		
	Free.	Combined.	*a.*	*b.*	*c.*
Tower liquors...	62	38	0·627	0·389	0·238
Stove liquors....	61	39	0·616	0·377	0·239
General mean...	61·5	38·5	0·6215	0·3830	0·2385

It is seen, therefore, that under the conditions of continuous production the hydrometer tests of the liquor give sufficient information as to composition.—C. F. C.

Sulphite Wood Liquors and Pollution. Papier Zeit. 17, 1892, 2148.

SEVERAL paper mills in the Breslau and Liegnitz districts have made serious attempts to minimise the pollution occasioned by the discharge of sulphite liquors. Neutralisation with lime followed by settling; addition of lime in excess and filtering off the precipitated sulphite, and variations of such treatments, have given very partial results. Two mills have adopted the drastic process of evaporation to dryness and calcining the residue, which appears for the moment to be the only effectual solution of the problem.—C. F. C.

Strength of Papers made from Sulphite Cellulose. O. Winkler. Papier Zeit. 17, 1892, 2174.

IN Class II. of the official list of papers, now generally adopted in Germany, the specified maximum for sulphite cellulose is 25 per cent. and for the remaining 75 per cent. cotton and linen fibre is required. The author is of opinion that the suspicion entertained of the strong and durable qualities of the sulphite cellulose is not warranted by the experimental evidence to hand. Alterations of breaking strain and elasticity over lengthened periods are given for certain specimens of pure "sulphite" papers, as under:—

Weight.	Date of Test.	Length of Paper for Breaking Strain.	Extension at Fracture.
			Per Cent.
(1.) 318 grms. per sq. m. ..	22nd Nov. 1890	6·7	3·6
„ „	17th Dec. 1891	6·1	3·3
„ „	11th Aug. 1892	6·6	3·7
(2.) 360 grms. per sq. m. ..	22nd March 1892	5·8	3·2
„ „	11th Aug. 1892	5·5	3·4

The author's general experience leads him to advocate the extension of the limit to not less than 50 per cent. of the pulp mixture used in making ordinary official and document papers.—C. F. C.

The Estimation of Pentosans and Pentoses in Vegetable Substances by Distillation with Hydrochloric Acid, and the Gravimetric Determination of the resulting Furfuraldehyde. E. R. Flint and B. Tollens. Ber. **25**, 1892, 2912.

See under XXIII., *page* 69.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Simple Apparatus for the Sublimation of Iodine, Benzoic Acid, and other Substances. J. Hertkorn. Chem. Zeit. 1892, **16**, 795.

To avoid the drawbacks of the usual sublimation vessels the necks of which become easily choked up by the sublimate, the author has constructed an improved apparatus shown in Figure 1. A represents a dish of enamelled iron into which is fitted a funnel B, of the same material. B is closed by a stopper perforated with two holes, into one of which is inserted the exit pipe *c*, whilst into the other is fitted the condenser C. This condenser is kept cool by a current of water entering at *a*, and leaving it at *b*. The groove *m m′* is filled with mercury, oil, paraffin, or gypsum, &c., and serves at the same time as a receiver for any liquid parts of the substance and which had arisen in vapour during sublimation. Such accumulated liquid is removed by means of the tube *d*. D is a porcelain plate which prevents any sublimate from falling back into the raw material.

Fig. 1.

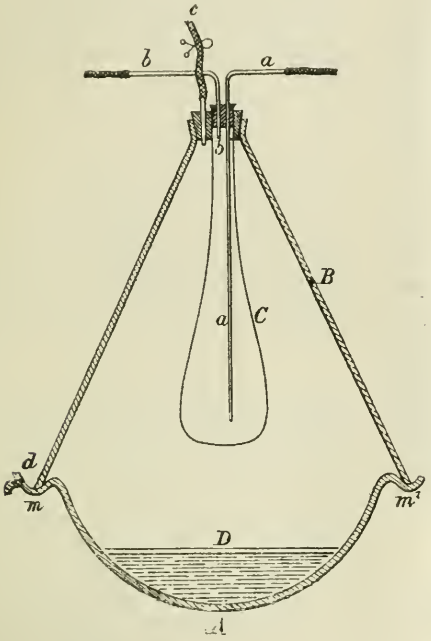


Fig. 2.

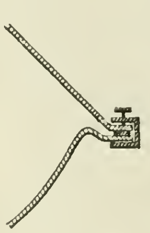
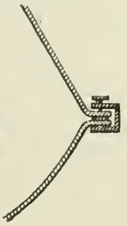


Fig. 3.



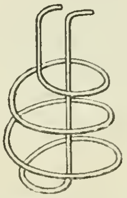


Fig. 4.

Figs. 2 and 3 show modifications of the apparatus adapted to manufacturing purposes. Fig. 4 represents another form of condenser.—J. L.

On the Manufacture of the Cinchona Alkaloids. W. D. Field. Jour. Anal. and Applied Chem. **6** (1892) 121—128 and 304—311.

After noticing the various methods employed for the extraction of alkaloids from cinchona bark, and pointing out objections to the use of alcohol, dilute acids, turpentine, fusel oil, benzene, and petroleum oil when employed separately, the author gives the following method as suitable either for commercial extraction or for analysis.

The bark, having been ground to a fine powder, is thoroughly incorporated with 20 per cent. by weight of cold slaked lime made into a stiff paste with water, placed in an extractor, and treated with a mixture of kerosene oil (three parts) and fusel oil (one part) until free from alkaloids. The two oils are mixed before use and the separated water allowed to settle; about 3,500 gallons of the mixed oils, divided into four equal charges, are required to extract a ton of bark. The oil is drawn off by means of an exhaust pump; the first two extracts are run into the washing tank, the last one or two, according to the results of tests, being used for the first extraction of a new charge. The first two extracts are then run into a washing tank and treated with dilute (1:15) sulphuric acid, of which about five gallons are required to every 100 gallons of oil. The acid solution, after standing for a day or two to allow the oil to separate, is neutralised with a saturated solution of caustic soda at a temperature about 5° below its boiling point, decolorised with bone-black, allowed to settle, and run through filter bags into the crystallising boxes.

For the purpose of analysis 100 grms. of bark in fine powder are similarly treated with the same proportions of lime, and extracted with the same mixed solvent, the acid washings being neutralised, precipitated as tartrate, and converted into iodo sulphate. The iodo sulphate of quinine which precipitates, is weighed, and the quinine calculated from the result obtained.

The four alkaloids are then separated by methods based on the following properties:—

I. Separation of quinine from *a*. cinchonine, *b*. quinidine and cinchonidine:—*a*. Slight solubility of quinine sulphate in water. *b*. Slight solubility of the normal tartrate of quinine.

II. Separation of cinchonidine from quinidine and cinchonine. *a*. Slight solubility of the normal tartrate of cinchonidine in water, and easy solubility of the tartrates of cinchonine and quinine.

III. Separation of quinidine from cinchonine. *a*. Slight solubility of the acid tartrate of quinidine in water.

IV. Separation of cinchonine and quinidine by solution of the quinidine in 66° B. sulphuric acid, based on the basic properties of quinidine.

V. Separation of the quinine, cinchonidine, and quinidine remaining in the cinchonine precipitate, by treatment with mixed oil.

The waste soda liquors containing dissolved and suspended alkaloids are run into a tank, mixed with caustic soda, and the alkaloids extracted with mixed oil; the alkaloids in the bone-black residue are also extracted by the same method as that used in the case of the bark.

Extractors, mixers, filter-boxes, &c. suitable for use in the above process are described and shown in two sheets of drawings.—F. S. K.

Hyoscine. A Ladenburg. Ber. 1892, **25**, 2388—2394.

A reply to Schmidt's investigations on the alkaloid Scopolamine (Archiv. de. Pharm. 1892, 207—231), which he considers identical with the hyoscine isolated by the author from the residues in the preparation of hyoscyamine and from Dubosia. The two bases are, in the opinion of the author, both present in hyoscyamines and in Dubosia, together with hyoscyamine, but they differ both in their properties and composition and there is no ground whatever for regarding them as identical. Hyoscine has the formula $C_{17}H_{23}NO_3$ whilst that of scopolamine is $C_{17}H_{21}NO_4$; a repetition of the analysis of the gold and platinum double chlorides of hyoscine and of its decomposition product by baryta pseudo-tropine, confirm this view. The identity of this base with the ψ-tropine obtained by Liebermann from coca (this Journal, 1891, 944) is also regarded as undecided. This point is under further investigation. A careful examination of the hyoscine of commerce which is manufactured for therapeutic use, pointed to the presence of some scopolamine in the product, the presence of which, however, was only recognised by decomposing the alkaloid with baryta when the analytical results showed that the pseudo-tropine was accompanied by a second product, the scopoline of Schmidt. Hesse has also thrown doubt on the author's investigation on hyoscine. (Pharm. Zeit. 1892, 29.)
—C. A. K.

Hyoscine (*Scopolamine*). E. Schmidt., Ber. 1892, **25**, 2601–2607.

A reply to Ladenburg's criticism of the author's work (previous abstract), in which the statement made by Ladenburg to the effect that the author stated hyoscine and scopolamine to be identical is negatived; the experiments referred to showed that the hyoscine of commerce consists essentially of scopolamine, the alkaloid first isolated from *Scopolia atropoides*, but no statement was made as to the identity of this base with hyoscine or as to the non-existence of the latter. The remainder of the paper consists of a comparison of the analyses of the bases, of their salts and of the products of decomposition by baryta water, all of which point to the formula $C_{17}H_{21}NO_4$, and not $C_{17}H_{23}NO_3$, for the chief constituent of the commercial product. The decomposition is represented by the equation :—

$$\underset{\text{Scopolamine.}}{C_{17}H_{21}NO_4} = \underset{\text{Scopoline.}}{C_8H_{13}NO_2} + \underset{\text{Atropic Acid.}}{C_9H_8O_2}.$$

Scopoline is therefore not an isomer of tropine as the supposed pseudo-tropine described by Ladenburg as the product of this decomposition, is.—C. A. K.

The Alkaloids contained in the Roots of Corydalis Cava. M. Freund and W. Josephy. Ber. 1892, **25**, 2411—2415.

To obtain the alkaloids the roots were extracted with alcohol, the solution filtered from resinous matter after distilling off a portion of the solvent, and the filtrate precipitated by ammonia, the resulting bases being extracted with ether. After distilling off the greater portion of the ether, a product melting at about 160° C. separates in the filtrate, from which on further concentration the crude *Corydaline* melting at 126°—130° C., crystallises out. This crude product contains at least three bases, one of which is identical with the product obtained by Dobbie and Lander (J. Chem. Soc. 1892, 244) and for which the name *Corydaline* is retained. It melts at 133°—134° C., has the probable formula $C_{22}H_{27}NO_4$, and constitutes 60–70 per cent. of the mixture. *Bulbocapnine* is the name given to the second base which melts at 197° C., and is distinguished from Corydaline by being soluble in alkali, the latter being insoluble. Analysis points to the formula $C_{34}H_{36}N_2O_7$, it is a bi-tertiary base, and forms a series of characteristic salts. The name is derived from *Bulbocapinus Carus* a synonym for *Corydalis cava*; it exists to the extent of 20—30 per cent. in the mixture of bases. The third product isolated, only occurs in very small quantity; the less soluble portion of the original ether extract (melting at 160° C.) containing the greater proportion of it. For this the name *Corycavine* is proposed; it crystallises in rhombic plates, which melt at 214°—215° C. and dissolves in alkali. The hydriodide and platinum double chloride are characteristic; analyses point to the formula $C_{23}H_{23}NO_5$ for the free base. Full references to previous work on the subject are given in the paper.—C. A. K.

Terpine Hydrate from Eucalyptus Oil. E. Merck. Arch. Pharm. **230**. 169.

The terpine hydrate obtained from eucalyptus oil separates in glittering crystals from alcoholic solution. These crystals melt at the same temperature as the hydrate from oil of turpentine, 115°—116° C. A 13·6 per cent. alcoholic solution does not deviate the plane of polarised light.—C. A. K.

Asboline, (Pyrocatechol and Homopyrocatechol.) Bekal and Desvignes. Compt. Rend, **114**, 1541—1544.

The authors have examined Braconnot's "*asboline*" which is obtained from the aqueous extract of wood-soot by treating with hydrochloric acid, extracting with alcohol, evaporating the alcohol from this extract and exhausting the residue with ether. The asboline left after expelling the ether is a clear syrupy liquid of a more or less yellow colour; under 30 mm. pressure a portion of it distils at 154°—155° and a second portion at 158°—160°. The first portion has been identified as pyrocatechol whilst the second portion was found to boil at 251°—252° under a pressure of 750 mm., to crystallise in cooling and melt at 46°, to deliquesce and to dissolve readily in water, alcohol, acetic acid, and benzene, but to be almost insoluble in petroleum spirit. When crystallised from a mixture of the latter solvent and benzene, it melted at 51°. This substance proved to be homopyrocatechol, which has hitherto been regarded as a liquid; for the sake of confirmation, the authors prepared some homopyrocatechol by the action of gaseous hydriodic acid on pure cresol, and found the product contained both pyrocatechol and homopyrocatechol; and when the former was removed, that the latter was identical in character with the wood-soot product. Pyrocatechol and homopyrocatechol form precipitates with egg-albumen and with quinine, the latter, when crystallised from alcohol, melt respectively at 157° and 167°; homopyrocatechol also forms a precipitate with gelatin, which dissolves on warming, but re-forms on cooling. In the soot-extract sometimes pyrocatechol, sometimes homopyrocatechol predominates.

It is interesting to note that asboline, which has been and is still used as a remedy for tuberculosis, contains the two phenols, which, as methyllic ethers, form *creosote*, pyrocatechol corresponding to guaiacol and homoprocatechol to creosol.—D. A. L.

Adulteration of Sandal Wood Oil. E. Mesnard. Compt. Rend. **114**, 1546—1547.

When treated with pure sulphuric acid, pure sandal wood oil, yields a viscid liquid becoming pasty and changing rapidly to a solid mass which adheres strongly to glass; it is pale greyish blue or greyish in colour, and on keeping assumes a dusty appearance. When another oil (cedar, cubebs, copaiba, terebenthene,) is present in the sandal oil, the resinous mass produced by the action of sulphuric acid never solidifies completely, and has always a dark colour with a brilliant lustre. By measuring the adhesiveness of this mass for glass, an approximate idea is obtained of the proportion of foreign oil present in the sandal oil.—D. A. L.

The Cinchona Alkaloids. A. Claus. Annalen, **269**, 232—294.

Many years ago, the author in conjunction with Buchner (Ber. **11**, 1820), found that cinchonidine ethiodide was converted by potash into a tertiary base having the composition of ethylcinchonidine, and also that it was capable of uniting with a second molecule of ethyliodide. These two reactions hold good for the four chief alkaloids of cinchona bark, and the author has further investigated them in the hope of throwing light on the constitution of these alkaloids, and especially with reference to the functions of the nitrogen atoms.

The new tertiary bases obtained by the action of potash on the mono-alkyl iodides of the cinchona alkaloids, are quite distinct from the quaternary compounds obtained by the action of silver oxide. They might be regarded either as alkyl or as alkylene derivatives of the alkaloids, but from the analogy which has recently been shown to exist between the mono-alkyl-haloid compounds of the cinchona alkaloids, and those of isoquinoline and pyridine (J. Prakt. Chem. **38**, 491, and this Journal, 1890, 649), the author has decided in favour of the second view, and he draws the conclusion that in the cinchona alkaloids, the nitrogen atom to which the first alkyl-halogen molecule becomes attached,—and which he calls I nitrogen atom—corresponds in its functions with the nitrogen atom in isoquinoline and pyridine.

With regard to the II. nitrogen atom to which the second molecule of alkyl-halogen-becomes attached, the behaviour of the dialkyl cyanides shows that it corresponds in its functions with the nitrogen of quinoline.—A. K. M.

The Detection of Veratrine. E. Laves. Pharm. Zeit. 1892, 338.

See under XXIII., *page* 66.

The Valuation of Nitric Ether. C. O. Curtmann. Pharm. Rundschau, 1892, 156.

See under XXIII., *page* 69.

Examination of the Lloyd Method for the Assay of Alkaloids. H. T. Nichols and T. H. Norton. Journ. Anal. and Applied Chem. **6**, 162.

See under XXIII., *page* 68.

PATENTS.

Improved Manufacture of Vanillin. C. D. Abel, London. From C. F. Boehringer and Söhne, Waldorf, near Mannheim, Germany. Eng. Pat. 361, January 7, 1892.

In preparing vanillin from eugenol it has hitherto been necessary to first convert the eugenol into iso-eugenol, and then to protect the phenol group of the latter from oxidation by introducing an organic acid residue into the molecule, which latter can again be removed after the oxidation of the iso-eugenol derivative to vanillin. (This Journal, 1891, 854.)

The improvement in the process consists in first converting the eugenol into the benzyl ether by treatment with benzyl chloride in alcoholic solution and in presence of caustic alkali. The ether forms a colourless oil, which crystallises at low temperatures, and melts at 29°—30° C. By boiling the ether with alcoholic potash for 16—24 hours, it is converted into iso-eugenol benzyl ether which crystallises from alcohol in fine felted needles, melting at 58°—59° C. This product is then oxidised by means of a sulphuric acid solution of sodium chromate to vanillin benzyl ether which forms fine needles or transparent plates melting at 63°—64° C., and from which the vanillin is readily obtained by treating with fuming hydrochloric acid for 24 hours in the cold. The vanillin is then isolated by the usual method.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

An Improvement in the Manufacture of Sensitive Plates for Photographic Purposes. J. T. Sandell, London. Eng. Pat. 21,381, December 7, 1891.

The object of this invention is to diminish the liability to halation to which plates as now made, are subject. The plates are coated with two or more strata of sensitive emulsions of different degrees of sensibility, the underneath being the least and the uppermost the most sensitive. By these means, portions of the same subject which are in strong contrast, will be photographed upon strata of different degrees of sensitiveness, the effect produced on the haloid salt of the lower stratum compensating for the deficiency due to over-exposure of the corresponding portion of the upper stratum. The prevention of halation is due to the greater opacity and lesser sensibility of the lowest stratum.
—J. C. C.

An Improved Instrument for Calculating the Duration of Photographic Exposures. J. A. Scott, Dublin, and J. Howson, Ilford. Eng. Pat. 17,642, October 4, 1892.

This is an improved arrangement of slide rule, and is circular in form. It consists of three concentric rings, revolving around a central disc. The central plate is inscribed with the speed values of plates, the first ring with the date and hour, the second ring with the focal values of the diaphragm, the third ring with the class of subject, and the exposure is read from the outer rim of the base plate.
—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

Notes on the Analysis of Nitro-Explosives. P. G. Sanford. Journ. Anal. and Applied Chem. **6**, (1892) 311—318.

The author has found the following methods of analysis to give satisfactory results:—

Kieselguhr Dynamite.—The moisture is estimated by drying 10 grms. of the sample in a desiccator over calcium chloride. The dry substance is then extracted with ether, the residual kieselguhr collected on a weighed filter, dried at 100°, and weighed. An actual analysis gave:—Moisture 0·92, kieselguhr 26·15, and nitro-glycerin (by difference) 72·93 per cent.

Gelatin Compounds.—This class includes blasting-gelatin, which consists of a solution of nitro-cotton in nitro-glycerin, and gelatin dynamite and gelignite, which are simply blasting gelatins containing variable proportions of wood-pulp and potassium nitrate. The moisture is determined by drying 10 grms. of the sample in a desiccator over calcium chloride. The dry substance is then treated with 250 cc. of a mixture of 2 parts of ether and 1 of alcohol, and, after keeping over night, the insoluble matter, which consists of wood pulp, potassium nitrate, and other salts, is separated by filtration. In the case of blasting gelatin, this residue, which is very small, and consists usually of sodium carbonate, is dried at 40° and weighed; in the case of gelatin dynamite or gelignite, the residue is extracted with boiling water to free it from mineral salts, which are then examined and estimated in the usual way, and the residual wood-pulp dried at 40° and weighed. The alcoholic ethereal solution is mixed with excess of chloroform, the precipitated nitro-cellulose separated by filtration through linen, redissolved in alcoholic ether, and again precipitated with chloroform; the precipitate is then dried at 40° and weighed. The nitro-glycerin is best determined by difference, as, if estimated by evaporating the solution obtained in the manner described the results come out much too low. An actual analysis gave :—

	Per Cent.
Nitro-glycerin	66·691
Nitro-cellulose	3·819
Wood-pulp	16·260
KNO_3	12·890
Water	0·340

Gun Cotton and *Collodion Cotton.*—The moisture is estimated by drying at 100° and, in the case of wet cotton usually amounts to 20—30 per cent. For estimating the quantity of gun-cotton present in soluble cotton, or the quantity of soluble cotton present in gun-cotton, the dried sample (5 grms.) is exposed to the air for two hours, then carefully extracted with alcoholic ether at the ordinary temperature, the insoluble matter dried at 100°, left for two hours exposed to the air, and weighed; this residue consists of gun-cotton and unconverted cotton. The quantity of unconverted cotton is determined by boiling a fresh quantity (5 grms.) of the sample with a saturated solution of sodium sulphide, keeping for 48 hours, and then decanting or filtering; after treating the insoluble matter again in the same way, the residue, which consists of unconverted cotton, is dried and weighed; it is then ignited and the weight of the ash deducted. The alkalinity is determined by digesting about 5 grms. of the air-dried finely-divided sample with 20 cc. of $\frac{n}{4}$ hydrochloric acid diluted to about 250 cc. with water; after decanting and washing with water until free from acid, the solution and washings are titrated with sodium carbonate, using litmus as indicator.

The estimation of the nitrogen in a sample of gun-cotton or collodion cotton is perhaps of more value than the foregoing method of examination, and can be conveniently carried out with the aid of Lunge's nitrometer, about 0·6 grm. of the dried sample being used. Pure hexanitrocellulose, $C_{12}H_{14}O_4(NO_3)_6$, contains 14·14 per cent. of nitrogen, so that if the percentage falls much below this value the sample probably contains considerable quantities of the lower nitrates, and perhaps some unconverted cotton. An analysis of a good sample of collodion cotton, suitable for the manufacture of blasting gelatin, gave the following results :—

	Per Cent.		Per Cent.
Soluble cotton	99·111	=Nitrogen	11·67
Gun-cotton	0·642		
Non-nitrated cotton	0·240	Total ash	0·25

The nitrogen in nitro-glycerin can also be estimated with the nitrometer, for which purpose 0·1—0·2 grm. of the sample is sufficient.—F. S. K.

Determination of Lime and Magnesia in Gun-Cotton. H. Schjerning. Zeits. Anal. Chem. 31, 283—285.

The usual method of estimating the ash and alkalinity of gun-cotton is that of Abel, which consists in first impregnating small pieces of the wool with paraffin and then burning the pieces in a platinum crucible and weighing the residue to obtain the percentage of ash, and in titrating the gun-cotton with decinormal hydrochloric acid and caustic soda solutions to ascertain the alkalinity. When, in 1887, it became the custom to mix gun-cotton with magnesia instead of lime, or together with lime, thereby increasing the alkalinity of the cotton without increasing the weight of the ash, the author adopted the following method for determining these two substances in gun-cotton.

From 3 to 5 grms. of gun-cotton are weighed into a good sized platinum crucible. A mixture of equal parts of alcohol and ether is saturated with paraffin and filtered, and about one quarter its volume of water added to it. The gun-cotton is then moistened with this liquid, and a few pieces of solid paraffin are put in the crucible. The crucible is then placed in an inclined position upon a triangle, and the ether vapour is lighted. In this way the combustion is effected without any loss of ash. It is advisable to turn the crucible about so that the gun-cotton may become equally impregnated with the melted paraffin. The carbonaceous residue is then crushed with a flat-ended glass rod, and the carbon burnt off over a large burner or the blow-pipe. The residual ash is then weighed and calculated into percentage.

The ash, which consists of magnesium and calcium oxides and small quantities of ferric oxide, aluminium oxide and silica, is then moistened with water, rinsed into a porcelain dish, an excess of decinormal hydrochloric acid added and warmed to about 90° C. No hydrochloric acid is lost at this temperature. The greater part of the oxides of iron and alumina in consequence of the previous ignition of the ash is unacted on by the dilute acid, but a small portion goes into solution, and would vitiate the subsequent titration of the excess of decinormal acid with decinormal caustic solutions. To obviate this the solution is cooled and a small quantity of pure ammonium chloride is added, and then after addition of a few drops of litmus solution, the liquid is rendered distinctly alkaline with decinormal caustic soda solution. The silica and undissolved oxides of iron and aluminium and the precipitated hydrates of these metals are filtered, washed well with water, ignited, and weighed. The filtrate and washings are then titrated with decinormal hydrochloric acid to determine the excess of soda that has been added. From this the number of cubic centimetres of decinormal acid that were required to saturate the lime and magnesia in the ash is known.

The percentages of magnesia and lime in the gun-cotton may then be calculated from the two following formulæ:—

$$x = [A \times 0{\cdot}0028 - (B - C)] \times 2{\cdot}5$$
$$y = [(B - C) - A \times 0{\cdot}002] \times 3{\cdot}5$$

where x = the percentage of magnesia, y = the percentage of lime, A = the number of cubic centimetres of decinormal acid required by 100 grms. of the gun-cotton, B = the percentage of ash, and C = the percentage of silica and oxides of iron and alumina.

Analyses are given which compare well with gravimetric determinations of the magnesia and lime. The method may also be applicable to other substances than gun-cotton, when the magnesia and lime can be converted into the state of oxide by ignition.—H. S. P.

Contribution to our Knowledge of Gunpowder. E. Nickel. Chem. Zeit. 1892, 16, 907.

The chemical theory of gunpowder has found an elegant expression in Debus' equation (this Journal, 1891, 947).

$$x\,NO_3K + y\,C + z\,S = t\,K_2CO_3 + u\,K_2SO_4 + v\,K_2S_2 + w\,CO_2 + \frac{x}{2}N_2$$

from which s CO is omitted for practical purposes.

For the composition of gunpowder there exist three limits which are determined by (1) $t = o$; (2) $u = o$; (3) $v = o$. These limits are expressed in general terms by the equation $f(x, y, z) = o$. If x be considered a constant —say 16 according to Debus—the three limiting equations may be graphically expressed by three straight lines forming a triangle. This triangle represents graphically the theoretical limits within which the constituents of gunpowder may be allowed to vary, and every sort of gunpowder will be represented by a point within this triangle. As the constituents of gunpowders are usually given in per cents., the author calculates the limits given by Debus into per cents. and by choosing the per cents. of sulphur as axis of the abscissae and the per cents. of NO_3K as ordinate—the per cents. of carbon being determined by the difference from 100—he finds the triangle D, C, B, to represent the theoretical limits within which the percentage of sulphur and nitrate may vary. The three points D, C, B, satisfy the following conditions :—

D –	: 87 per cent. KNO_3	0 per cent. S.
C	: 67 „	21 „
B	: 82 „	13 „

Line D B is the geometrical locus for powders not yielding K_2S_2; D C for powders not giving any SO_4K_2, and B C the geometrical locus for powders not producing CO_3K_2. The three points D, C, B, satisfy respectively two of these conditions. These explanations hold good for gunpowders made of chemically pure carbon. For practical purposes—

assuming that the oxygen and the hydrogen of the carbon are separated as H_2O and do not influence the other chemical changes—the theoretical limits of a gunpowder will be represented by the triangle D′, B′, C′, in which—

D′	corresponds to	84	per cent. KNO_3 and	0	per cent. S.
B′	,,	65	,,	20	,,
C′	,,	81	,,	13	,,

The point E within this triangle would be the graphical representation of the old military powders.—J. L.

PATENT.

Improvements in the Manufacture of Gunpowder. C. H. Curtis, London, and G. G. André, Dorking, Surrey. Eng. Pat. 19,068, November 4, 1891.

Gun-cotton (trinitrocellulose), which generally contains about 12 per cent. of dinitrocellulose soluble in ether (mixed with a little alcohol), is mixed with 6—16 per cent. of dinitrocellulose and manufactured while wet into pellets; or the usual process for making gun-cotton is so modified as to produce a nitrated cellulose containing 18—28 parts of the dinitro- to 88 parts of the trinitro-compound, which is then made into pellets. The pellets are dried and treated with a solvent capable of dissolving only the dinitrocellulose, which is thus made to thoroughly impregnate the trinitrocellulose and to bind it together into hard unfriable granules when the solvent has evaporated. This hardening process differs from those previously suggested in that they only serve to harden the surface of the granule, and leave it friable. By varying the proportion of dinitrocellulose within the above-mentioned limits any requisite degree of explosiveness may be obtained, for the larger the proportion of dissolved cotton present the slower the rate of combustion. By dissolving nitroglycerin in the solvent used for the dinitrocellulose this explosive may be combined with the new gunpowder. Suitable proportions are 44 parts by weight of trinitrocellulose, 12 parts by weight of dinitrocellulose with or without 40 parts by weight of nitroglycerin.—A. G. B.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Composition of Glass Suitable for Chemical Apparatus. R. Weber and E. Sauer. Ber. **25**, 1814—1818.

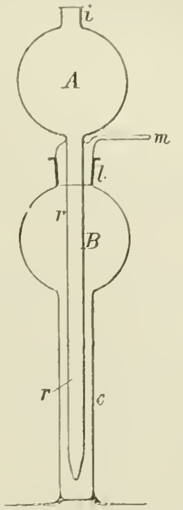
See under VIII., *page* 45.

Absorption Apparatus for Estimating Sulphur in Iron. L. Blum. Zeits. Anal. Chem. **31**, 290—292.

The apparatus consists of two parts, the bulb A with the long tube *r* attached, and the bulb B, affixed to the cylinder *c*. A and B have each a capacity of about 200 cc. The tube *r* is inserted into the cylinder *c*, and reaches nearly to the bottom, and fits into the neck *l* of the bulb B by a ground hollow stopper, to which is also attached the exit tube *m*. Ammoniacal peroxide of hydrogen or hydrochloric acid saturated with bromine is poured into the apparatus at the mouth *i* of the bulb A, and rising in the cylinder *c* forms a lute. The gases from the flask in which the iron to be tested is dissolved and led into the apparatus at *i*, and passing over the moistened surface of the bulb A and down *r* bubble up through the liquid in *c*, by which means the oxidation of the sulphuretted hydrogen is completely effected, and the residual gases freed from sulphur then pass away by the tube *m*. It is advisable to stand the apparatus in cold water to prevent overheating by the steam that distils over from the generation flask.

If bromine-saturated hydrochloric acid be used it is impracticable to precipitate the sulphur directly, because of the sticky, resinous bromine hydrocarbon compounds which stop up the pores of the filter so that before precipitating it is necessary to evaporate the liquid to dryness. The author finds, however, that this evaporation can be dispensed with by adding to the liquid before precipitation a small piece of ash-free filter paper (a quarter of a 9 cm. filter paper). On then boiling the solution and precipitating, the paper becomes disintegrated into fine fibres to which the sticky hydrocarbons become attached, while at the same time the precipitate of barium sulphate is caused to settle more rapidly. The operation of filtering is thereby much accelerated, and a clear filtrate is invariably obtained.

—H. S. P.



Lead in Glass-Wool. L. Blum. Zeits. Anal. Chem. **31**, 292.

The author calls attention to the fact that some glass-wools, as sold in commerce, contain lead, being made from glass containing lead. Acids should therefore not be filtered through such wool, as they will thereby become contaminated with lead. It was also found that sulphuretted hydrogen causes such wool to blacken owing to the formation of lead sulphide.—H. S. P.

INORGANIC CHEMISTRY.—QUALITATIVE.

On the Qualitative Separation and Detection of Strontium and Calcium by the Action of Amyl Alcohol on the Nitrates. P. E. Browning. Journ. Anal. and Applied Chem. 6 (1892), 343—345.

For the qualitative separation and detection of strontium and calcium, the author proceeds as follows:—The substance, not more than 0·2 grm., is heated to boiling with 5 cc. of amyl alcohol, and the filtrate and washings examined for calcium. The residue, if very small, may be simply a deposit of some calcium compound (see above), but if strontium nitrate is present, even in very small quantities, a decided residue is obtained; the residue is dried, ignited, treated with a drop of nitric acid, and again heated with amyl alcohol; if strontium is absent, the whole passes into solution, but if present, a distinct residue or deposit is obtained, even when the amount present is equivalent to 0·0005 grm. SrO.—F. S. K.

PATENTS.

Improvements in or connected with Thermometers. A. T. Rapkin and F. Cossor, London. Eng. Pat. 1172, January 21, 1892.

The inventors provide ordinary thermometers with a "vernier" or registering tube, sealed at both ends, and containing a suitable liquid; within this is placed a moveable index, composed of magnetic metal, which may be moved up or down by a magnet from the outside. When applied to a Six's thermometer, either a single or two "vernier" tubes are arranged between the limbs of the thermometer, each tube being provided with an index, or a single tube bent so as to form two limbs may be employed. —J. C. C.

Improvements in Spatulas. C. W. Fox, Saugus, Mass., U.S.A. Eng. Pat. 16,830, May 19, 1892.

The blade of this spatula is made of india-rubber, and is provided with a broad thin steel core, which gives the blade the necessary flexibility.—J. C. C.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Eudiometric Determination of Nitric Acid. Glaser. Zeits. Anal. Chem. **31**, 285—288.

The error in eudiometric estimations of nitric acid, caused by the oxidation of the nitric oxide to nitrous acid by oxygen contained in the liquid over which the gas is measured, the author finds can be entirely obviated by measuring the gas over a 1 per cent. aqueous solution of potassium iodide. Any nitrous acid that is formed is at once reduced to nitric oxide, accompanied by the separation of iodine. By adopting this plan it is possible to estimate the nitric acid, both in saltpetre and in water with great accuracy, but in the case of water analysis it is necessary to wash the gas with caustic soda solution to remove any carbonic acid.—H. S. P.

The Determination of Sulphur. T. P. Treadwell. Ber. 1892, **25**, 2377—2382.

The author has shown that the sulphur in insoluble sulphides can be determined by heating with iron powder in a current of carbon dioxide and decomposing the resulting sulphide by hydrochloric acid, the sulphuretted hydrogen evolved being determined either by absorption in ammoniacal hydrogen peroxide and subsequent precipitation as barium sulphate, or volumetrically by absorption in a titrated iodine solution, the excess of iodine being titrated back by sodium thiosulphate. The latter method is only applicable in absence of arsenic and antimony. (This Journal, 1891, 951.) Sulphates, when present with the sulphide, are also reduced under these conditions so that in the analysis of roofing slate containing sulphate of lime the total sulphur (both as sulphide and sulphate) is obtained. The sulphur contained as sulphide is, however, completely liberated as sulphuretted hydrogen without the sulphate being attacked, when the mineral is decomposed by granulated tin and hydrochloric acid. The decomposition is effected in a large test-tube 20 cm. long and 2·5 cm. broad, on the bottom of which a thin layer of finely granulated tin is first placed; the weighted substance wrapped in tin foil is then introduced, and on the top of this a layer of 6 cm. of the granulated tin is placed. The tube is fitted with a stopper provided with a stop-cock funnel and a bulb-exit tube, the latter leading to a Peligot's tube and then to the absorption bulbs containing ammoniacal hydrogen peroxide. A current of hydrogen is first passed through the apparatus for 3—5 minutes, the cock of the tap-funnel being open; the funnel is then charged with concentrated hydrochloric acid and the decomposition started by running in the acid until the layer of tin is about half covered. The contents of the tube are warmed and in 10—20 minutes the decomposition is complete. The heating is continued until the hydrogen peroxide solution in the first absorption vessel (two are generally used) is no longer yellow. More hydrochloric acid is then added so that the layer of tin is completely covered, and the heating continued for half an hour, a current of hydrogen being again passed through the apparatus after the contents of the Peligot's tube have been heated to boiling. The sulphur in the hydrogen peroxide solution is then determined as previously described. Analytical data confirm the accuracy of the method which is specially applicable to the determination of the sulphide in burnt pyrites and in roofing slate. Arsenic and antimony when present are liberated as hydrides, apparently quantitatively; the author is engaged in working out a method for the determination of these two metals based on this behaviour. A sketch of the apparatus employed is given. —C. A. K.

Estimation of Antimony: the Gooch Crucible. T. Paul. Zeits. f. Anal. Chem. 1892, 537—543.

The author precipitates the antimony as sulphide and heats the precipitate in an atmosphere of carbon dioxide to from 200°—230° C., according to Rose's method, whereby it is freed from much admixed free sulphur and entirely converted into Sb_2S_3. (*See* Rose's Handbook d. anal. Chem. 6 Aufl (Finkener's) Bd. II. 295.) The sulphide is filtered through a Gooch crucible of the ordinary pattern; a special air-bath for heating the crucible at 200°—230° in a current of carbon dioxide is figured in the original. It consists essentially of a glass tube fashioned in the form of an ordinary clay pipe with a constriction in the bowl; in this constricted portion the crucible rests. The stem of the pipe is passed through the side of a cylindrical air-bath, and carbon dioxide is conducted through it. The temperature of the bath is kept at 230° until the weight of the crucible is constant. The paper concludes with directions for using the Gooch crucible; these are only such as are generally followed.—A. G. B.

Estimation of Thallium by Titration. K. Sponholz. Zeits. f. Anal. Chem. 1892, 519—520.

The liquid must contain the thallium as a thallous salt, and must be acid. A $\frac{1}{6}$ normal or $\frac{1}{10}$ normal solution of bromine in water is run in from a burette, the end of which dips under the surface of the liquid. The termination of the reaction is indicated by the yellow colour imparted to the oxidised solution by the excess of bromine: this excess must be taken into account by subtracting from the number of cc. of bromine water used, the number of cc. necessary to similarly colour an equal volume of distilled water. Two atoms of bromine are equivalent to one atom of thallium. The strength of the bromine water is determined by potassium iodide and sodium thiosulphate, and this valuation must be made anew every time the burette is filled.—A. G. B.

Estimation of Phosphoric Acid in Basic Slag. A. F. Jolles. Zeits. f. Anal. Chem. 1892, 516—519.

Maercker's method of dissolving the slag in sulphuric acid gives low results because the calcium sulphate encloses particles of calcium phosphate which thus escape action. H. and E. Albert (Zeits. f. angew. Chem. 1891, 280) boil 5 grms. of the finely-powdered slag with 40 cc. of hydrochloric acid (16°—20° B.) until only a few cc. of a thick magma of silicic acid remains. Water is added, and the flask shaken until the lumps of silica are broken up, the volume is then made up to 500 cc. and filtered. To 50 cc. of the filtrate 15 cc. of Joulie's solution (400 grms. of citric acid made up to a litre with ammonia of sp. gr. 0·9) and magnesia mixture are added. H. and E. Albert claim that the silica is rendered sufficiently insoluble by this method, and evaporation to dryness is thus avoided. The author, however, has tested the process against the molybdate method, and has always obtained results which are too high, because the ammonium magnesium phosphate contains silica, the separation of which is not perfectly effected by the boiling down with hydrochloric acid. Titration of the dissolved magnesium precipitate with uranium acetate also gives too high results. The author recommends that the hydrochloric acid solution be evaporated to dryness and the residue heated to 120°, and that 50 cc. of citrate solution be employed; otherwise his process is similar to that of H. and E. Albert.—A. G. B.

A Method for the Determination of Barium in the Presence of Calcium and Magnesium. F. W. Mar. Journ. Anal. and Applied Chem. **6** (1892), 346—351.

Barium chloride is soluble to an extent not exceeding 1 part in 20,000 in pure concentrated hydrochloric acid, but the solubility increases very rapidly with the diminution in the strength of the acid; in concentrated hydrochloric acid containing ether its solubility is not more than 1 part in about 120,000. For the separation of barium from calcium and magnesium, the chlorides of the metals are dissolved in the least possible amount of boiling water, and precipitated with 25 cc. of concentrated hydrochloric acid, with the addition of 5 cc. of ether after cooling. The acid should be added drop by drop at first, allowing the precipitate formed to redissolve as long as possible, as in this way the precipitate is obtained in a coarse crystalline condition; after standing for a few minutes the precipitate is collected on a Gooch filter, washed with hydrochloric acid containing about 10 per cent. of ether, and dried at 150°—200°. The method is accurate and rapid.—F. S. K.

A Method for the Quantitative Separation of Strontium from Calcium by the Action of Amyl Alcohol on the Nitrates. P. E. Browning. Journ Anal. and Applied Chem. **6** (1892), 333—339.

The solubility of strontium nitrate in boiling amyl alcohol is extremely small, being equivalent to about 0·0010 grm. SrO in 25 cc. of the alcohol; calcium nitrate, on the other hand, dissolves freely in boiling amyl alcohol, although traces of some solid substance, possibly the calcium salt of some organic acid, separate on the sides and bottom of the vessel in which solution takes place. The separation of the two nitrates can, therefore, be effected with the aid of amyl alcohol; the mixed nitrates are heated with the solvent to the boiling point of the alcohol, the filtered extract evaporated, the residue treated with nitric acid, dried, and again extracted as before, the solution being filtered through the original filter. The combined residues, after correcting for the solubility of strontium nitrate, give the weight of the last-named salt; the solution contains the calcium nitrate which is estimated as sulphate. The average error in the determination of the strontium is less than 0·0001 grm. SrO; in the case of the calcium it varies from 0·005 to 0·0017 grm. CaO.—F. S. K.

A Method for the Quantitative Separation of Barium from Calcium by the Action of Amyl Alcohol on the Nitrates. P. E. Browning. Journ. Anal. and Applied Chem. **6** (1892), 339—342.

As barium nitrate is insoluble in boiling amyl alcohol, it can be readily separated from calcium nitrate in the manner already described in the case of strontium (see preceding abstract), one treatment, however, being sufficient; quantitative experiments gave very satisfactory results. —F. S. K.

Valuation of Tin Crystals and of Zinc Dust. A. Fränkel. Mittt. k.k. Techn. Gewerbe-Museums, 1892, 223—227.

Tin-Crystals.—The customary method of estimating tin in stannous chloride by means of a standard solution of iodine has the drawback that the iodine solution is unstable, and hence requires to be frequently restandardised. This is also the case with the potassium permanganate solution employed in the method of Löwenthal and Stromeyer (Ann. **117**, 261) in which the stannous salt is heated with an excess of ferric chloride and the ferrous chloride which is produced, determined, and also with the alkaline potassium manganate employed by Jolles (Chem. Zeit. **12**, 597). Potassium bichromate solution, which has been recommended by Goppelsröder and Trechsel (Zeit. f. Anal. Chem. **16**, 364) is free from this objection. The authors have, therefore, investigated the accuracy of the method, which consists in adding the stannous chloride to excess of an acidified solution of potassium bichromate, adding potassium iodide, and titrating with sodium thiosulphate. The length of time required for the completion of the reaction between chromic acid and potassium iodide was first ascertained. This was found to depend upon the state of dilution of the solution, as Zulkowski (Zeits. f. Anal. Chem. **8**, 74) has shown. With a decinormal solution of potassium bichromate (4·9167 grms. per litre) half an hour is required. The influences of the excess of chromic acid and hydrochloric acid used, were also studied, and the following method finally adopted: 3—4 grms. of the stannous salt are dissolved in 30—40 cc. of hydrochloric acid (10 per cent.) and diluted to 500 cc. 50 cc. of this solution are taken and treated in a stoppered flask with 50—60 cc. of decinormal potassium bichromate solution and allowed to stand for 15 minutes. Then 10—15 cc. of potassium iodide solution (1:10) and 5—10 cc. of hydrochloric acid (1 : 10) are added, and the whole allowed to stand for 30 minutes. The solution is then diluted to 200 cc., a small quantity of starch paste added, and the liberated iodine titrated with decinormal sodium thiosulphate. A series of determinations by this method gave percentages of $SnCl_2, 2\ H_2O$, ranging from 88·37 to 88·84, the iodine test giving a mean of 88·39. Streng's direct method of titration by potassium bichromate, with potassium iodide and starch as indicators, gave with the same sample 86·13 per cent.

Zinc Dust.—Drewsen's method of estimating zinc in zinc dust consists in adding to the latter an excess of potassium bichromate and sulphuric acid, and titrating with ferrous sulphate. The following modification of it is proposed: 0·5 grm. of zinc dust is placed in a dry flask, 50 cc. of seminormal potassium bichromate solution (24·58 grms. per litre), and 5 of dilute (1 : 5) sulphuric acid added, and the mixture shaken for 10 minutes. Then further 7—10 cc. of dilute sulphuric acid are added, and when the zinc is dissolved 40—45 cc. of potassium iodide solution (1 : 10) and 20 of dilute sulphuric acid. After standing for five minutes 200—300 cc. of water are added, and the iodine estimated by a seminormal solution of sodium thiosulphate, the starch-paste indicator being added near the close of the titration only. Satisfactory results are obtained. The amount of zinc present is calculated by multiplying the number of cc. of potassium bichromate reduced, by 0·016275. —E. B.

Discrimination of the Suitability of Glass Vessels for Chemical Use, and the Action of Water on Glass. F. Mylius and F. Foerster. Zeits. Anal. Chem. **31**, 241.

See under VIII., *page* 44.

Determination of Lime and Magnesia, more particularly in Gun-cotton. H. Schjerning. Zeits. Anal. Chem. **31**, 283—285.

See under XXII., *page* 62.

Examination of Iodine containing Chlorine. F. Ulzer and A. Friedreich. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 287—289.

A rapid and exact method of determining chlorine in commercial iodine consists in dissolving 10—20 grms. of the sample in 100 cc. of carbon disulphide in a small separating funnel. 5—10 cc. of water is added and the cylinder agitated until the aqueous layer, which contains the iodine chloride, is saturated with iodine, standard potassium iodide solution is then run in with constant shaking. So long as iodine chloride is present, a turbidity is produced in the aqueous layer on the addition of potassium iodide, owing to the liberation of iodine; the termination is reached when no further cloudiness is obtained. Trial estimations gave very good results.—W. J. P.

ORGANIC CHEMISTRY.—QUALITATIVE.

A Reaction of Aldehydes and Ketones with Aromatic Nitro-Compounds. B. v. Bittó. Annalen, 269, 377—282.

Certain aromatic nitro-compounds yield a red coloration with aldehydes and ketones on the addition of alkali. The following table gives in the second column the coloration obtained with metadinitrobenzene and alkali, and in the third column the change produced on adding organic acids or metaphosphoric acid :—

Acetic aldehyde	Violet Red.	Yellowish Red.
Propionic aldehyde	Brownish Red.	"
β-Chloropropionic aldehyde .	Cherry Red.	Violet Red.
Valeric aldehyde............	"	Yellowish Red.
Acroleïn	Violet Red.	"
Crotonic aldehyde	Red.	Unchanged.
Methylethylacroleïn	Violet Red.	"
Tiglic aldehyde	"	"
β-Sulphobutyric aldehyde...	Red.	"
Sulphocapronic aldehyde....	Violet Red.	"
Aldehyde of oil of lemon	Brownish Red.	Yellowish Red.
p-Cuminic aldehyde.........	Intense Red.	Colourless.
Cinnamic aldehyde	Brownish Red.	"
Anisaldehyde	Cherry Red.	"
Acetone......................	Intense Violet Red.	Cherry Red.
Chloracetone................	Cherry Red.	Colourless.
Diethylketone	Violet Red.	Cherry Red.
Methylpropylketone	"	"
Methylhexylketone	"	"
Methylnonylketone.........	Cherry Red.	Pink.
Acetophenone	Violet Red.	Cherry Red.
Monobromacetophenone	"	"
Benzylideneacetone.........	Cherry Red.	Yellowish Red.
Pyruvic acid	"	Colour diminished.
Acetoacetic acid	"	"
Levulinic acid	Violet Red.	Unchanged.
Benzoylacetic acid	Brownish Red.	Violet Red.

The following substances do not give the reaction : — formaldehyde, chloral, butylchloral, glyoxal, benzaldehyde, *o*-hydroxybenzaldehyde, vanillin, *p*-homosalicylic aldehyde, benzophenone, naphthyl-phenylketone and benzil.

α- and β-dinitronaphthalenes give an intense red colouration with aldehydes and ketones of the fatty series. Trinitroresorcinol gives no reaction. Picric acid gives an orange yellow coloration with aldehydes and ketones. Creatinin gives an orange yellow coloration with picric acid, but no reaction with the other nitro-compounds. Iridole gives no reaction with the above-mentioned nitro-compounds.—A. K. M.

Examination of Ethereal Oils. Jahresbericht von Schimmel and Co., Leipzig, April 1892.

According to investigations carried on in the laboratory of the above-mentioned firm, pure oil of lavender contains only a small quantity of constituents boiling at a low temperature. Cineol, which is found in considerable quantity in spike oil (the oil from *Lavandula spica*), was not found in lavender oil, nor was camphor found to be present, although according to older authorities it is said to be an important constituent of lavender oil. The chief components of lavender oil are an alcohol having the formula $C_{10}H_{18}O$, and the acetic ester (ether) of this alcohol. The alcohol boils at 197°—199°, has a specific gravity of 0·869 at 20°, and rotates the plane of polarised light in a tube 100 mm. long, − 10° 35′. Its refractive index for sodium light is 1·64. When heated with hydrogen-potassium sulphate, with sulphuric acid, or similar water-abstracting reagents, it yields a mixture of hydrocarbons, among which were recognised dipentene and terpinene. On oxidation, the alcohol formed an aldehyde, $C_{10}S_{16}O$, identical with citral (Semmler's geranium aldehyde). The alcohol of lavender oil forms an additional compound with four atoms of bromine. With hydrochloric acid it gives a liquid compound having the composition $C_{16}H_{18}Cl_2$. The action of the acid anhydrides upon it produces the corresponding ester. The acetic, propionic, butyric, valeric, and benzoic esters were prepared. The acetic ester, which occurs naturally in lavender oil, possesses in a high degree the characteristic smell of bergamot. Bergamot oil contains about 40 per cent. of this ester.

The alcohol of lavender oil is identical with linalool, which was found by Semmler in Linaloë oil, and it is the source of the perfume of this oil. Schimmel and Co. place pure linalool in the market. It is an almost colourless liquid, easily soluble in alcohol, and with a peculiarly fine odour. Its specific gravity is 0·878 at 15°, its boiling point 197—198°, and its optical rotating power + 2°. Besides linalool, geraniol is also found in Linaloë oil. (See also this Journal, 1891, 157, 269, 362, and 1892, 706.)

Schimmel and Co. find Thom's method for testing oil of cloves accurate to about 1 per cent., but they do not find Panjatow's method for detecting geranium oil in oil of roses practicable, owing to the fact that when pure rose oil has been exposed to the air and to light, an aldehyde is formed in it which gives the same characteristic colour reaction as citral the aldehyde of geranium oil does with the reagent used, viz., a solution of magenta decolorised by sulphurous acid.—H. S. P.

Distinguishing Gum Arabic from Gum Senegal. L. Liebermann. Pharm. Post through the Deutsch-Amerik. Apotheker Zeit. 11, 71.

The woody particles insoluble in water are usually of a red colour in gum arabic, and of a black colour in gum senegal. Apart from these woody particles, both gums are perfectly soluble, which is not the case with some other kinds of gum, *e.g.*, cherry gum (Kirschgummi). An aqueous solution of gum arabic gives a blue precipitate with caustic potash solution and a few drops of cupreous sulphate, which collects together and rises to the surface, whilst gum senegal gives a blacker coloured precipitate, which is equally diffused through the liquid in small flocculent particles. On heating, these precipitates are only very slightly soluble, and there is no reduction of copper on boiling. These two points distinguish these gums from dextrin.

Gum arabic and dextrin, when heated for some time with caustic soda solution, yield amber-yellow liquids, but gum senegal gives scarcely any colour, or only a faint yellow colour. If it be desired to distinguish the gums in presence of dextrin, the solution is precipitated with caustic potash and cupreous sulphate, heated to dissolve the dextrin compound, filtered, the precipitate washed with distilled water, and then dissolved in hydrochloric acid. The gums are then precipitated with a large excess of alcohol and the precipitate allowed to settle for from 12 to 24 hours, when the liquid is poured away, and the precipitate washed with alcohol. The alcohol retained by the gums is then allowed to evaporate, and the gums are dissolved in water and tested as above described.—H. S. P.

The Detection of Veratrine. E. Laves. Pharm Zeit. 1892, 338.

Three to four drops of a 1 per cent. aqueous solution of furfuraldehyde mixed with 1 cc. of sulphuric acid (conc.) form the reagent, 3 to 5 drops of which are used for the test, which is made in a small porcelain dish. In presence of veratrine, dark green and blue striae are formed as the reagent mixes with the substance to be tested, and on agitating, the whole turns to a dark green colour, which becomes violet on prolonged standing—more rapidly on gentle warming. The violet coloration is fairly permanent. —C. A. K.

Baudouin's Reaction for Sesame Oil. V. Villavecchia and G. Fabris. Zeits. Ang. Chem. 1892, 509—510.

Many varieties of olive oil obtained from the provinces of Bari, Brindisi, Lecce, and other places, and of undoubted purity, give a red coloration in Baudouin's reaction which has hitherto been regarded as characteristic only of sesame oil. The reaction is generally carried out as follows:—0·1 grm. of sugar are dissolved in 10 cc. of hydrochloric acid of sp. gr. 1·18 in a test tube, 20 cc. of the oil to be tested added, the whole thoroughly shaken, and then allowed to stand. After a short time the lower aqueous solution is coloured more or less carmine red, in presence of sesame oil, 5 per cent. of which can thus be readily detected. Under these same conditions the olive oils referred to above produce the same red coloration. In the opinion of the authors the coloration in both cases is due to the existence or the formation of levulose in the hydrochloric acid solution of the sugar; this point is still under investigation. Meanwhile, the following modification of the reaction serves to distinguish the above olive oils from sesame oil. The test is carried out as described, the shaking after the addition of the oil being continued for one minute. The aqueous solution separates immediately in the case of pure olive oil, and remains colourless for at least two minutes. The somewhat milky oily layer remains of a greenish or yellowish colour, but in the presence of the least quantity of sesame oil it turns red, and it is this colouring of the oil, rather than that of the aqueous solution, that is taken as the indication of the presence of sesame oil, as experiment showed that the coloration in the case of olive oil takes place by preference in the aqueous solution.—C. A. K.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Analysis of Lard. C. Amthor and J. Zink. Zeits. f. Anal. Chem. 1892, 534—537. (This Journal, 1891, 801.)

The lard was rendered by the authors themselves from different individuals, and at different seasons. The mean values of the results obtained are given in the following table:—

		I.		II.		III.	
		Fresh.	Old.	Fresh.	Old.	Fresh.	Old.
Melting point....	Fat	48·1	47·7	47·8	..	47·6	..
	Fatty acids	44·0	46·2	..	..	44·5	..
Solidifying point	Fat	29·1	29·2	27·5	..	27·6	..
	Fatty acids	38·4	40·9	..	..	38·0	..
Iodine absorption	Fat	50·15	49·5	52·6	51·84	50·73	..
	Fatty acids	51·61	..	52·27	49·9	..	..
Acetyl value		5·52	..	..	..	..	..
Saponification equivalent		194·9	..	..	..	..	..
Mgrms. KOH required to neutralise 1 grm. fat (*sic*).		0·0012	0·0015	..	..	0·0009	..
Hehner's number		95·4	..	..	..	..	..

The iodine absorption of the fatty acids decreases considerably with their age and with their exposure. Thus the mean iodine absorption of fatty acids which had been kept in closed vessels for 42 days was 46·1, and of those which had been kept in open vessels 44·34, the same value for the fresh acids was 51·61.

With regard to the controversy as to the conditions under which the iodine absorption of fats should be determined (compare this Journal, 1891, 954; 1892, 183; Chem. Zeit. 1892, 651), the authors find that in several analyses of the same sample of lard the mean values obtained are practically the same, whether the iodine solution be old, new, or made at the moment, after Fahrion's recommendation (this Journal, 1892, 183), but the values vary least among themselves when the iodine solution is some 45 days old. In the case of lard, at all events, there is no necessity for a large excess of iodine; equal values were obtained when the excess varied from 21·2 to 84 per cent.—A. G. B.

The Determination of Indigotine in Indigo. F. Ulzer. Mitt. k.k. Techn. Gewerbe-Museums, 1892, 215—217.

Further experience of the rapid method of indigo-testing devised by the author (this Journal, 1892, 63), has shown that the results accord with those obtained by other methods only with samples of high quality, being in other cases too low. This has been discovered to be due to the reducing action, in the presence of alkali, of the impurities contained in the indigo on the indigotin, and is obviated by the employment of hydrogen dioxide along with the alkali used. The improved process is as follows:—About 1 grm. of the finely-powdered sample is mixed with 50 cc. of a 5 per cent. aqueous solution of hydrogen dioxide and boiled for 10 minutes. The mixture is cooled, diluted to twice its volume, filtered through a weighed paper of 10—12 cc. diameter, and the residue washed successively with warm water, dilute hydrochloric acid, water, and boiling alcohol, which is passed through it until the filtrate is no longer brown or red but pure blue, the filter being thereupon dried and weighed. The dried mass is then burnt, and the weight of ash found deducted from the previous weighing, the difference representing the indigotin. To determine the indigo-red (indirubin) the alcoholic solution is evaporated and the residue weighed. The following results were obtained by this method:—

	Indigotine.			Indirubin.	
	I.	II.	III.	I.	II.
	Per Cent.				
Indigotine (prepared by Fritzsche's method).	99·64	..	..	..	..
Bengal indigo (medium quality)	70·10	70·01	69·45	2·29	..
Benares indigo (native manufacture).	69·01	68·11	..	2·67	2·23
Indigo (manufactured by ammonia process).	44·71	45·29	..	1·49	1·73

—E. B.

The Behaviour of Sugar Solutions with Acetone. W. H. Krug and K. P. McElroy. Journ. Anal. and Applied Chem. **6**, 1892, 153—154.

When small quantities of sugar are successively added to a mixture of acetone and water, containing more than 10 per cent. of the former, a point is reached whereupon the next addition of sugar produces a turbidity, owing to the separation of acetone, which collects at the surface of the solution; when sufficient sugar is added to saturate the water a small quantity of acetone still remains in solution. Determinations of the quantity of acetone soluble at different temperatures in sugar solutions of various strengths, were made, by gradually adding acetone to a known quantity of the sugar solution until a turbidity was produced, and then estimating the increase in weight; the results are given in tables and are expressed in the form of curves. As examples of the results the following extreme observations may be quoted:—A 40 per cent. sugar solution dissolves 96·44 per cent. of acetone at 20°; 92·76 per cent. at 25°; and 89·84 per cent. at 30°; a 70 per cent. solution dissolves 13·22 per cent. of acetone at 20°; 12·82 per cent. at 25°; and 12·53 per cent. at 30°.—F. S. K.

Examination of the Lloyd Method for the Assay of Alkaloids. H. T. Nichols and T. H. Norton. Journ. Anal. and Applied Chemistry, **6** (1892), 162—178.

The method proposed by Lloyd for the assay of alkaloids is, briefly, the following:—The alkaloidal solution or extract (5 cc.) is treated in a mortar with a mixture of equal parts of ferric hydrate and sodium bicarbonate, in sufficient quantity to form a stiff paste; this magma is then triturated with 20 cc. of chloroform, a little water or a solution of glucose being added if it becomes pulverulent. The clear chloroform solution is decanted into a dish, the magma washed three times by trituration with 10 cc. of chloroform, and the combined chloroform extracts evaporated to dryness; the residue is digested on the water-bath with 2 per cent. sulphuric acid, the solution filtered, and the residue washed with fresh quantities of the dilute acid. The filtered acid solution is then rendered slightly alkaline by ammonia and rotated in a separating funnel for about two minutes with 10 cc. of chloroform, the operation being repeated four times; the combined chloroform solutions were then evaporated to dryness and the residue weighed.

The chief advantage claimed for the above process is the total avoidance of any emulsion in the chloroform extract from the original magma.

The authors, having submitted Lloyd's process to a searching investigation, give the following summary of their conclusions:—

1. The manipulation involved in the method is exceedingly simple, and fairly uniform results should be obtained by one familiar with elementary quantitative work.

2. Absolutely pure chloroform must be used. Ferric, chromium, or aluminium hydrate may be used in the production of a magma.

3. Ammonium sulphate is insoluble in chloroform.

4. The completeness of the extraction of the alkaloids from the ferric magma by means of chloroform is all that the most rigid analyst can demand.

5. The extraction of alkaloids from an alkaline solution in presence of ammonium sulphate by means of chloroform is complete after three treatments, and very nearly so after two in the cases of brucine, strychnine, atropine, aconitine, quinine, cinchonine, and cinchonidine, while an additional treatment is necessary in the case of caffeïne.

6. The quantity of alkaloid recovered in the manner first mentioned is somewhat variable; in the cases of brucine, aconitine, and quinine an increase in weight occurs (see 7); in all other instances there is a loss, varying from 2·4 per cent. in the case of atropine to 11·2 per cent. in that of brucine.

7. Simple solution of certain alkaloids in chloroform, and subsequent evaporation on the water-bath brings about an increase in weight; namely, of about 9 per cent. in the case of brucine, of about 5·5 per cent. in that of aconitine, and of about 0·6 and 1·2 per cent. in the cases of atropine and quinine respectively; caffeïne, cinchonine, and cinchonidine are apparently unaltered, whereas strychnine shows great variation, with a tendency to loss.

8. Quantitative experiments showed that Lloyd's process gave more reliable results than any other rapid method.

—F. S. K.

Application of the Pearson Method of Determining Sulphur to the Analysis of Horn. T. H. Norton and I. J. Smith. Journ. Anal. and Applied Chem. **6**, (1892), 179—180.

Determinations of the sulphur in samples of horn were made by Pearson's method, namely, by oxidising with nitric acid and potassium chlorate, and also by the method of Rivot and of Beudant and Daguin. Both methods gave satisfactory results, but Pearson's was found to be preferable as it is more rapid and convenient.—F. S. K.

Contributions to Hübl's Iodine Absorption Method. W. Fahrion. Chem. Zeit. 1892, **16**, 862.

The author maintains, as against Benedikt, that in using Hübl's method an excess of 30 per cent. iodine is not always sufficient; he modifies, however, his former statement that an excess of 300 per cent. is necessary by admitting that 100 per cent. will suffice. He further maintains the advisability of keeping the iodine and mercury bichloride solutions separate.—J. L.

A New Method for the Determination of Soda in Soap, together with a Few Notes on Methods Generally Employed. W. H. Low. Journ. Anal. and Applied Chem. **6**, 1892, 423—431.

The author reviews the ordinary method of soap-analysis, and then proposes some improvements to ensure greater accuracy and economy of time. Ordinarily the soap to be tested is dissolved in alcohol and filtered. The filtrate is neutralised and the alkalinity or acidity calculated as sodium hydroxide or fatty acid. As sodium carbonate is slightly soluble in ordinary alcohol and gives an alkaline reaction with phenolphthaleïn (the indicator generally used), and as further the combining-weight of the free fatty acid is not generally known, the above estimation is not accurate. The alcoholic solution is evaporated to dryness, the residue dissolved in water, and then decomposed with standard acid. The fatty acids are separated by shaking with ether and weighed after evaporation of the ether. The excess of standard acid in the acid solution is estimated by titration with alkali in presence of methyl orange as indicator.

The author removes the errors resulting from the above method by procedure, as follows:—The alcoholic soap-solution to be tested is heated to boiling, and an excess of standard acid added. Boiling is continued till all carbonic acid is expelled, when the solution is titrated with alkali in presence of phenolphthaleïn. The difference in the two titrations is a measure of the *sodium carbonate* present.

The soda in the soap is now estimated by titration with hydrochloric acid and blue lacmoïd as indicator. (Whilst blue lacmoïd solution and methyl orange are reliable indicators in aqueous solution, methyl orange is useless in alcoholic solutions.) If the combining weight of the *fatty acids* is not known, they may now be estimated by neutralising the fatty acids in the alcoholic solution. After evaporating to dryness and dissolving the residue in water, a slight excess of acid is added. Heat is then applied. When the fatty acids have become clear they are cooled with constant agitation, so that on solidification they are obtained in pieces of the size of a pin-head. They are filtered, washed, dissolved in hot alcohol, and neutralised with alcoholic soda. The neutral soap thus obtained is free from glycerin; its weight after drying and deducting the amount of soda found as above, represents the fatty anhydrides. By this method the fatty acids do not undergo any change by being heated or unnecessarily exposed to the air, nor can they lose weight by becoming anhydrides.

The soluble fatty acids in the original soap are determined by shaking the filtrate from the insoluble acids with ether, adding alcohol, neutralising with alcoholic soda, evaporating to dryness, and weighing.

The results of a number of experiments are given to prove the accuracy of this method.—K. E. M.

The Valuation of Nitric Ether. C. O. Curtmann. Pharm. Rundschau. 1892, 156 and 180.

The author regards the valuation of nitrous ether by the nitrometer as easier and more exact than by the volumetric method, and refers to the nitrometric methods proposed by Eykmann and Allen respectively (this Journal, 1885, 179). In the former, the decomposition is effected by ferrous sulphate and sulphuric acid, in the latter by potassium iodide and sulphuric acid, a Lunge's nitrometer being employed to measure the evolved nitrogen in both cases. Amyl nitrite can be similarly tested.—C. A. K.

Determination of Formic Acid in Presence of Acetic Acid and Butyric Acid. A. Scala. Gazetta. Chim. Italiana, 1890, 393, through Journ. of Anal. and Applied Chem. **5**, 233.

The method depends upon the reduction of mercuric chloride to mercurous chloride by formic acid, whilst acetic acid and butyric acid have no reducing action upon mercuric chloride. A weighed quantity of the liquid to be tested is placed in a beaker, an excess of a concentrated solution of mercuric chloride added, and the mixture heated for two hours on the water-bath, the beaker being covered with a glass cover. The precipitated mercurous chloride is filtered on a weighed paper, washed with water at a temperature of 60° C., dried at 100° C., and weighed. The method is very exact, as the weight of the mercurous chloride is more than ten times as great as that of the formic acid that has effected the reduction. If formic, acetic, or butyric acids exist in the liquid in the free state, they are first neutralised by an alkali.—H. S. P.

The Estimation of Pentosans and Pentoses in Vegetable Substances by Distillation with Hydrochloric Acid and the Gravimetric Determination of the Resulting Furfuraldehyde. E. R. Flint and B. Tollens. Ber. 1892, **25**, 2912–2917.

The authors have experimented with Günther and Tollens' volumetric method and they find that its accuracy is impaired through the presence of other substances besides furfuraldehyde in the distillate, which interfere with the titration. The gravimetric method is to be preferred, though the results obtained by it are not absolutely correct and are influenced to a certain extent by the presence of starch, but not appreciably by cellulose.

The method is essentially that previously described by De Chalmot and Tollens (this Journal, 1891, **10**, 577). To the distillate obtained as previously described, salt is added in such quantity that after the solution has been neutralised with sodium carbonate, it shall contain 81·5 grms. of sodium chloride. Acetic acid and then phenylhydrazine acetate are added, the solution is diluted to 500 cc. agitated for half an hour, and the hydrazone collected in a tube plugged with glass wool. The following formulæ are given for calculating the arabinose, xylose, pentose or furfuraldehyde from the hydrazone found :—

I. Arabinose = Hydrazone × 1·229 + 0·0177

II. Xylose = Hydrazone × 1·031 − 0·001

III. Pentose = Hydrazone × 1·13 + 0·0083

This equation is the mean of I. and II. and can be used in cases where it is not known which pentose is present.

IV. Furfuraldehyde = Hydrazone × 0·516 + 0·0252

In order to calculate the pentosan the percentage calculated as pentose must be multiplied by 0·88.

The following table gives the results obtained :—

—	Furfuraldehyde.	Xylose.	Arabinose.	Pentose.	Pentosan.
Pine wood	4·87	9·32	..	..	8·20
Beech „	18·29	35·08	..	..	30·87
Wheat straw.......	12·99	24·89	..	..	21·90
Maize cobs.........	18·36	35·16	..	..	30·94
Sulphite-cellulose..	2·89	..	..	6·25	5·50
Soda-cellulose	2·90	..	..	6·35	5·59
Cherry gum........	25·41	..	59·05	..	51·96
Gum tragacanth ...	16·17	..	37·28	..	32·81
Agar-Agar	0·88	..	..	2·02	1·78
Wood-gum No. 1...	38·78	74·27	..	..	65·36
„ „ 2...	16·90	89·83	..	..	79·05
„ „ 3...	48·08	92·07	..	..	81·02
„ „ 4... (obtained with lime.)	33·30	63·73	..	..	56·08

—A. K. M.

Notes on the Analysis of Nitro-Explosives. P. G. Ganford. Journ. Anal. and Applied Chem. **6**, 311.

See under XXII., *page* 61.

ANALYTICAL AND SCIENTIFIC NOTES.

Occurrence of Coniferin. E. O. von Lippmann. Ber. 1892, **25**, 3220—3221.

The author showed several years ago (Ber. **18**, 3335) that coniferin was present in asparagus, and he has now obtained it in the same manner from black root (*Scorzonera hispanica L.*) in which vanillin is also present.—A. K. M.

An Acid in Beet-Leaves. E. O. von Lippmann. Ber. 1892, **25**, 3220.

Some years ago the author showed that the yellow autumnal leaves of the beet contained in addition to pyrocatechol a readily soluble crystalline organic acid, the composition of which agreed with the formula $C_9H_{10}O_4$ (this Journal, 1888, 128). This was previously noticed by Reinke (Ber. **15**, 1203) and is probably identical with Hlasiwetz's hydrocaffeic acid.—A. K. M.

Levulan. E. O. von Lippmann. Ber. 1892, **25**, 3216.

In his description of levulan several years ago (Ber. **14**, 1509) the author stated that this substance yielded mucic acid when it is oxidised by means of nitric acid. He now finds that this is not the case but that other organic acids, especially oxalic acid, are produced, and that not a trace of mucic acid is formed.—A. K. M.

New Books.

Chemisch - technisches Repertorium. Uebersichtlich geordnete Mittheilungen der Neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1891. Zweites Halbjahr; Zweite Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder. Schönebergerstrasse 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

This number of Jacobsen's Journal, which is the closing one for 1891, treats of the following subjects of Chemical Technology:—Food-stuffs, Paper, Photography, Waste Materials, Manures, Disinfection and Public Health. Soaps, Matches, and Explosives. Preparation and Purification of Chemicals. Chemical Analysis. Apparatus, Machinery Electro Technology, Thermo Technology. Appendix. New Books.

Also the opening number for 1892, Erstes Halbjahr, Erste Hälfte, which treats of the following subjects:—Building Materials, Cements and Artificial Stone. Colours, Dyeing and Printing. Fats, Oils, Illuminating and Heating Materials. Fermented Liquors. Tanning, Leather, and Glue. Textiles. Glass and Earthenware. Wood and Horn. Caoutchouc. Cements, Adhesives, &c. Lakes, Varnishes, and Paints. Metals.

These numbers of the Repertorium are well illustrated, and the one concluding the year 1891 contains Alphabetical Indexes of Authors and Subject-matter.

Handwörterbuch der Pharmacie. Herausgegeben von A. Brestowski. Wien und Leipsig: Wilhelm Braumüller. K. U. K. Hof und Universitäts Buchhändler. 1892. London: H. Grevel and Co., 33, King Street, Covent Garden.

This work is complete in two volumes, consisting of some 24 parts, costing M. 2·40 each. Parts 5 and 6 have just appeared. Part 5 commences with "*Burtscheid*" on page 321, and closes with "*Chemotropismus*," page 400. Part 6 commences with the word "*Chenocholalsaüre*" and ends with "*Comprimirte Arzneimittel*."

Quantitative chemische Analyse durch Elektrolyse. Nach eigenen Methoden, von Dr. Alexander Classen. Professor der Chemie an der königl. tech. Hochschule zu Aachen und Vorstand des anorganischen Laboratoriums. Dritte vermehrte und verbesserte Auflage. Berlin: Verlag von Julius Springer. 1892. London: H. Grevel, & Co., 33 King Street, Covent Garden. Price 6*s*.

This is the third edition, improved and enlarged, of the above-named most important work, Classen's Quantitative Electro-chemical Analysis. It has been translated into French by Professor Blas, and into English by Professor Herrick. Professor Classen states that so largely is Electro-chemical analysis now adopted in the laboratories of the chemical factories, that in certain of those factory laboratories as many as 3,000 analyses per annum are carried out by its aid, the principal advantages claimed for it being exactitude combined with rapidity. The book is of 8vo. size and contains, besides the prefaces, the table of contents and 212 pages of subject-matter, embellished with 43 excellent wood engravings and a lithographed table. The introduction pages 7 to 55, is devoted to a description of batteries and other generators of electricity, accumulators; Measuring the current strength; carrying out the analyses, &c., &c., Part I. Estimation of the Metals by weight. Separation of the metals. Part II. Alloys, Ores, Pig iron, Steel, Spiegel and Ferro-manganese. Part III. Tables for calculating the analysis. The Reagents Analytical Checks and Experimental data. These latter will be of great service as a guide both in the college and works laboratories.

An Introduction to the Chemistry of Farming, specially prepared for Practical Farmers, with Records of Field Experiments. By the Rt. Hon. Sir Thomas Dyke Acland, Bart. Second Edition. London: Simpkin, Marshal, Hamilton, Kent, & Co., Lim. 1892. Price 2*s*. 6*d*.

Small 8vo. volume, bound in cloth, and containing dedication by the author to his friends and teachers, Philip Pusey and Augustus Voelcker; Preface, Table of Contents Introductory Chapter, and Subject Matter, filling 211 pages An Alphabetical Index concludes the little Book.

The object of this work is to furnish in a concise manner such an amount of information, scientific (mainly chemical) and statistical, for the dweller in agricultural districts, that he need not err as to the cardinal facts of agricultural chemical science, whilst he may receive an amount of enlightenment that will be of decided practical benefit to him. The beginnings of both Inorganic and Organic Chemistry are foreshadowed, with illustrations as far as possible, taken from Chemical Phenomena observed in Agricultural Work. The author also, apparently fearful that the beginnings of scientific study may imperil what of religious belief there may already exist in the British farmer, seeks finally to fortify him by an Appendix largely consisting of extracts from the writings of the late venerable Prof. Asa Gray, more especially on Evolution and Christianity. Thus, the text is subdivided as follows:—Part I., Chap. I. The Produce of the Farm. II. Water, Air, Warmth. III. Chemical Constituents. IV. Chemical Principles and Symbols. Part II., Chap. V. Organic Chemistry. VI. Chemical Formulæ. VII. Carbohydrates and Fats. VIII. Albuminoids and Amides. IX. The Soil. Part III., Chap. X. Action of Manures. XI. Food for Grazing and Dairy. Part IV., Chap. XII. Practice with Science. XIII. Suggestions for Field Experiments on Ordinary Farms. XIV. Record of Experiments 1885—1890. Appendix I. Extracts from Asa Gray on Botany. Appendix II. Extracts from Asa Gray on Science and Religion.

Untersuchungen aus der Praxis der Gährungsindustrie. Beiträge zur Lebensgeschichte der Mikroorganismen. Von Prof. Dr. Emil Chr. Hansen. II. Heft. München und Leipzig. Verlag von R. Oldenbourg. London: 33, King Street, Covent Garden. 1892.

Large 8vo. volume, in paper cover, containing Preface to Part II., Table of Contents, and text filling nearly 128 pages. The matters treated of in the several sub-divisions of the work are as follows:—I. Technical Analysis with reference to the Fermentation Industries, as applied to the determination of the Micro-Organisms in Air and Water. II. What is Pasteur's Pure Yeast? III. Investigations of Diseases in Beer which are brought about by Alcoholic Fermentation Organisms. IV. The present Extension of the Author's System of Pure Yeast Culture.

Chemisch-technische Untersuchungsmethoden der Gross-Industrie, der Versuchsstationen und Handelslaboratorium. Unter Mitwirkung von C. Balling, M. Barth, Th. Beckert, R. Benedikt, C. Bischof, E. Büchner, C. Councier, C. v. Eckenbrecher, A. Ehrenberg, A. Frank, O. Guttmann, W. Herzberg, J. Jeserich, C. Kretzschmar, O. Mertens, A. Morgen, R. Nietzki, A. Pfeiffer, B. Philips, E. Ritsert, E. Scheele, H. Seger, F. Simand, K. Stammer, A. Stutzer, R. Weber, A. Ziegler. Herausgegeben von Dr. Friedrich Böckmann. Dritte vermehrte und umgearbeitete Auflage. Berlin: Verlag von Julius Springer. London: H. Grevel & Co., 33, King Street, Covent Garden. Price 32*s*. Bound in cloth 36*s*.

This work is comprised in two volumes of 8vo. size, bound either in paper covers, or strongly in cloth, as desired. The present is the third edition, the second having appeared in 1888. It commences with Preface, Tables of Contents, List of Collaborators, with addresses, List of Journals referred to in the work, and text covering, in Vol. I., 1144 pages, and in Vol. II., 778 pages. The work closes with a copious Alphabetical Index of Subjects. The text is embellished with no less than 194 well-executed wood engravings. Volume I. is divided into two parts, Part I. treating of the Analytical Processes of the large Scale Chemical Industries (Chemische Grossindustrie), whilst Part II. is devoted to the Methods of Investigation of the large Scale Chemical Industries, the Research Stations, and Trade Laboratories, as well as those of the State or City Analysts. Chemical Works, *Acid Industry.*—I. Sulphuric Acid. II. Salt-cake and Hydrochloric Acid Manufacture. III. Nitric Acid and Bisulphate. *Alkali Industry.*—I. Manufacture of Soda. II. Soda Waste. III. Carbonate of Soda (Ash). IV. Caustic Soda. V. Alumina Compounds. VI. Chloride of Lime. VII. Potash. VIII. Prussiates. IX. Potash Saltpetre, Matches, &c., Manures, Clay analyses, Earthenware, Glass. The Mortar and Cement Industry. Fuels, Technical Gas analysis. Iron, Iron alloys. Other metals. Coal Gas. Petroleum. Candle Manufacture. Glycerin. Paraffin and Mineral Oil Manufacture. Lubricating and Packing Materials. Soil analysis, Air, Water, Bacteriological Examination of Water, Technical Water and Sewage analysis. Appendix.

Volume II. treats of the following subjects:—The Distillation of Coal-tar; Tar Colours; Ultramarine. The more important Mineral- and Organic Non-tar Colours. Testing of Textile Fibres. Sugars and Sugar Manufacture. Beer, Wine, Argols, and Yeasts. Starches. Spirits, Brandies, Liqueurs, and Vinegars. Fats, Turkey-red Oil. Soaps. Cellulose manufacture. Paper, Inks. Tanning, Vegetable Matters, Leather. Foodstuffs for Animals and Men. Dietetic Preparations. Medicaments. Urine Analysis. Judicial Chemical Investigations.

Odorographia: a Natural History of Raw Materials and Drugs used in the Perfume Industry. Intended to serve Growers, Manufacturers, and Consumers. By J. Ch. Sawer, F.L.S. London: Gurney and Jackson, 1, Paternoster Row. 1892. Price 12*s.* 6*d.*

This is a manual into which is collected information on the subject of the raw materials and drugs used in the manufacture and preparation of perfumes, information hitherto only obtainable by reference to a large number of treatises and journals, foreign and English, and some by no means easily accessible. It is an 8vo volume, bound in cloth, containing Preface, Introduction, List of Illustrations, which number thirteen, List of Principal Works referred to, and subject-matter covering 375 pages. The work closes with a complete Alphabetical Index. The grouping of the odours forms the basis of the sub-division of the text, and accordingly the work is divided into chapters bearing the following headings:—I. The Odour of Musk. II. The Odour of Rose. III. The Citrine Odours. IV. Jasmine, Jonquil, and Hyacinth. V. The Odour of Violet. VI. Ylang-ylang. Champa. Artabotrys. VII. Odour of the Hayfields. VIII. Vanilla. IX. Odour of Bitter Almond. Cherry Laurel. Heliotrope. X. Cinnamon. Cassia. Clove. XI. Benzoin. Storax. Balsam of Peru. Balsam Tolu. XII. Opopanax. Bdellium. Myrrh. Balsam of Mecca. Frankincense. XIII. Lign-aloes. Patchouli. Vetiver. Camel Grass. Hennah. XIV. Santal. Cedar. XV. Camphor. XVI. Cajeput. Lavender. Rosemary. Addenda, referring to Adulteration of Santal-wood Oil; the Source of Ambergris, Lemon-grass Oil, and Identification of a new species of Vanilla from New Granada.

Anleitung zur Chemisch-technischen Analyse Organischer Stoffe. Von F. M. Horn, 35, Tabellen und 32, Figuren im Text. Vienna: Verlag von Josef Šafář, 1890. London: H. Grevel and Co., 33, King Street, Covent Garden. Price M. 5.40 or 5*s.* 5*d.*

The methods of technical analysis described refer to the branches of the sugar industry: Flours, Starches, Dextrin, &c.; Alcohols, Wines, Spirits, Liqueurs, and Beer; Vinegars and Acetic Acid; Milks, Fats, Butters; Soaps, Glycerin and Candles; Oils; Petroleum, &c.; Ethereal Oils, Balsams, Resins; Paper, Glues, Size; Tanning Material. (See this Journal, 1890, 332.)

Erratum.—This Journal, 1892, 1041, col. 1, for "Printers' Colours" read "Painters' Colours."

Trade Report.

BOARD OF TRADE NOTICES.

Analysis of the Railway Rates and Charges Order Confirmation Acts, 1891 and 1892.

The analysis of the Railway Rates and Charges Order Confirmation Acts, 1891 and 1892, recently presented to Parliament, has now been published by the Queen's printers. The analysis contains:—(*a.*) A list of the Acts; (*b.*) A list of the railway companies affected; (*c.*) The classification of merchandise traffic; (*d.*) The general conditions under which the maximum rates and charges can be made; and (*e.*) The schedules of the maximum rates and charges. The price of the publication is 1*s.*, and copies may be obtained from Messrs. Eyre and Spottiswoode and the usual agents, or through any bookseller.

Factory and Workshop Acts, 1878 to 1891.

The following is the text of a notice issued from the Home Office on the 24th December last with reference to works dangerous or injurious to health:—

Whereas by section 8 (1) of the Factory and Workshop Act, 1891, it is enacted that:—

"Where the Secretary of State certifies that in his opinion any machinery or process or particular description of manual labour used in a factory or workshop (other than a domestic workshop) is dangerous or injurious to health, or dangerous to life or limb, either generally or in the case of women, children, or any other class of persons, or that the provision for the admission of fresh air is not sufficient, or that the quantity of dust generated or inhaled in any factory or workshop is dangerous or injurious to health, the Chief Inspector may serve on the occupier of the factory or workshop a notice in writing, either proposing such special rules or requiring the adoption of such special measures as appear to the Chief Inspector to be reasonably practicable, and to meet the necessities of the case."

Now I, the Right Honourable Herbert Henry Asquith, one of Her Majesty's Principal Secretaries of State, do hereby certify that in my opinion such processes carried on in factories and workshops, or parts thereof, as are named in the schedule hereunder, are dangerous or injurious to health.

(Signed) H. H. Asquith.

Whitehall,
24th December 1892.

Schedule.

Processes in—

The manufacture of earthenware.
The manufacture of explosives, in which dinitrobenzole is used.
Chemical works.
Quarries.

The Production of Kauri-Gum in New Zealand.

The following particulars of the production of kauri-gum in New Zealand are extracted from the New Zealand Hand-Book for 1892, prepared by the Registrar-General of that Colony:—

Kauri-gum is formed of the turpentine that has exuded from the kauri-tree, the finest, and for general purposes, the most useful forest tree in New Zealand.

Thirty years ago the Maoris were the only people who occupied themselves in searching for this gum, which at that time was to be found on, or cropping out of the surface of the ground where perhaps, ages before, forests of kauri had stood. After a few years' exports this surface-gum became exhausted, and then the Maoris began to dig for the gum that was to be found within a few inches below the surface. As the uses for it increased, its market value rose, and presently Europeans betook themselves to digging for it, until, at the present time, it is estimated that there are probably as many as 4,000 whites and 1,000 Maoris engaged in the work in the Auckland Provincial District, where alone the gum is to be found. The best qualities are obtained from the undulating, open, fern land north of Auckland, but considerable quantities, although of inferior grade, are taken from the branches of standing kauri-trees in the forest, and, in the summer time, from the bottoms of many of the swamps.

The country on both sides of the Northern Wairoa River, of which the town of Dargaville is the centre, is the chief source of the supply of this commodity, the output of which has steadily increased over the last 30 years, notwithstanding that it is not being reproduced, except to a very inappreciable extent, in the existing forests, and these are being rapidly cut down now, because of the commercial value of the timber. The cause of the increased output is of course that a greater number of men are now engaged in gum digging, attracted, doubtless, by the higher price paid for the gum and by the comparatively easy and independent mode of life the occupation affords. Within a measurable period of time the production of this gum must cease; although competent persons estimate that it will take 50 years at least, at the present rate, to exhaust the gum deposits in the Auckland district. It is a remarkable fact that new parties of diggers have been known to work over the same piece of ground year after year, and that the last to work it have obtained as much gum as the first. In some cases gum-bearing land has been purchased from the Crown for settlement purposes, and the gum unearthed in ploughing it has sold for enough to pay the purchase-money of the land, and for ploughing, fencing, and sowing it as well.

The ordinary method of searching for the gum is by first feeling for it a little below the surface with a steel-pointed piece of iron about ½ in. in diameter and 4 ft. long, called a "gum-spear," and then digging it out with an ordinary spade. A skilful and industrious digger can earn as much as 3*l.* to 4*l.* per week at the work, and even children can make a few shillings a day at it. As, however, the gum-fields offer a refuge for all sorts and conditions of men, many who are old and infirm resort to them, and so the average earnings of those engaged in the work is reduced to 1*l.* 15*s.* to 2*l.* per week.

The gum is used principally in the manufacture of varnish, but it is found useful for many other purposes, such as dressing "glazed" calicoes, &c. The best quality, which is scarce, is worth as much as 8*l.* to 10*l.* per cwt., while the poorest quality is worth only about 1*l.* per cwt. in London.

The following are the quantities and values of the exports in 10-year periods since 1853:—

Year.	Tons.	Pounds.
1853	829	15,971
1861	856	9,888
1871	5,054	167,958
1881	5,460	253,778
1891	8,388	437,056

This last is the highest value for any year. In 1888 the number of tons was the greatest, 8,482; but the value, 380,033*l.*, was less than last year's.—*Board of Trade Journal.*

Dyeing and Finishing of Textiles in the United States.

A report on the dyeing and finishing of textiles as a distinct industry has just been presented in a Bulletin issued by the Census Office at Washington. According to this report there were 248 establishments devoted to dyeing and finishing textiles in 1890, as compared with 191 in 1880, an increase of 29·84 per cent. The capital invested in these establishments amounted to 38,450,800 dols. in 1890, as compared with 26,223,981 dols. in 1880, an increase of 46·62 per cent. The total for 1890, is should be explained, does not include hired property to the value of 1,819,779 dols., which is omitted for comparative purposes, inasmuch as this item was not reported at the Census of 1880. The number of hands employed increased from 16,698 to 20,267, an increase of 21·37 per cent. The amount of wages paid increased from 6,474,364 dols. to 9,717,011 dols., an increase of 50·08 per cent. Miscellaneous expenses, which were not included in the statistics for 1880, amounted in 1890 to 3,154,319 dols. The cost of materials decreased from 13,664,295 dols. in 1880 to 12,362,082 dols. in 1890, a decrease of 9·53 per cent., and the total value of work done showed a decrease from 32,297,420 dols. to 28,900,560 dols., a decline of 10·52 per cent.

In spite of the decrease shown in the total value of the work done there has, it will be seen, been an increase in the amount of wages paid. There was also an increase in the average amount of wages per employé, which increased from 387·73 dols. in 1880 to 479·45 dols. in 1890. This increase in average earnings is attributed to more regular employment, a large increase in the number of males earning the higher rate of wages, a small increase in the number of women, and a marked diminution in the number of children employed. It appears that the number of males employed in 1890 was 17,146 as compared with 12,788 in 1880, an increase of 4,358; the number of women employed increased from 2,038 in 1880 to 2,328 in 1890, an increase of 290; and the number of children employed fell off from 1,872 in 1880 to 793 in 1890, a decrease of 1,079. Expressed in percentages, these comparisons show that while there was an increase of 38·08 per cent. in the number of males employed, there was an increase of only 14·23 per cent. in the number of females, and there was a decrease of 57·64 per cent. in the number of children employed.

It is explained that the tables given in the report do not embrace the statistics of establishments connected with cotton, woollen, or silk factories, but show only the operations of independent dyeworks, bleacheries, and print works, the value of the products reported being merely the values added to the fabrics by the processes of dyeing and finishing. Much of the dyeing and finishing is done by the manufacturers themselves, the data showing that, while chemicals and dyestuffs to the value of 8,407,593 dols. were consumed during the Census year in the establishments devoted exclusively to this industry, the silk, cotton, and woollen mills in which dyeing and finishing is done, used chemicals and dyestuffs valued at 11,278,970 dols., divided as follows:—In woollen mills, 6,453,665 dols.; in cotton mills, 4,266,773 dols.; and in silk mills, 558,532 dols. These figures show that, as a matter of fact, more dyeing and finishing was done in the textile mills than in the establishments devoted to dyeing and finishing alone.

Reference is made in the report to an anomaly presented by the statistics given, which show that while there has been an increase in the number of establishments engaged in the industry, in the amount of capital invested, and the amount of wages paid, the increase amounting to 29·84 per cent. in the first item, 46·62 per cent. in the second, and 50·08 per cent. in the third, there has been a decrease in the total value of work done amounting to 10·52 per cent. Touching the apparent increase of capital, the report says that the large increase shown in this item for the past decade is partly due to the fact that invested capital, as returned at the Census of 1880, did not take cognizance of all items that properly embrace "live assets," which it is believed were for the first time fully included at the Census of 1890, and that in making comparison between the returns of capital invested at the two Census periods these facts should be carefully borne in mind.

Regarding the decrease in value of the work done, the report says:—

"Dyers and finishers explain that the decrease in value of the work done, as reported for 1890, is due to the fact that competition and improved processes have reduced their charges for work at least 25 per cent. The market cost of chemicals and dyestuffs remains about the same, but it is not necessary to use as much of these articles now, in a given quantity of goods, as was employed at the Census period of 1880. This is particularly noticeable in the manufactures of silk, as by the introduction of machinery operated by power it is now possible to do work that ten years ago could only be performed by hand. Therefore, the decrease in the value of work done is not due to an increase in the number of manufacturers of textiles doing their own dyeing and finishing, since the proportion of such manufacturers in 1890 is about the same as in 1880."

Touching the relation between the cost of materials and the value of the work done, the Bulletin says :—

"At the Census of 1880 the cost of materials and wages was 20,138,659 dols. to give a product of 32,297,420 dols. ; while at the Census of 1890 the cost of these two principal items was 22,079,093 dols. to give a product of 28,900,560 dols. Thus materials and wages cost 62·35 per cent. of the value of work done at the former Census year, while at the present Census the percentage has risen to 76·40. The work done, both in quantity and value, is principally in dyeing, bleaching, and printing cotton yarns and piece goods. The amount of 28,900,560 dols. given as value of product of dyehouses, bleacheries, and print works, does not show the full value added to textile manufactures by these processes. In the woollen mills chemicals and dyestuffs costing 6,453,665 dols. were used. From the returns made by manufacturers it is found that the cost of these materials is 36·18 per cent. of the added value. Applying this basis of compilation it would appear that the added value of work done in woollen mills is 17,837,659 dols. Chemicals and dyestuffs costing 4,266,773 dols. were used in cotton mills. The cost of these chemicals and dyestuffs, according to the returns of establishments dyeing, printing, and bleaching cotton goods, is 26·61 per cent. of the value added by these processes, which would make the value of the work done 16,034,472 dols. In silk mills the chemicals and dyestuffs cost 37·21 per cent. of the value added by their use. The cost of these materials is 558,532 dols., and the value of the work done, which means the cost of the dyestuffs plus the value added by their use, is 1,501,027 dols. The value of this work done in mills engaged in textile manufactures is therefore, approximately, as follows :— Cotton, 16,034,472 dols. ; woollen, 17,837,659 dols. ; silk, 1,501,027 dols. ; total, 35,373,158 dols. Adding this total to the value of work done in establishments devoted exclusively to dyeing and finishing textiles, the gross value added by dyeing, bleaching, and printing is shown to be 64,273,718 dols."—*Ibid.*

THE ECONOMIC CONDITION OF THE PHILIPPINE ISLANDS.

M. Paul Dreyfus, writing in the *Economiste Français* for the 19th November, with reference to the products, trade, and shipping of the Philippine Islands, supplies the following information :—

The cultivation of sugar has diminished ; in 1873, 136,111 hectares were planted with canes, against 58,779 in 1891, but that of coffee has extended. Of this article 20,000 quintals were harvested in 1850 against 80,000 piculs in 1890, and 120,080 in 1891 ; the production of cotton has largely diminished, and it has ceased to contribute a large proportion of the exports, but it may recover if, as has been several times suggested, cotton tissue factories are started in the Philippines.

The manufacture of coprah instead of improving yields at the present time rather inferior products, owing to the deplorable processes introduced into its preparation by the Chinese. The same may be said for indigo and gutta-percha. The stores at Manila contain at the present time gutta-percha to the value of 80,000 piastres, rejected by the European markets by reason of the adulteration to which it has been subjected and by which it has depreciated in value.

Tobacco has largely gained in quality since the exporters have grown it themselves in special plantations, instead of purchasing it as formerly from the Chinese and the Indians. —*Ibid.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

AUSTRIA-HUNGARY.

Prepared Medicines.

Prepared medicines and cosmetics, if not imported for druggists, require a special permission from the Customs authorities for importation.

Medical preparations, the recipes for the making of which are not open to the inspection of the physicians at the drug stores, or for which the substance of the medicine cannot be ascertained exactly as to the quantity and quality from the recipe presented, are not allowed to be offered for sale or to be sold, even in the drug stores.

The offering for sale and the sale of pharmaceutical preparations, without distinction, whether they have been prepared according to the prescriptions of the Austrian Pharmacopœia, or of that of other countries, are permitted only to and in the drug stores.

Exempt from these regulations are the dietetic and cosmetic preparations ; further, all mineral waters and artificial imitations of the same, and surgical dressings.

Prepared solutions of mineral salts in water, which in their appearance present themselves as natural mineral waters, without, however, being prepared according to such, may only be sold in the drug stores.

For these reasons, coupled with the fact that all medical preparations are excluded from protection by the Patent Laws in Austria, there cannot virtually exist any patent medicines in Austria, that is, medicines protected by law from imitation.—K. E. M.

MEXICO.

German Chemicals and Surgical Instruments.

In Mexico, if we may accept the German Consul's statements, chemicals have lately been imported from Germany exclusively, with the exception of a few heavy articles such as bleaching-powder, chlorate of potash, and caustic soda, which Great Britain supplies at a lower rate. Sulphuric, hydrochloric, and nitric acid are manufactured in the country. Sulphate of copper—an important article for the Mexican market—is of German origin, but English and American mining companies also import a good deal of English vitriol. Quicksilver is obtained in Mexico, but a good deal also comes from London and San Francisco, and a little Russian quicksilver from Hamburg. Surgical instruments are mostly of Bavarian and Viennese manufacture. If some French goods are still used it is because many medical men have studied in France and follow French methods ; but since the Berlin Medical Congress a certain preference for German medicinal preparations and instruments shows itself, and many students already apply themselves to the acquisition of the German language. Optical instruments are principally German, and to a slight extent French or Austrian. *Chemist and Druggist.*

PERU.

Coca Leaves.

In 1891, 204,922 kilos of coca leaves were exported from the Peruvian port of Arequipa. Almost the whole of this was produced in Cuzco, and for the first time a few parcels of inferior quality were received from Bolivia for export by this route. The bulk went to Hamburg, small shipments to New York and Lima.

Matico and Rhatania.

The exports of matico from Arequipa in 1891 amounted to 1,362 kilos., and of rhatania-root to 3,854 kilos.

MOROCCO.

Gum Arabic.

The exports in 1891 were 287 tons, of which white Senegal gum forms the principal item ; next to this come gum Amrad and brown Barbary (Berbera) gum, but the two latter are of very inferior importance. The Senegal gum is brought into commerce under the name of white Mogadore gum, and is brought by caravans from Timbuctoo to Tissounin and Tinduft at the Moroccan frontier. There it is taken in barter by local merchants, who carry it to market in Mogadore. Since 1889 the prices have fallen 100 per cent. The highest figure ever attained by this gum was in 1887, after the closing of the Soudan, when it realised 44 douros per 50 kilos.

Sandarach.

The very large crop of 1891 was directly due to the failure of the harvest of other Morocco produce, for in years of plenty the Arabs do not care to take the trouble to tap the sandarach trees, which is a work requiring great time and trouble, as the trees have to be felled in the summer in order to collect the resin in the autumn. Until last year all the acacia and sandarach exported were sent to London; but since German steamships call at the Moroccan ports, a direct export trade with Germany has sprung up, which absorbed 39 tons of sandarach last year. Sandarach is collected exclusively in the province of Haha, and the only port of shipment is Mogadore.

The exports from Mogadore were, in 1891 :—

—	Germany.	England.	France.	Spain.
	Tons.	Tons.	Tons.	Tons.
Cumin-seed	24	1	13	13
Acacia gum	30	253	3	..
Sandarach	39½	155	45	..
Orris-root	13¼	7	32½	..
Beeswax	25	129	40	..

SERVIA.

Drugs and Chemicals.

Last year the importation of drugs increased somewhat, and concessions for five new pharmacies were granted. Nitric, hydrochloric, and sulphuric acids, all of very inferior quality, are imported from Austria and Hungary, and dry plates for photographic use, formerly only sold by Belgium, are now also purchased in Austria. Silver and albuminised paper come from Austria, surgical instruments and bandages from Germany and Austria, mineral waters are still brought from abroad, although the Servian Government are doing what they can to promote the sale of the native waters. Dyes come from Germany and Austria, common varnishes only from Austria, fine varnishes exclusively from England. Perfumes and scented soap come from France, England, and Germany.

SPAIN.

Quicksilver.

The Austrian (Northern Spanish) mines produced 120 tons of quicksilver last year, valued at 21,000*l.*, as compared with 60 tons, valued at 12,300*l.*, in 1890; all is exported to the United Kingdom.

Drugs.

Consul Rawson Walker, of the Corunna District, reports that the import of drugs showed an increase from 440 tons in 1890, valued at 15,840*l.*, to 500 tons in 1891, the value being 19,800*l.*, or 3,960*l.* more.—*Ibid.*

SWEDEN.

Soda Manufacture.

A manufactory of soda is being established at Landscrona. This article has hitherto principally been imported from England.

UNITED STATES.

Manufacture of Manure.

Up till four years ago the district of Charleston (in Florida) imported large quantities of artificial manures, but this is no longer the case. There is an immense amount of phosphatic rock in the district, and more than half a million tons of it are mined annually, the production of fertilisers from it in 1891 amounting to 287,975 tons. Concurrently, sulphuric-acid manufacture has developed, and this year a number of mills are being equipped with the necessary appliances for making sulphuric acid from pyrites instead of brimstone; it having been found that at present prices acid can be made from pyrites at a saving of 50 to 60 per cent. The last four fertiliser-mills built are said to be model establishments, combining all the latest improvements in mill-construction, acid-chambers, wharves, store-rooms, &c. The imports used in the manufacture during 1890—91 were 21,676 tons of kainite, 25,556 tons of brimstone, 2,014 tons of nitrate of soda, 3,232 tons of muriate of potash, and 5,500 tons of pyrites—the aggregate value being about 880,000 dols.

Turpentine.

Charleston is also a centre of the turpentine-distilling district. The Charleston resin and turpentine sheds are situated in close proximity to the tracks of the East Shore Railway Company, and are convenient to the docks at which vessels loading naval stores for foreign ports are generally moored. Resin and turpentine shipped to the north can be taken now, without breaking bulk, to the wharves of the New York steamship line and loaded directly into the ships. For many years Wilmington, North Carolina, was the principal turpentine market in America, but as the Carolina forests have been gradually worked out, the turpentine hands year by year pushed forward into the virgin forests of South-west Georgia, Florida, and Alabama, so that at the present day Savannah is one of the first turpentine-ports in the world, and prices elsewhere are controlled by that market. But notwithstanding the movement of the turpentine-distillers and resin producers, Charleston will be able for many years yet to do a fair share of the business. In 1890—91 the exports of spirits of turpentine amounted to 18,512 casks, and of resin to 135,105 barrels. Half of the spirit comes to England.

Borax.

The secretary of the San Bernardino Borax Mining Company, writes to Consol Donohoe that the average price of American borax in 1891 at point of shipment was 26*l.* per ton, and that the average cost of production was 16*l.* per ton. He adds: "The selling price of 26*l.* per ton is a competitive price, there being five different companies producing borates and borax in California and Nevada, all selling to different buyers, dealers, and consumers. The product of the Nevada fields has greatly fallen off by partial exhaustion, while the Death Valley fields lie under the present prices."

Californian Olive Oil.

The culture of the olive is extending in California. The bulk of the crop is manufactured into oil, which is of good quality. The trees do not become productive until they are about eight years old. The production has risen from 590 gallons in 1888 to 11,011 gallons in 1891.

Chicago.

The amount of business done by the wholesale drug trade at Chicago was valued at 1,402,000*l.* in 1889, 1,464,000*l.* in 1890, and 1,567,000*l.* in 1891. In 1891 there was an increase of more than 20 per cent. in chemical productions and 30 per cent. in the cost of labour in the manufacture, over 1890. Competition reduced the value of oil-mill products by nearly 50 per cent.; the soap industry brought in 1,650,000*l.*, one firm alone out of the eight houses engaged in the business producing 80,000,000 lbs.

St. Louis.

26,952*l.* worth of chemicals and drugs were imported into St. Louis last year from abroad upon which 6,309*l.* duty was paid.

STRAITS SETTLEMENTS.

Langkat Petroleum.

Petroleum from Langkat, in East Sumatra, now such a disturbing element in the oil market, has only lately come into prominence from being pushed to the front by a company started in Holland. That company, through concessions from native chiefs, had secured large tracts of oil-bearing land in that section of Sumatra, but at the outset working the petroleum wells met with serious difficulty from the inexperience of those in charge. Trial borings soon, however, disclosed the alleged fact that the land under concession contained abundance of petroleum, so that every well sunk yields copiously. Experience and knowledge of the work apparently soon so improved matters that the report of the company just issued anticipates an outturn of 1,000 cases a day before the end of the year, the intention being to increase the output to 2,000 cases a day before the end of 1893. The land under the control of the company borders on Aru Bay, which is the only seaport in the Straits of Malacca on the east coast of Sumatra which is accessible to large vessels; and the company expects to distribute a handsome dividend on the expected outrun of 1,000 cases a day, as it has now rights over 40,000 hectares of land. In the report much is made of the fact that the oil brought to market has met with a favourable reception at Pekang, and that the lower cost of production will prove to be an advantage against American and Russian competition. The company also contemplates the building of tank vessels to convey oil from Langkat to the Straits ports, which are only a few hours' steam distant, and has taken steps to raise additional capital. The chairman, at a meeting of shareholders on the 7th of June, mentioned as an encouraging sign that petroleum which, on a yield of 1,000 cases a day, cost the company only 1 dol. per case could be sold in Penang at a profit for 1·40 dols. per case. The various influences at work in the petroleum oil trade in the far East generally and Singapore especially are such that prices will run down to an exceedingly low ebb, so low, in fact that the largest and wealthiest of concerns now under way must necessarily come out on top. There is already the nearly finished tank for Batoum oil at Pulau Bukum; there is the Langkat field with prospect of a considerable output with a complement of bulk tanks; there is the large American case-oil trade, which until recently, wholly supplied Singapore; and now there has just arrived at Singapore an agent of the Standard Oil Company of the United States, who has come with a view of seeing whether the market here cannot be worked so as to operate against the Samuel's syndicate. In a word, the object of the Standard Company's agent is competition. He will look over the Langkat field and consider the prospects of its product as affecting the market in the Straits, and he will look about to see if petroleum tanks need be erected at some convenient spot so as to be in close competition with those at Pulau Bukum.

NICARAGUA.

Fibres.

In answer to an inquiry about the fibrous plants that are indigenous to the soil of Nicaragua and if a business could be carried on there profitably in extracting fibres, the consul has collected and embodied the facts contained in this report.

This question will interest many, as it is well known that one of the most valuable agricultural products is fibre, which enters into the manufacture of rope, cord, sacks, osnaburg, and the various classes of cloths that are used in packing goods for transportation.

The vegetables that produce fibres are numerous, but the one most cultivated in all hot climates is that belonging to the family of agaves. The principal fibre of this family is hennequen, found abundantly in Mexico, and which has been a source of great riches to Yucatan and other departments of that Republic. In Nicaragua it grows perhaps more vigorously and exuberantly than in any other country; especially is it abundant in the departments of Leon and Chinendega. With a view to foment the cultivation of fibre, the Hon. Roberto Sacassa, President of Nicaragua, then a representative in Congress, proposed a law in 1883, which was unanimously adopted by Congress, and reference to which is made in this report later on. Notwithstanding that law, the subject did not receive the attention that it merited; but this abundant fountain of riches remained inactive until lately, when a Nicaraguan gentleman, Señor Dr. Don Fernando Sanchez, who, comprehending all the advantages consequent upon the culture of fibrous plants, celebrated a contract with the Government for the cultivation of hennequen and for the exclusive privilege of manufacturing sacks and cordage with this fibre for a period of 25 years.

By the terms of this contract Mr. Sanchez binds himself to form and cultivate a plantation of penca that will contain not less than 500,000 plants and to establish and have in service during the period hereafter mentioned machinery that may be necessary to extract this fibre with a capacity sufficient for the production of 500 tons of fibre annually. He also agrees to put in operation the machinery required to fabricate not less than 150 tons annually of rope and a like amount of sacks. The plantation must be completely established within the term of two years, counting from the date of the ratification of this concession, and the necessary machinery must be in operation one year afterwards. This contract was ratified by Congress on December 1st, 1891. The Government concedes to Mr. Sanchez for the space of 25 years, the exclusive right to manufacture rope and sacks of fibre by means of machinery moved either by steam or hydraulic force. Furthermore, it binds itself not to rebate the duties now actually existing for the introduction of cables and articles of cordage. The Government agrees to pay the freight on the machinery that Mr. Sanchez may introduce, within the term of three years, and to transport the same free on the National Railroad, save if he shall have sold or leased the same at the date of introduction. During the continuance of this concession the enterprise of Mr. Sanchez will be exempt from all fiscal imposts. The employés will be relieved from military service in time of peace and at all times from public duties. The number of employés will be fixed in accordance with the ideas of the Government. Should Mr. Sanchez deem it expedient to introduce fibrous plants of a better quality than penca, the Government will contribute 5 per cent. of the cost of introduction and will pay the freight; it will also transport the same gratis upon the National Railroad. Power is granted Mr. Sanchez to organise a company for the execution of this contract.

The privileges conceded in this concession become inoperative if the plantation is not formed or the machinery is not in full working order within a period of three years from the date of the ratification of this contract. It also becomes null and void if the works are suspended during ten consecutive months, except for fortuitous circumstances.

As an evidence of good faith Mr. Sanchez is required to give either a bond or to deposit 2,000 dols. in the Government treasury. So far as the Consul has been able to ascertain, no steps have been taken to carry out the provisions of this concession.

The law of March 13, 1883, conceded a premium of three pesos for each quintal of pita or bromelia and one peso for each quintal of cabulla (*Agave Americana*) that was exported in fibre or manufactured. This law was to remain in operation for eight years from the date of the issuance of the decree. By a decree dated March 16, 1889, the provisions of the law of March 13, 1883, were extended.

It would be a lengthy task to enumerate all the fibrous plants that grow in Nicaragua, for, besides the very many that belong to the amaryllidaceous family, almost all palm trees produce fibres.

The principal fibres that are produced and utilised in Nicaragua are the pita, bromelia pita, and the cabulla (*Agave Americana*). Of these the most cultivated is the cabulla. Panama hats are manufactured from pita. Though cabulla and pita are abundant, they are not so much so as to warrant the introduction and operation of machinery for the extraction of fibres.

The plants that produce pita and cabulla grow generally in rich soil and thrive best where there is an abundance of rain. The localities where the most and the best cabulla is produced are in the departments along the Atlantic coast. These fibres are found in places very difficult of access.

Fibrous plants have not as yet been cultivated to any great extent in Nicaragua, for the natives have never thought of exporting pita or cabulla. They are satisfied to sell in the Republic the few hundred pounds that they extract. The Consul thinks that if mills were established there would be no difficulty in obtaining a sufficient number of labourers to collect the fibre and to assist in its transportation. As will be noticed in the previous lines of this report, the extraction of pita fibre in Nicaragua has become a monopoly.

The methods that have hitherto been employed in the extraction of fibres are very primitive, as well as very simple. The leaves are first soaked for several days, after which they are beaten. A species of bamboo is next split in two, through which the leaves are drawn, and this is the way that the fibre is extracted. The Consul states that Señor Don Ricardo Contreras, of Leon, has an apparatus for beneficiating cabulla. The apparatus referred to is, he thinks, the only mechanical appliance used in Nicaragua to obtain fibres.

On account of the limited production, there is no exportation of fibre. All that is produced is used in the manufacture of hammocks, hats, and rope, the articles being sold in the country. It would not pay to export fibre unless both varieties named of *Agave Americana* belonging to the natural order amaryllidaceæ were cultivated and not far from a seaport.

Mexico.

Tariff Changes.

U. S. Cons. Repts. Nov. pp. 426—430.

A decree just promulgated by the Government relates to the Mexican customs tariff, and effects many important changes therein. These changes consist of very material reductions upon certain items; the placing of one item, *i.e.*, waste and torn paper, pulse of vegetable fibres, &c., used for manufacturing purposes, on the free list; and the removal from the free list and the imposition of a "light duty" upon about twenty items.

The decree discloses, as the reasons for these respective changes, the fact that some foreign merchandise is so heavily taxed in the tariff now in force that its importation has become almost null, the recent depreciation of silver and the needs of the federal exchequer urging that articles of large consumption hitherto free should contribute their quota of revenue.

The decree takes effect on December 1, 1892, as far as concerns merchandise on which the import duties are therein reduced, and on January 1, 1893, as far as concerns other merchandise; "provided, in all cases, the same are introduced by the frontier, or the vessels carrying the same to the port of destination enter such port after the hour of midnight of the day just preceding."

Tariff and Custom Rules.

The federal revenue is chiefly derived from customs, imposts, sale of stamps, and occupation taxes, and hence the importer and merchant have to pay into the treasury the larger portion of the money needed to meet the expenses of the Federal Government, and hence, also, we have in Mexico a high tariff, primarily for revenue. Every business man seeking trade in Mexico should procure a copy of the Mexican tariff and make a thorough study of the requirements of the law. As the subject is so extensive, I would recommend every American merchant to limit his study of the tariff to the classes of merchandise in which he trades. There are general rules in the tariff applying to all importations that merit close examination.

The present tariff, recently promulgated, is a great advance over all former tariffs in simplification and reduction of classification, and it possesses, also, the great advantage of explanatory notes to guide importers and customs officers in the determination of the proper classification of the importations.

Customs duties are specific, and, with few exceptions, all importations pay duty by weight. Weights are divided into three classes, viz, gross (*bruto*), net (*neto*), and legal (*legal*). The first two need no explanation, but the legal weight is especially a feature of the Mexican tariff, and is the weight of the article, with that of the bottle, pasteboard, wooden or tin box, or whatever serves as a wrapper or holder of the article in its ultimate or smallest packing, and not including the weight of the outer larger box, case, or package in which the smaller packages are contained or the straw, excelsior, or paper shavings used to prevent injury in transportation. To illustrate: Take, for example, a box containing a dozen quart bottles of mineral water. The water in each bottle will weigh two pounds, or 24 pounds for the dozen; each bottle will weigh $1\frac{1}{4}$ pounds, or 15 pounds for all, and the outer, or containing box will weigh 8 pounds. Then the gross weight is 47 pounds, the net weight is 24 pounds, and the legal weight 39 pounds.

As the bulk of importations pay upon weight, and mostly upon gross or legal weights, it will be readily seen how great is the importance of using a kind of packing as light as consistent with safety in transportation. The precaution as to packing is less forceful when duties are imposed upon the net weight, as it then becomes a question of a little extra railroad freight save in cases where the ultimate destination of the shipment is to a point beyond the line of the railroads. The last exception needs less consideration, owing to the rapid extension of railroads in Mexico. Most all of the larger cities of the Republic have rail facilities, and in all these cities are large importing houses that are depôts and distributing centres from which remoter towns beyond the railroads are supplied. At these centres any needed repacking to meet the requirements of mule packing and mountain trails will be done; so that our shippers of goods to Mexico need only consider the matter of packing in relation to weight as affecting duties and thereby the cost.

It is very important that each package should bear its mark and number, so as to be easily distinguished. Old marks and numbers should be carefully erased, because there is a fine up to 1 dol. for each package having more than one mark or number or if the mark or number does not correspond with that indicated in the consular invoice. The importance of carefully marking and numbering is also due to the practice of generally examining one tenth of the number of packages, and the inspector designates by mark and number those to be opened.

The rules for preparing consular invoices and manifests are very strict and should be carefully studied. Any omission or error, even clerical, imposes the liabiltty of a fine.

As a rule, Mexican merchants, when ordering goods, are very particular in their directions how goods should be packed, labelled, marked, &c. This may often appear trifling to manufacturers in the United States, but they should remember that their own business experience may widely differ from long-established practices in Mexico.

Customs Fines.

It should be constantly borne in mind that the Mexican tariff is very severe in the matter of fines, and hence it will be well in all cases to have importations made by experienced customs brokers.

The practice of giving a portion of the fines imposed to the officer who discovers or reports the cause of a fine acts naturally as a strong temptation to discover all possible errors in the classification of the entry. Customs officials consider only facts, and not the intention, and the enumeration of the cases in which fines are to be imposed is very large.

Another important consideration is that the customs officials will not express an opinion upon the duties any given importation should pay or indicate the proper classification and manner of declaring the importation. Whenever goods are not plainly specified in the tariff and there is the least doubt as to proper declaration and classification, the best way, in advance of importation, is to send samples to the secretary of the treasury, city of Mexico (Secretaria de Estado y del Despacho de Hacienda y Crédito Publico), or, if samples cannot be sent, cuts showing kinds of goods and full description of the same should be sent in lieu of samples for a decision.

Weights and Measures.

The metric system is the legal standard for weights and measures in Mexico; but it frequently happens that the old Mexican weights and measures are used, and hence it will be well to remember that there is a slight difference between the Mexican and English pound, and that the Mexican inch is shorter than our English inch. The measures for cereals differ also in most of the States of the Republic.

A consideration of the commercial advantages arisising from the use of the metric system in our foreign commerce, suggests the conclusion that our old English weights and measures are stumbling blocks to our Latin neighbours, whose commerce we seek.

We annually lose considerable trade with Mexico and the other New World nations, owing to the persistent use by our merchants and manufacturers of the English weights and measures in their circulars, catalogues, and price lists. These lists are not infrequently unintelligible to the foreign buyer. I have been in a large exporting house in New York city and found the salesmen totally ignorant of meters, kilograms, &c. Our French, German, and Belgian competitors all use the metric system, and Mexico and all the nations of the New World south of us use it. The use of the metric system was authorised by our laws many years ago, but as it was not compulsory we still cling to the old system.

Paints and Oils.

The duty on oils, paints, varnishes, and painters' utensils and supplies has been considerably reduced.

Paints should be shipped ready mixed and packed as light as possible, as duty is upon gross weight. Oils for mixing paints pay double the duty imposed upon mixed paints.

Painters' brushes pay now $2\frac{1}{2}$ cents per pound, and only best grades should be shipped. Importations for all the northern portions of Mexico are exclusively drawn from the United States.

Importations of illuminating oils are confined to crude and refined petroleum from the United States. Two American companies have established refineries in Mexico and have a virtual control of the trade. They import crude oils from the United States in tank cars, and have agencies in all the principal cities of Mexico. The high duty upon refined coal oils, gasoline, &c., makes direct importations too costly. These companies also produce lubricating oils. It will be seen that the field is now well covered by American companies.

Fish oils are imported to a limited extent for use in miner's lamps, and comes from the United States. The duty was formerly about 2 dols. per gallon, but has now been reduced to 40 cents per gallon.

Until a few years ago there were hardly any drug importations from the United States. Recently some pushing energetic firms have sent agents to Mexico speaking Spanish and well acquainted with the trade, and it is astonishing to see what good results have been accomplished. American preparations, and especially proprietary medicines, are now seen in most drug stores. Before, and now to a great extent, French patent medicines were the only ones in demand or known.

The great majority of drug stores are owned by practising physicians, who are very familiar with French prescriptions, having used French text-books in their studies, and they give the preference to French drugs.

The sale of patent medicine is less than in the United States, relatively, on account of higher duties. Sulphate of quinine is now lightly taxed, and much is used and largely imported from the United States.

With the exception of Florida water, imported in large quantities and sold even by grocers, few articles of perfumery are now imported from the United States. Perfumery is from France chiefly, and in spite of high duties, is largely used.

Ordinary unscented soaps cannot be imported on account of duties. Fine toilet soaps are heavily taxed, and demand for them is confined to the richer classes. Cocoanut soap can be imported, as it pays the light duty of 25 cents per kilogram gross weight, and is very largely used in Mexico for toilet purposes. Medicinal soaps fare better as to duties, but shippers should be sure that what they call medicinal soaps are so classed by the Mexican tariff. The new tariff is a great improvement on former imposts, and the explanatory notes are of the greatest help. Nothing is harder than to prepare the Mexican customs papers for an invoice of drugs. The danger of fines is very great, and an exhaustive study of the tariff is needed.

To meet the requirements of the country, drugs, whenever practicable, should carry descriptions and directions in Spanish. French drug houses have issued in Spanish some very elegantly illustrated catalogues, with every article shown in colours, and an ingenious scale allows actual size of goods to be shown, and weights are given.

Drugs imported into Mexico should have their Latin names upon packages. Packing of all drugs, &c., should be as light as consistent with safety in transportation, as the weights of flasks, bottles, pasteboard boxes, and all interior wrappings are included in the weight of goods paying duties upon legal weights.

Caustic soda in drums is very largely used throughout Mexico in soap-making, but comes exclusively from England, because cheaper; and unless the English price can be met, this large trade must remain in English hands. Large amounts of cotton-seed oil from the United States were imported for soap-making prior to November 1891, when a duty of five cents per pound was imposed, and imports have almost ceased. Disinfectants, hide poisons, and sheep dips are on the free list, are largely used, and chiefly come from the United States.

Glass and Glassware.

Plate glass has so far been mostly imported from Europe on account of cheapness and freight rates. Until recently the reputation of European plate glass has been favourable to larger importations than from the United States; but this is all changed now, and ourp late-glass manufacturers have only to meet European prices and secure as low rates of freight to entirely control the trade in Mexico, providing always they work to secure it. The duty is 10 cents per pound gross weight on plates of 39 inches in length or width and about $7\frac{1}{2}$ cents per pound for larger sizes. As no allowance is made for breakage and as duty is levied upon gross weight, it is evident that packing should be as light as is consistent with safety.

Window glass of an inferior quality is made in Mexico, but American glass is now more widely imported. Glass in houses is almost a luxury. Many houses in Mexico are without a single pane of glass. The duty is the same as for plate glass.

Of table glass and glass for druggists' use there are no manufactories in Mexico. The duty of 20 cents per kilogram gross weight makes glassware of all kinds very expensive. Preference is given to lighter weights. This line was, until recently, entirely from Europe; but now some orders are placed in the United States, because some enterprising American firms have sent out agents and distributed catalogues well made up and only lacking full data as to weights to be complete. This line affords a good field and should worked up.

Crockery, china, ond porcelain are now mostly imported from Europe. The duty of 15 cents per kilogram gross weight applies to plain and decorated ware. As the consumption is large, our manufacturers should pay more attention to this line.

Lamps and fittings are exclusively from the United States on account of the latest improvements being American.

Plated lamps of metal pay duty upon the metal with which they are plated. China and glass lamps pay on china and glass.

Bottles for beer, wine, ginger ale, and soda water are in large demand. There are no home products, and supplies are wholly drawn from imports. The duty on bottles will be removed May 1, 1892, and should largely increase importations, and this possibility should receive attention.

Lanterns can now be shipped in cases without paying duty upon the packing.

Electric-light plants are now well established in most towns of any size, and it will be well for manufacturers of electroliers and other appliances for electric lighting to send their illustrated catalogues to the local companies or to hardware dealers.

Paper and Stationery.

The tariff in force since November 1891, has reduced the duty upon plain paper of all kinds and largely increased the duty upon paper with printed or engraved headings and upon blank books. As the prices of American papers have been greatly reduced, there is now a chance, for the first time, for American paper to enter this market, entirely controlled by European importations at present. The duty is upon weight exclusive of packing; and hence for the Mexican trade paper should combine lightness with strength and smooth surface. Paper admitting of writing upon both sides is preferred. As there is a difference of duty of nearly 2½ cents per pound in favour of unruled writing, bill, and note paper as against ruled, the former will generally be preferred. Water lines are not considered as constituting ruled paper.

The high rates of interior postage cause light-weight writing paper to be in vogue. Envelopes should also be light and strong and coloured (generally blue tinted) to prevent writing from being read through the thin envelope. A kind of paper very much used in Mexico is the so-called "papel ministro," used for all official documents and correspondence. In dimensions it corresponds to our foolscap, but size may vary slightly, as dimensions are not fixed by law. This paper should be of medium weight, unruled, and finished to admit of writing on both sides of sheet. Large envelopes to contain this paper when folded once will be in demand. It is believed our paper mills could supply satisfactory grades of this official paper, of which the consumption is very great. Samples can easily be procured from the departments, or any United States consul can mail samples.

A paper mill is in process of construction near Mexico city. The question will be what grade of paper it will manufacture. If suitable for printing purposes, the importations will be considerably reduced, as hitherto only wrapping paper of poor quality has been made in Mexico.

The paper manufacturer in the United States will do well to make inquiries as to sizes mostly used for newspapers. Newspapers are smaller in Mexico than in the United States. The largest may be 16 by 24 inches and the average size about 12 by 16 inches and even less.

Cardboard should have an increased demand, since the new tariff taxes visiting cards heavily, and they will be printed and engraved in the country.

Paper bags with cuts, name of merchant, or other advertising matter can not be imported and pay the duty on the paper alone.

Wrapping paper of straw and striped coloured paper are in good demand, the latter especially. It should be as light as is consistent with strength.

Hitherto the excessive duties have limited the use of wall papers to the wealthy. The new duties of about 5, 10, and 25 cents, according to grade, should increase the demand. Cheap wall papers in bright colours and flowered designs are preferred and will find a good sale.

Pasteboard and coloured paper, marbleized paper, and imitation leather for bookbinding will have ready sales.

It is impossible to state rules or make suggestions covering all cases, but, bearing in mind that paper in its many manufactures pays duty by weight, the chief requirement for Mexican trade is strength united to highest degree of lightness possible. Another point is to adapt size to the use paper is for in all well-determined cases, thereby avoiding paying duties upon an excess of paper. A few questions of the buyer as to sizes and grades he can best use will secure desired results.

Leather and Rubber Goods.

The tariff on these lines of goods is almost prohibitive and is completely so on the cheaper grades. In all that makes good leather that of the United States will compare most favourably with European, and the prices are evidently lower on many grades or we could not export leather to Europe; but, notwithstanding this fact, I am informed that the bulk of the importations of leather into Mexico comes from Europe. If this is a fact, the reasons are superior business enterprise on the part of European dealers. The duty on leather of any and all grades is dol. 1·50 per kilogram or 2·2046 pounds.

It may be of interest to show what 1 pound of prime American leather will cost in Mexico, exclusive of freights and commissions. Good oak-tanned harness leather is now quoted at from 30 to 35 cents per pound. Estimating at 32 cents per pound, a kilogram will cost 70½ cents in American coin; this, converted to Mexican silver at the present rate of exchange of 1·50 dols. will be 1·05 dols. per kilog. Adding the duty of 1·50 dols., we will have 2·55 dols. as the cost in Mexico of 1 pound of harness leather that originally cost 32 cents, without any allowance for freights, commissions, &c. The best grades of Mexican harness leather cost about 1·90 dols. to 2 dols. The finer grades of calf, kip, and patent and morocco can stand such a heavy duty.

Practically no rubber footwear is imported to Mexico. Rubber ponchos and mackintoshes come almost exclusively from Europe, because cheaper than in the United States. The trade in this line of rubber goods is sufficiently large to merit the attention of our rubber manufacturers. Patterns of rubber ponchos can easily be secured. Ponchos and rubber coats for the Mexican trade should have three essential points—cheapness, light weight, and a certainty not to stick when rolled up for any time in hot water.

GENERAL TRADE NOTES.

The Consumption of Wood Pulp in Germany.

The Prussian Secretary of State has recently published an interesting report upon this industry. Scarcely any other branch of industry, says the report, has shown so rapid an extension as the manufacture of chemical pulp. Up to 1882 the greater number of mills still worked the soda process. After Dr. Mitscherlich's claim for a Royalty on all pulp made by the sulphite process had been cancelled by the law courts, a great number of sulphite works were erected, and somewhat anticipated the expected greater consumption. The price of 42 marks per 100 kilos. during the time of the monopoly went down to about half that figure, in spite of higher cost of wood and coal, and the introduction of the Compulsory Workmen's Insurance Fund.

This fall has caused a great number of mills to work without profit, and to lose even the interest on the capital invested. Those works that made arrangements with Dr. Mitscherlich realised large profits during the time of the monopoly, and therefore suffered from its abolition, but the trade as a whole derived a great benefit from this decision, which could in justice not have been otherwise. Nor could the Austrian and the Scandinavian competition have been prevented from seriously injuring the Prussian makers, both in foreign parts and in their own country.

The present production of chemical pulp is about 150,000 tons, of an estimated value of 1,700,000*l*. One-third is exported and two-thirds consumed in the country. The wood necessary for this production is a million cubic metres, mostly pine. The number of workmen employed is about 8,000. Of the 150,000 tons of chemical pulp only 12,500 are soda, the remaining 137,500 being sulphite. As the production in 1889 was only 100,000 tons, it has since been increased by 50 per cent.

The exports comprise 5,000 tons of soda and 45,000 tons of sulphite. Of the 62 factories in operation in 1892, only 21 participate in the export, 21 consume their own pulp, and do not sell it, and 21 sell it in the country only.

Wood, coal, wages, and freights are all factors which place the Germans at a very great disadvantage as compared with their Scandinavian competitors. Wood there costs half as much as in Germany, and fuel is very much cheaper. The late great rise in German coal has injured the German paper trade all the more, as Germany does not possess a water-power at all to be compared with that of its rivals. A third disadvantage was the running up of wood prices. But even at normal wood and coal prices the Scandinavians still have the advantage. Wages are much lower; nor has the Scandinavian maker to contribute to a workmen's insurance fund, which costs the German chemical pulp industry 10,000*l.* per annum.

Freights are also against the Germans. The steamers which bring the cheap English coal to Norway and Sweden take pulp back at very low rates, after it has been carried from inland works to the ports very inexpensively on the numerous canals. The saw mills offer their remnants as fuel at almost a nominal price to the pulp-maker.

Austria has also many advantages over Germany—cheaper wages, lower freights, and State assistance, which often shows itself in an exemption from taxation. Nor is the import duty high enough to prevent foreign pulp from coming into Germany. Considering the great advantages the foreign competition enjoys, the German pulp-makers ask for assistance through lower freights, both on raw material and on the pulp as well for inland sales as for exportation.

If in spite of all the disadvantages enumerated above, the German chemical industry has been able to hold its own; this is simply owing to its superior quality, which it is stated is unrivalled for cleanness, white colour, and great strength of fibre. So says this official report.—*Chemical Trade Journal.*

The Proposed Patent Law Amendment.

At the last ordinary meeting of the Board of Directors of the Manchester Chamber of Commerce the special committee appointed to consider the question of amending the present Patent Law, laid their report before the Board.

The report states that an amendment of the law of Patents is desirable, making the following provisions:—(1) an official preliminary examination of applications for patents; (2) the compulsory working on a manufacturing scale within a fixed time of foreign inventions patented in this country; and (3) the restriction of the power to amend specifications of patents. At the suggestion of the committee the Board agreed to confine its efforts at present to the attainment of the first of these objects, and the following resolution was passed:—"That a strong recommendation be made to the Government asking it to take early steps to bring in a Bill reforming the present patent laws, so as to make them, so far as relates to preliminary examinations, analogous to the law and practice at present in force in the United States of America, and that Chambers of Commerce, the Institute of Inventors, the Chartered Institute of Patent Agents, the Society of Chemical Industry, and other kindred Societies be invited to co-operate in this movement."—*Ibid.*

The Russian Platinum Deposits.

The most distinctive feature of the platinum beds in the Ural Mountains is that in them the metal occurs in grains, embedded in a layer of friable, easily washable sand, whereas in Brazil and the American Andes the platinum occurs in hard serpentine rocks as an ore, and is never found in grain form. The principal districts in the Urals in which platinum is found are at Bisserski, in the Government of Perm, in the district of Khotourski, and in the State properties of Goroblagodatski, where 66 mining concessions have already been granted. On the western declivity of the Ural Mountains there is another platinum bed, near the river Outka. The proportion of platinum grains is from 17 to 21 grms. to every 1,640 kilos. of sand. In some of the beds the thickness of the turf covering the sand does not exceed from 2·16 metres to 2·88 metres, while in others it varies from 10·80 metres to 14 metres, so that it becomes necessary to work underground. The thickness of the platinum sands does not vary much. The platinum found in the northern district contains a considerable proportion of gold, whereas that found in the Taghil district contains hardly any. They are also very different in appearance. The former appears clear and very brilliant, while the latter is of a dull colour, and is frequently found mixed with rare metals, such as iridium and osmium. The demand for platinum for industrial purposes only dates from the last twelve or fifteen years. It is now largely used for electric lighting and dynamo conductors, and considerable quantities of platinum are also employed in chemical and other factories. During the last twelve years the annual production of platinum has averaged about 3,194 kilos., of which half has been derived from the beds in the north of the Ural Mountains, belonging either to the State or to private persons. Throughout the whole world only about 3,270 kilos. of platinum are annually used; but it is anticipated that this amount will soon be considerably increased, and it is stated that the platinum-beds of Bisserski can alone supply the total quantity required for the consumption of the world. When the demand for platinum was insignificant, and the price very low, the gold-miners who found platinum while seeking gold frequently, it is stated, used the former instead of lead as shot for firing at wild birds. All the platinum extracted from the Ural Mountains, after having paid a tax of 3 per cent. in kind, is sent as raw ore to St. Petersburg for treatment and shipment to foreign markets.—*Chemist and Druggist.*

Cyanide of Potassium in Mining.

Cyanide of potassium is now being imported largely into New Zealand for use in the extraction of gold from refractory ores, especially in the Thames district. The duty is 15 per cent., and the Government having been asked to remit this tax when the cyanide is used for mining purposes, have agreed to do so. How they are to distinguish between cyanide for photography and for mining purposes does not seem clear.—*Ibid.*

Japanese Imports of Alcohol.

The *Bulletin du Museé Commercial* of Brussels publishes an extract from a report by the Belgian Legation at Yokohama, with reference to the importation of alcohol into Japan. The following is a translation of this extract:—

For some time the import of alcohol into Japan has been developing in a marked degree.

Although the product does not appear under a special heading in the Customs returns, the value of the alcohol introduced into Yokohama during the first eight months of the year 1892 may be estimated at 41,000*l.*

This enormous importation was at first considered as a result of the development of the chemical industry in the Empire. But it would appear rather that this alcohol, generally of a very inferior quality, is used not only to make imitations of foreign liqueurs, but also to supply many of the shops of the sellers of native rice brandy, which is being replaced among certain classes of the population by a simple mixture of coloured alcohol and water.

In spite of the data given in the official statistics, which classify the liquid in question among "chemical products not distinguished," it may be said, however, that the article is to a great extent of German origin.

The importation is effected either in casks containing 150 kilogrammes net, or in tin cases. For alcohol of 95 degrees, prices vary according to quality between 7*d.* and 8*d.* per pound (English).—*Board of Trade Journal.*

The Use of Wood Pulp.

The *Toronto Monetary Times* for the 2nd December says:—The subject of the cutting of young trees for use in the manufacture of paper is discussed in the annual report of the New York State Forest Commission. The manufacture of wood pulp was at first considered a matter of economy in forestry management, as it furnished a market for the small-sized timber or undergrowth. But the consumption of timber by the pulp mills has increased so rapidly, that it endangers rather than promotes the welfare of the forests. In 1891 the timber cut for wood pulp in the great forest of Northern New York was equal to one-third the amount cut by lumbermen. In the last eight years the amount used for this purpose has increased 500 per cent. This increase would not be so noticeable were it not for the fact that only young trees were taken. Only a small amount of pulp timber can be gathered from the limbs and tops left from lumbering operations.

The principal supply is obtained from spruce and balsams, but only the tree trunks of these varieties are available. The mills on the Upper Hudson use poplar to the extent of 25 per cent., and spruce for the remainder, but the proportion of poplar used is less each year. Other mills use spruce, balsam, poplar, and a small second-growth pine. Hemlock is used to some extent when mixed with other woods, and tamarack is used in small quantities, but no cedar nor hardwood is used.

Wood pulp, when first manufactured in this country, was used for paper only, but new uses for it are multiplying. It is used to some extent in the manufacture of gunpowder, and under the name of indurated fibre, is used to a large extent in making building material, furniture, barrels, and tubs.—*Ibid.*

Queensland Bismuth.

Queensland has now become one of the important sources of the world's supply of bismuth, although at present only one mine is being worked :—viz., that of Flateau and Tarrant, at Selheim, in the Ravenswood district. In December 1891 the property was visited by the Under-Secretary for Mines, who reports that it had upon it 15 engines, representing 30 horse-power and seven shafts down to 82 feet at deepest. The value of the ore already produced was said to be about 30,000*l.* About 38 tons of hand-dressed ores, averaging 17 per cent. to 18 per cent., has been forwarded, and 5 tons of 30 per cent. ore was then ready. The property, which embraces 70 acres, belongs to what is known as the "Bismuth Ring," the London body which controls the sale of the metal. The machinery cost about 7,000*l.*, while the entire expenditure on works and mines had been about 15,000*l.* A number of buildings were leased to workmen, and there was a large settlement around the mine.

The total quantity of bismuth raised in 1890 in Queensland was returned at 31 tons, valued at 1,481*l.*; in 1891, 117 tons valued at 11,070*l.*—*Chemist and Druggist.*

Nitrate of Soda.

Shipments, Consumption, Stocks, and Prices, from 1885 *to* 1892.

——		1885.	1887.	1889.	1891.	1892.
Shipments from South American ports to all parts for the six months ending 31st December.	Tons	243,000	447,000	573,000	494,000	373,000
Do. for the 12 months ending 31st December	„	420,000	680,000	930,000	759,000	784,000
Afloat for Europe on 31st December	„	154,000	325,000	380,000	321,000	215,000
Stocks in United Kingdom ports:—		40,000	16,000	30,000	23,000	20,000
Stocks in Continental ports on 31st December	Tons	116,000	50,000	160,000	191,000	185,000
Consumption in United Kingdom for the six months ending 31st December.	„	22,000	30,000	32,000	30,000	33,000
Do. in Continent do. do.	„	70,000	145,000	205,000	153,000	192,000
Do. in United Kingdom for the 12 months do.	„	95,000	98,000	105,000	120,000	117,000
Do. in Continent do. do.	„	290,000	385,000	564,000	703,000	685,000
Do. in United States do. do.	„	45,000	65,000	80,000	100,000	100,000
Do. *in the World* do. do.	„	430,000	548,000	749,000	923,000	902,000
Visible supply on 31st December (including the quantity afloat, for—Europe and Stocks in United Kingdom and Continent	„	310,000	391,000	570,000	535,000	420.000
London Spot price on 31st December	per Cwt.	11*s.* 3*d.*	9*s.*	8*s.* 4½*d.*	9*s.* 1½*d.*	9*s.* 1½*d.*

——		1885.	1887.	1889.	1891.	1892.
Liverpool	Tons	18,000	2,000	11,000	7,000	9,000
London	„	6,200	3,250	4,100	3.900	3,500
Out ports	„	15,800	10,750	14,900	12,100	7,500

—W. Montgomery & Co.'s Circular.

FOREIGN TRADE RETURNS.

The following is a monthly review of the export and import trade of foreign countries in chemical and allied products such as are produced in the United Kingdom. The actual amount exported by, and imported into Great Britain being specified where possible.

Germany.

During the year 1890—91 there were 91 salt works in operation in Germany, from which there were extracted 10,613,206 quintals of salt; the production of the 92 works operating in 1889—90 having been 10,054,324 quintals. The exports are returned as below, in quintals:—

	1890—91.
To German countries not in the Customs Union	94,916
Belgium	225,384
Denmark	60,907
England	129,163
Holland	240,297
Austria-Hungary	222,233
Russia	122,794
Sweden	103,239
British India	576,064
Australia	58,595
Other Countries	132,280
Total exports	1,965,872

Imports in 1890—91 attained to only 26,499 quintals, of which 23,228 were derived from England, and 1,466 from Portugal.

AUSTRIA-HUNGARY.

The following are the returns of the Statische Übersicht for the first nine months of 1892 (January to September). In the under-mentioned imports every item, with the exception of "chemical substances," shows an increase, while in the exports, gums and resins, minerals and chemical substances, show an increase as compared with the same period in 1891. The total imports and exports, as compared with the corresponding period of last year, show a decrease in both cases.

Class.	Imports.	Exports.
	Met. Ct.	Met. Ct.
Seed oil, &c.	225,570	3,695
Minerals	3,169,585	5,685,883
Dye and tannin stuffs	337,813	513,990
Gums and resins	279,802	124,909
Minerals, oils, &c.	1,069,808	16,837
Chemical substances	536,720	215,888
Chemical products	53,007	65,331

(A metric centner is about 91 lb. avoirdupois.)

INDIA.

The following is a *résumé* of the official returns published by order of the Governor-General in Council, and represents the imports of foreign merchandise into India, and the exports of Indian manufacture and produce, for the month of August 1892 :—

Imports.

Class.		Quantities.
Salt	Ton.	41,908
Quicksilver	Lb.	20,325
Alum	Cwt.	7,700
Arsenic	,,	130
Bicarbonate of soda	,,	1,790
Chemicals for paper making	Value (Rs.)	52,152
Sulphur	Cwt.	1,923
Quinine	Lb.	1,923
Aniline and alizarine dyes	Oz.	7,926,624
Mineral oils	Gall.	2,887,403
Linseed oils	,,	18,456
Gums and resins	Cwt.	9,288
Manures	Ton.	4
Pitch, tar, and dammer	Cwt.	10,201
Dynamite and other explosives	,,	Nil.
Cement	,,	40,979
Candles	Lb.	507,518
Paints and colours	Cwt.	13,581
Soap, all kinds	,,	4,751

Exports.

Class.		Quantities.
Cinchona bark	Lb.	57,247
Cutch	Cwt.	7,713
Indigo	,,	3,181
Myrabolans	,,	34,574
Turmeric	,,	5,752
Castor oil	Gall.	182,712
Cocoanut oil	,,	73,293
Borax	Cwt.	433
Caoutchouc	,,	219
Mica	,,	266
Saltpetre	,,	19,464
Shellac	,,	2,678
Oil cake	,,	35,278
Soap	,,	619

In the above mentioned, out of the sum total for each item, the following quantities were either shipped from, or sent to, the United Kingdom :—

Imports of salt, 28,887 tons were imported from the United Kingdom, and 5,217 from Germany. Of quicksilver, 10,950 lb. are sent from the United Kingdom. Gums and resins: of the 9,288 cwt. of gums and resins, 6,696 were resin. Of paints and colours, 12,067 cwt. were sent from the United Kingdom.

N.B.—All petroleum which has its flashing point at or above 200° F., and is proved to the satisfaction of the Customs collector to be intended to be used for the batching of jute or other fibre, or for lubricating purposes, is free of duty.

Exports of cutch, 1,446 cwt. were sent to the United Kingdom; of indigo, 2,772 cwt.; myrabolans, 24,669 cwt.; turmeric, 2,270 cwt.; castor oil, 53,046 gall.; cocoanut oil, nil; caoutchouc, 195 cwt.; of saltpetre, 11,397 cwt. were sent to the United Kingdom, and 2,800 cwt. to the United States, America; of shellac, 1,311 cwt. were sent to the United Kingdom; to France, 12 cwt.; to the United States, America, 609 cwt.; and 746 cwt. to other countries.

The total value of the imports for August 1892, as compared with the same month in 1891, show an increase, while the exports have decreased. For the five months, April to August 1892, as compared with that period in 1891, there has been a decrease in both exports and imports.—*Chemical Trade Journal.*

ITALY.

The following are the returns for the first ten months of 1892, January to October :—

Class.	Imports.	Exports.
	Lire.	Lire.
Chemicals, medicines, &c.	36,123,010	33,676.525
Colours, paints, and dyes	20,583,538	8,185,843
Minerals and metals	97,418,819	34,560,412

(A lire is equivalent to 9½*d.*)

In the imports minerals and metals show a decrease, the other two items showing an increase as compared with the same period in 1891. In the exports there is an increase all round as compared with the same period. In regard to the total imports and exports, there has been an increase in both cases.

Mineral, Metallurgical, and Industrial Chili.

C. Vattier. Mem. de la Soc. des Eng. Civils, Paris, July 1892, 371—140; Proc. Inst. Civil Eng. 1892—3, **111** (1), 66—69.

The object with which this paper is written is to draw the attention of French engineers, and of others interested in the extension of French industry, to the large field for their energy which exists in Chili, which of all the South American Republics is the most enlightened, the most honest, and the most liberal protector of industrial undertakings. The climate is healthy; hot and dry in the north, temperate in the centre, and wet, but never very cold in the south. The labouring classes are brave, intelligent, and first-rate workmen in mining and metallurgical operations, in which last they compete on equal terms with the best European artizans.

Frenchmen already occupy many important posts, chiefly in the schools of medicine, of architecture, of arts and handicrafts, of agriculture, &c., but the commerce and industry of the country when conducted by foreigners are mostly in the hands of Englishmen and Germans. One of its most important industries consists in the production of nitrate of soda, in the province of Tarapaca, the export duty on which produces to the Government an annual revenue exceeding 2,500,000*l*. The works are owned chiefly by Englishmen, some few by Germans and Italians, but hardly any by Frenchmen or Chilians. They are situated on elevated plains, of which the centre is at about forty miles from the Port of Iquique. The raw nitrate of soda yields from 20 to 40 per cent. of pure saltpetre, which is separated from the earth by boiling it under pressure, and many works have been erected on a vast and costly scale for extracting and refining it.[*] There are also various establishments for the manufacture of Roman cement, beet-root sugar, beer, potato and grain spirit, ice, aërated waters, gunpowder, rope, cloth, coarse paper, lucifer matches, &c., and at Santiago, Valparaiso, Caldera, and Carrizal there are large foundries and workshops in which pumps, boilers, and even (at Valparaiso) railway locomotives have been constructed.

Geologically, the country may be divided into three regions, with two ranges of mountains, or *Cordilleras*, viz., the Western, or Maritime Cordillera, and the more elevated Andes. Granites, syenites, and other crystallised rocks are met with in the western range of mountains which forms the first region, and it is here that the most important copper and gold mines are found. Eastward of this range is the second geological region, which consists of stratified rocks of different ages, among which are jurassic limestones and clays, rich in fossils, and gypsum and barytes, resting in some places on metamorphic rocks and in some on other stratified rocks, Here are found iron and manganese ores, and the richest silver mines, such as those of Caracoles and Chanarcillo. Further to the east lies the third region, which extends partly up the slopes of the Andes; the rocks consist of conglomerates, porphyries, and schists, and contain iron and manganese ores, rich sulphates of copper (as at Los Condes, in the province of Santiago), and other minerals.

Gold is met with in many parts of Chili, but has not been worked on a large scale. At Guanoco, in the department of Taltal, very fine specimens are found in a matrix of quartz and sulphate of baryta, which is often transparent, and a good deal of gold is raised and exported. There are also mines worked in the provinces of Copiapo, Coquimbo, and Santiago; the value of the gold exported in 1890 was about 90,000*l*.

The silver mines are much more important. Near Iquique, at a few miles from the sea coast, rich silver ore is raised at the mine of Huantajaya, and the mines of Caracoles, on the line of railway from Antofagasta to Bolivia, have produced enormous quantities of rich silver ore since their discovery in 1869. There are other important mines at Los Condes, Cachinal, Chanarcillo, Tres Puntas, Chanaral, and some in the provinces of Copiapo, Huasco, Vallenar, and Coquimbo. Bar silver of the value of 993,499*l*. and silver ore of the value of 69,351*l*. were exported in 1889, and besides this a considerable amount of silver was sold to the Mint at Santiago.

Above all, their copper mines for a long period formed the principal mineral wealth of Chili. Forty years ago Chili supplied one-third of the world's yield of copper, and until a few years since the annual produce was 40,000 tons, but this has now fallen to about 22,000 tons, while it is estimated that the rest of the world will produce upwards of 300,000 tons in 1892. It was customary until about fifty years ago to work only such mines as produced native copper and copper oxides, carbonates and oxychlorides (*atacamite*), and when, at a certain depth, copper sulphides (pyrites) were met with, they were thrown aside because they could not be smelted in the small furnaces which were at that time used. But in 1840 a French engineer, Mr. Lambert, showed the people how to treat copper pyrites. He acquired mines in the province of Coquimbo, which is now the principal centre of copper production, and founded a wealthy family, now English. These pyrites contain only 3 per cent. to 4 per cent. of copper, while the average yield in Chili is from 12 to 14 per cent. The ores richest in copper are those of San Augustin, Los Bronces, Rio Blanco, &c., near to the rich silver mines of Los Condes, north-east of Santiago, and they contain from 20 to 25 per cent. of copper; but the great elevation of this district above the sea renders it impossible to work the mines for more than seven or eight months of the year. Other rich copper mines, far too numerous to particularise, are met with throughout the country.

Iron ores are met with in great abundance, and the author earnestly impresses on his countrymen the advantage they might derive from being the first to establish blast-furnaces near to the immense virgin forests in the south of Chili, for the purpose of producing and also exporting charcoal iron. Lignite of good quality, in beds of from 2 to 5 feet in thickness, is found in abundance in the province of Bio Bio, not far from the sea-coast at Lota, Coronel, Arauco, and Labu; about 600,000 tons are now raised annually, and the production is rapidly increasing. Manganese ore containing 56 per cent. of peroxide and 24 per cent. of protoxide is now exported to England and to the United States on a considerable scale.

The several systems on which the mines are worked, and the ores enriched by washing and selection, and finally roasted and fused, are described at great length in the paper. Copper ores of 3 or 4 per cent. are usually raised by such means to 16 or 18 per cent., and sometimes, as at Invernada, near Tiltil, to from 45 to 50 per cent. When roasting the copper ores it is important to be able to mix oxides and sulphides together, by which means, as at Lota, in the province of Illapel, a regulus is obtained at a single roasting containing 50 per cent. of copper. The ores are smelted sometimes with wood, but more often with lignite, or foreign coal, and usually in reverberatory furnaces similar to those used at Swansea; but in some parts of the country blast-furnaces are preferred. They are cheaper to construct, and a greater quantity of ore can be treated in them at one fusion, 40, 50, and even sometimes as much as 60 tons being fused in twenty-four hours.

In the treatment of silver ores containing less than 10 per cent. of lead, a system of amalgamation was introduced in 1862 by the late Mr. Hertzog, and further improved by Mr. Kronke, by whose name it is now known, which, in the opinion of the author, is very superior to the processes employed either in the United States or in Europe. A sub-chloride of copper is prepared by dissolving together in wooden casks some sulphate of copper and salt, adding thereto some leaves of metallic copper, steam being then admitted until the whole has acquired a green appearance. From 3 to 5 tons of finely-ground silver ore having been charged into a large wooden vat 7 feet in diameter, a hot salt solution and some of the chloride of copper preparation (varying in quantity according to the nature of the silver ore) are added to it, The vat is then made to revolve, at first slowly, until the whole is well mixed together, when some mercury and an amalgam of zinc, with the addition of more water, and sometimes of a little sodium, are introduced into the mass and thoroughly mixed with it.

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[*] Minutes of Proceedings Inst. C. E., vol. lxxxii., p. 337.

After this the vat is again revolved more rapidly during six or eight hours. The greater part of the mercury and amalgam is then allowed to collect at the bottom of the vat, and the rest is poured into a vertical wooden pug-mill, and again stirred up. The liquid mud is made to run from this over a winding, inclined, and slightly corrugated floor, more water being added until the matrix has been exhausted; the mercury and amalgam are collected and washed, filtered, prsssed, and distilled in the usual way. Two operations are performed in twenty-four hours, and this system of amalgamation is much more economical than the fusion of the ores.

Mines of mercury, of cobalt, and of nickel are met with, but only worked on a small scale.

ARTICLES OF INTEREST TO TECHNOLOGISTS AND MANUFACTURERS.

The following articles, which appear in the *Board of Trade Journal* for November, will repay perusal.

"Mineral Production, &c., in Russia"	p. 14
"Ramie Machine Trials at New Orleans"	p. 30
"The Mineral Wealth of Venezuela"	p. 38
"Mineral Products of Canada"	p. 42
"New Customs Tariff of Queensland"	p. 70
"The precious metals of New Brunswick"	p. 93

NEW MANURE ADULTERATION ACT.

NEW ZEALAND.

An Act for the better Prevention of Frauds in the Sale of Manures for Agricultural Purposes.

Be it enacted by the General Assembly of New Zealand in Parliament assembled, and by the authority of the same, as follows:—

1. The short title of this Act is "The Manure Adulteration Act, 1892." It shall come into operation on the first day of March, one thousand eight hundred and ninety-three.

2. In this Act, if not inconsistent with the context,—

"Analyst" means any person appointed as an analyst under "The Adulteration Prevention Act, 1880:"

"Manure" means and includes artificial and all other manures for agricultural purposes, other than farm-yard and stable manure, lime, refuse from fell-mongeries, gasworks, tanneries and such like.

3. Every person who sells any manure shall deliver to every purchaser of such manure in any quantity not less than ten hundredweight, at the time of purchase, or not later than the delivery thereof to the purchaser, an invoice-certificate which shall be printed or legibly written and having the written or printed signature at the foot thereof of such vendor or his agent.

Every such invoice-certificate shall state—

(1.) The names in full and the place of business or places of business of the manufacturer and vendor of such manure, if manufactured within the colony, and, if imported, then the name and place of business of the vendor;

(2.) The figure, word, trade-mark, or trade description which is to be stamped upon or affixed to every sack, barrel, case, or other package containing any portion of such manure delivered with such invoice-certificate;

(3.) In the case of "artificial manure," the percentage of soluble phosphate of lime, of insoluble phosphate of lime, and of nitrogen, or its equivalent as ammonia;

(4.) In the case of "bone-dust," or "bone-meal," the percentage of tribasic phosphate of lime and of ammonia;

(5.) In the case of "nitrate of soda" the guaranteed percentage of pure nitrate of soda;

(6.) In the case of "mineral superphosphates," the guaranteed percentage of soluble phosphate of lime;

(7.) In the case of "sulphate of ammonia," the guaranteed percentage of ammonia;

(8.) In the case of "guanos and mineral manures," the guaranteed percentage of the various phosphates and their calculated equivalents as phosphate of lime, and of ammonia;

(9.) In the case of "muriate of potash," the guaranteed percentage of pure muriate of potash;

(10.) In the case of "kainit," the guaranteed percentage of sulphate of potash;

(11.) In the case of "basic slag," the guaranteed percentage of the various phosphates and their calculated equivalents as basic phosphate of lime;

(12.) The value per unit per ton the vendor attaches to each constituent of said manures, such unit-value to be the basis of valuation.

4. Every person who sells or offers for sale any manure, as provided by the preceding section, shall brand upon, or durably affix to, or cause to be branded upon or durably affixed to, every sack, barrel, case, or other package, containing any portion of such manure, the name of the manufacturer or vendor, and a figure, word, trade-mark, or trade description corresponding to the figure, word, trade-mark, or trade description stated in the invoice-certificate, as provided in the preceding section.

5. Every person who sells any manure in any quantity not less thad ten hundredweight and fails to deliver to any purchaser thereof an invoice-certificate as provided in section three of this Act, or who fails to stamp upon or affix to every package of such manure a mark of indentification as provided in section four of this Act, is guilty of an offence against this Act, and is liable, on summary conviction, for the first offence to a penalty not exceeding ten pounds and not less than one pound, and for the second or any subsequent offence to a penalty not exceeding twenty-five pounds.

6. Every purchaser of any manure under the provisions of this Act is entitled, on payment to an analyst of such sum as may be agreed upon between such person and the analyst, to have such manure analysed by such analyst and to receive from him a certificate of the result of such analysis, and for such purpose the said person shall deliver or send to such analyst, within fourteen days after the delivery of such manure, and before bulk is otherwise broken, a sample thereof, sufficient in quantity for the purposes of such analysis, in the manner provided in the next section.

7. The person purchasing any manure under the provisions of this Act with the intention of submitting the same to analysis shall, after the purchase shall have been completed, forthwith notify to the vendor or his agent selling such manure his intention to have the same analysed by the public analyst under this Act, and shall offer to divide in the presence of the vendor or his agent, and immediately on the delivery of the said purchase, any sufficient sample of the contents of such packages into five parts, to be then and there separated, and each part to be marked and sealed, and fastened up in such manner as its nature will permit, and shall, if required to do so, proceed accordingly, and shall deliver two of the parts to the vendor or his agent; he shall afterwards retain two of the said parts for comparison, and submit the fifth part, to have the same analysed, to the analyst.

8. The vendor or his agent may also send one of their portions of the sample as herein provided to any analyst, and should the analysis so obtained be different from that obtained by purchaser, as provided for by section six, then one or both remaining parts of samples shall be forwarded to the school of agriculture analyst at Lincoln, the mean of the three analyses to be accepted.

9. If the analyst does not reside within two miles of the residence of the person requiring a sample of the manure to be analysed under the provisions of this Act, such sample may be forwarded to the analyst through the post as a registered parcel, subject to any regulation which the Postmaster-General may make in reference to the carrying and delivery of such sample, and the charge for the postage thereof shall be deemed to be one of the charges of this Act, or of the prosecution, as the case may be.

10. The certificate of the analysis shall be in the form set forth in the Schedule hereto, or to the like effect, and shall

state explicitly in what particulars, if any, and to what extent, the result of such analysis materially differs from the statements set forth in the invoice-certificate delivered to the purchaser of the manure so analysed; and a copy of the analyst's certificate shall be sent forthwith by the said purchaser to the vendor of the manure or his agent.

11. The certificate of analysis shall also state the total value of the manure sampled, on the basis of the value per unit per ton, published by the vendor, any difference between such total value and the price charged for such manure to be allowed for by vendor at the unit price specified in invoice. Should such deficiency exceed the following limits, that is to say, phosphates (soluble or insoluble), three per centum; potash, one per centum; nitrogen, one per centum; such deficiency to be allowed for by vendor at double the aforesaid unit-values until they reach the following limit: Phosphates, six per centum; potash, two per centum; nitrogen, one and a half per centum. Should the certificate of analysis show a greater difference than herein provided for from the statements of the invoice-certificate, the vendor shall be liable on summary conviction before a resident magistrate, for the first offence to a penalty not exceeding twenty pounds and not less than two pounds, and for a second or any subsequent offence to a penalty not exceeding fifty pounds and not less than five pounds.

12. At the hearing of the information in such proceedings, the production of the certificate of the analyst shall be sufficient evidence of the facts therein stated, unless the defendant shall require that the analyst shall be called as a witness, and that the part of the sample retained by the purchaser shall be produced.

13. Every person who forges, or utters knowing to be forged, for the purposes of this Act, any certificate as provided for under this Act is guilty of a misdemeanor, and is punishable, on conviction, by imprisonment for a term not exceeding two years, with hard labour.

Every person who in any proceedings under this Act wilfully applies to any package containing manure, a certificate, or a mark of identification corresponding to such certificate, given or used in describing or identifying any other and different manure or package thereof is guilty of an offence under this Act, and is liable, on summary conviction, to a penalty not exceeding twenty pounds and not less than two pounds.

14. Every analyst shall report quarterly to the Colonial Secretary the number and nature of the articles analysed by him under this Act during the foregoing quarter, and shall specify the result of each analysis, and the sum paid to him in respect thereof.

15. Nothing in this Act contained shall affect the power of proceeding by indictment, or take away any other remedy against any offender under this Act, or in any way interfere with any right or remedy by civil process at law or equity which any party aggrieved by any offence against this Act might have had if this Act had not been passed.

16. The Colonial Secretary may at his discretion issue an order authorising a county council, for any period of time specified in such order, to appoint one or more inspectors, who, if so directed by the county council at any time during the period specified in such order, shall obtain samples as provided in section seven of this Act, and from the bulk of each lot of any manures offered for sale within such county, and shall be entitled to obtain an invoice-certificate thereof from the vendor, as provided in section three of this Act, and shall submit the same to be analysed by the analyst; and such analyst shall with all convenient speed analyse the same, and give a certificate to such inspector, wherein he shall specify the result of such analysis, and shall state explicitly in what particulars, if any, such result materially differs from the statements set forth in the invoice-certificate.

17. If any such inspector shall so apply to purchase portions of not less than five packages of such manures so offered for sale within the county, and shall tender the price for the quantity he shall require for the purpose of analysis, not being more than shall be reasonably requisite, and the person offering such manures for sale shall refuse to sell the same to such inspector, or to deliver to him an invoice-certificate thereof, as provided in section three of this Act, then such person shall be liable to a penalty not exceeding ten pounds, and not less than one pound.

SCHEDULE.

"*The Manure Adulteration Act*, 1892."—*Form of Analyst's Certificate.*

To [*Here insert the name of the person submitting the article for analysis*].

I, the undersigned, Public Analyst under "The Adulteration Prevention Act, 1880," do hereby certify that I have received on the day of 18 , from [*Here insert the name of the person delivering sample*], a sample of for analysis, and have analysed the same, and declare the result of my analyses to be as follows:—

I am of opinion that the said sample contained the parts as under [*or*, the percentages of constituent substances as under]:—

I have examined the invoice-certificate tendered or delivered with said sample, and find that it corresponds with the results of my analysis [*or*, that it differs from the results of my analysis in the following particulars: that is to say,—]

Observations.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

—	Year ending 31st December	
	1891.	1892.
	£	£
Metals	23,030,124	21,093,537
Chemicals and dyestuffs	7,314,337	7,707,390
Oils	7,339,994	7,076,035
Raw materials for non-textile industries.	40,035,435	40,977,063
Total value of all imports	435,691,279	423,892,178

SUMMARY OF EXPORTS.

—	Year ending 31st December	
	1891.	1892.
	£	£
Metals (other than machinery)	39,210,022	33,057,739
Chemicals and medicines	8,877,712	8,587,506
Miscellaneous articles	32,203,658	28,676,725
Total value of all exports	247,235,150	227,060,224

Imports of Metals for Year ending 31st December.

Articles.		Quantities.		Values.	
		1891.	1892.	1891.	1892.
Copper :—				£	£
Ore	Tons	90,664	91,919	739,590	585,273
Regulus	„	123,337	134,168	3,319,938	3,292,106
Unwrought	„	44,348	35,057	2,372,250	1,655,540
Iron :—					
Ore	„	3,180,543	3,778,653	2,453,107	2,715,420
Bolt, bar, &c.	„	77,416	75,915	751,587	692,259
Steel, unwrought	„	8,436	7,083	87,568	62,936
Lead, pig and sheet	„	169,724	182,782	2,137,674	1,976,436
Pyrites	„	616,227	604,411	1,126,247	1,063,506
Quicksilver	Lb.	4,707,804	4,274,274	507,503	396,184
Tin	Cwt.	563,144	589,365	2,565,072	2,743,814
Zinc	Tons	58,483	52,793	1,328,750	1,102,591
Other articles	Value £	..	..	5,640,538	4,807,472
Total value of metals		..	..	23,030,124	21,093,537

Imports of Raw Material for Non-Textile Industries for Year ending 31st December.

Articles.		Quantities.		Values.	
		1891.	1892.	1891.	1892.
				£	£
Bark, Peruvian	Cwt.	106,551	106,401	250,697	230,557
Bristles	Lb.	3,413,175	3,001,385	498,383	439,356
Caoutchouc	Cwt.	278,845	272,163	3,351,938	2,982,412
Gum :—					
Arabic	„	62,352	68,602	162,232	191,617
Lac, &c.	„	109,354	114,833	426,519	445,584
Gutta-percha	„	60,911	45,497	734,841	519,511
Hides, raw :—					
Dry	„	453,268	368,191	1,185,360	946,354
Wet	„	555,692	540,284	1,251,278	1,136,524
Ivory	„	10,952	11,505	549,259	559,073
Manure :—					
Guano	Tons	23,623	27,874	138,642	189,433
Bones	„	82,945	63,008	416,849	286,452
Paraffin	Cwt.	559,352	552,572	805,034	749,704
Linen rags	Tons	32,937	23,032	318,855	213,565
Esparto	„	212,666	212,967	1,030,938	1,029,903
Pulp of wood	„	156,464	199,938	848,986	981,025
Rosin	Cwt.	1,811,740	1,631,393	400,939	384,050
Tallow and stearin	„	1,371,201	1,375,679	1,772,268	1,747,968
Tar	Barrels	124,868	131,886	79,940	80,412
Wood :—					
Hewn	Loads	2,251,577	2,469,140	4,508,787	4,905,846
Sawn	„	4,378,452	5,094,309	9,379,808	11,180,141
Staves	„	130,101	136,063	590,543	593,539
Mahogany	Tons	48,021	56,315	449,433	501,213
Other articles	Value £	..	..	10,883,906	10,682,824
Total value		..	..	40,035,435	40,977,063

☞ Besides the above, drugs to the value of 832.762*l.* were imported, as against 812,531*l.* in 1891.

Imports of Chemicals and Dyestuffs for Year ending 31st December.

Articles.		Quantities.		Values.	
		1891.	1892.	1891.	1892.
				£	£
Alkali	Cwt.	87,168	56,245	50,404	41,516
Bark (tanners, &c.)	„	489,846	380,337	216,815	158,105
Brimstone	„	428,778	521,589	129,512	147,781
Chemicals	Value £	..	..	1,369,073	1,516,686
Cochineal	Cwt.	7,911	5,153	47,547	33,763
Cutch and gambier	Tons	23,926	25,192	565,453	548,395
Dyes :—					
Aniline	Value £	..	..	239,391	198 712
Alizarine	„	..	..	331,374	335,001
Other	„	..	..	15,907	8,529
Indigo	Cwt.	50,879	71,344	1,043,442	1,356,695
Nitrate of soda	„	2,440,652	2,372,813	1,049,818	1,012,519
Nitrate of potash	„	278,782	308,381	251,021	267,823
Valonia	Tons	17,202	33,173	334.268	459,429
Other articles	Value £	..	..	1,670,612	1,622,436
Total value of chemicals		..	..	7,314,337	7,707,390

Imports of Oils for Year ending 31st December.

Articles.		Quantities.		Values.	
		1891.	1892.	1891.	1892.
				£	£
Cocoa-nut	Cwt.	186,469	164,569	264,228	190,380
Olive	Tuns	18,105	20,476	733,435	763,112
Palm	Cwt.	1,018,420	1,058,580	1,186,705	1,169,490
Petroleum	Gall.	130,615,360	130.188,085	2,685,458	2,446,906
Seed	Tons	23,011	22,033	609,890	555,842
Train, &c.	Tuns	21,969	21,121	454,704	415,180
Turpentine	Cwt.	422,530	516,597	576,207	590,933
Other articles	Value £	..	..	829,367	944,192
Total value of oils		..	..	7,339,994	7,076,085

Exports of Drugs and Chemicals for Year ending 31st December.

Articles.		Quantities.		Values.	
		1891.	1892.	1891.	1892.
				£	£
Alkali	Cwt.	6,227,400	5,885,655	2,335,281	2,118,791
Bleaching materials	„	1,513,700	1,489.979	522,415	598,929
Chemical manures.	Tons	321,919	339,125	2,111,350	2,136,099
Medicines	Value £	..	..	1,053,436	1,012,303
Other articles	„	..	..	2,855,239	2,721,384
Total value		..	..	8,877,712	8,587,506

Exports of Metals (other than Machinery) for Year ending 31st December.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Brass............ Cwt.	114,014	108,088	516,606	452,623
Copper:—				
Unwrought..... „	707,182	846,032	1,964,748	2,062,087
Wrought........ „	323,292	324,330	1,076,849	973,111
Mixed metal.... „	281,399	295,096	786,515	730,311
Hardware..... Value £	..	..	2,527,375	2,206,563
Implements....... „	..	..	1,311,573	1,261,332
Iron and steel..... Tons	3,240,146	2,740,217	26,877,000	21,763,190
Lead............. „	48,233	58,101	682,479	707,573
Plated wares... Value £	..	..	390,655	321,999
Telegraph wires, &c. „	..	..	1,434,020	910,070
Tin............... Cwt.	103,307	112,954	491,492	544,376
Zinc.............. „	153,485	196,805	161,733	179,587
Other articles .. Value £	..	..	988,777	944,917
Total value.........	..	..	39,210,022	33,057,739

Exports of Miscellaneous Articles for Year ending 31st December.

Articles.	Quantities.		Values.	
	1891.	1892.	1891.	1892.
			£	£
Gunpowder...... Lb.	11,224,400	7,936,400	274,394	202,392
Military stores.. Value £	..	..	1,145,020	1,022,444
Candles.......... Lb.	15,874,200	18,367,300	314,394	344,388
Caoutchouc..... Value £	..	..	1,242,794	1,216,662
Cement.......... Tons	575,969	493,128	1,140,697	902,599
Products of coal Value £	..	..	1,569,914	1,339,731
Earthenware... „	..	..	1,958,344	1,899,859
Stoneware...... „	..	..	149,532	152,776
Glass:—				
Plate........... Sq. Ft.	3,284,513	2,158,046	212,422	116,569
Flint........... Cwt.	109,502	94,851	242,938	227,056
Bottles......... „	791,147	754,375	371,354	360,881
Other kinds.... „	213,974	220,436	186,703	181,931
Leather:—				
Unwrought.... „	148,975	131,446	1,364,183	1,244,674
Wrought..... Value £	..	..	386,001	332,577
Seed oil.......... Tons	70,416	67,318	1,535,283	1,318,725
Floorcloth ..... Sq. Yds.	19,685,000	16,417,400	833,787	711,160
Painters' materials Val. £	..	..	1,617,318	1,524,600
Paper........... Cwt.	1,003,863	930,601	1,732,594	1,579,550
Rags............. Tons	49,638	57,699	355,135	401,833
Soap............. Cwt.	524,382	541,949	571,362	586,223
Total value..........	..	..	32,203,658	28,076,725

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

1892.

23,321. L. B. Miller, and M. W. Woods. Heating liquids by electricity. December 19.

23,404. J. S. Williams. Improvements in methods and means for treating wood and other materials thermically, thermo-chemically, and chemically. December 19.

23,850. W. V. V. Lidgeriwood. Improvements in drying plant. December 24.

23,876. M. Arndt. Apparatus for ascertaining the volume of a particular gas in a gaseous mixture, and for ascertaining the weight of gases. December 27.

24,109. J. J. Meldrum, and T. F. Meldrum. Improvements in or connected with puddling, heating, and other furnaces. December 31.

1893.

54. R. Sickel. Improvements relating to the evaporation of liquids and to apparatus therefor. January 2.

91. F. M. and D. D. Spence. *See* Class XVIII.—B.

145. J. Y. Johnson. From A. Bornholdt, and J. Glatz, United States. Improvements in and apparatus for separating, by means of highly compressed air, fluid from solid substances, or lighter from heavier particles of liquid bodies. Complete Specification. January 3.

187. B. Redwood, F. Clowes, and S. Waters. Improvements in the detection and estimation of combustible gas or vapour present in air, and apparatus for that purpose. Complete Specification. January 4.

439. J. Dewar. Improvements in the production of vacuum and means for that purpose. January 9.

513. H. D. Fitzpatrick. From F. A. Kleemann, Germany. Improvements in apparatus for heating and cooling fluids. Complete Specification. January 10.

816. H. A. A. Dombrain, and J. S. Critchley. Apparatus for drying granular pulverulent or pulpy substances. January 13.

Complete Specifications Accepted.*

1892.

801. J. Pelat. Apparatus for use in filtering and purifying oils, glucose, or other like matters. December 31.

3215. C. Pryce. Improvements in kilns. December 31.

19,837. A. H. Wendt. Apparatus for controlling the flow of acid or other liquid to and from casks or other receptacles. December 31.

II.—FUEL, GAS, AND LIGHT.

Applications.

1892.

23,347. T. Critchley and F. Hewitt. Improvements in and apparatus for cooling, washing, and condensing smoke and other products of combustion. December 19.

23,403. J. S. Williams. Improvements in apparatus and process for producing and utilising heat, and generating, measuring, and storing heated gases and heated and other materials, and employing the same in the treatment of wood and other materials, and in the working of various processes. December 19.

23,419. J. Gray. Apparatus for the manufacture of gas. Complete Specification. Filed December 20. Date applied for May 28, 1892, being date of application in the United States.

23,497. E. Wardell and J. H. Evers. Improvements in apparatus for washing the gaseous products escaping from boiler and other furnaces, and for increasing the draught in such furnaces. December 20.

23,498. H. H. Lake.—From A. Kimber, United States. Improvements relating to the generation of gas, and to apparatus therefor. Complete Specification. December 20.

23,577. H. Weymersch. *See* Class VII.

23,581. E. Benoiste and L. A. Comolli. Improvements in apparatus for separating solid particles from smoke or gases. December 21.

28,657. B. Friedl. Gas lamp with incandescent light. Complete Specification. December 22.

23,847. J. Speir. Improvements in and apparatus for producing a material to be used as fuel. December 24.

24,116. J. D. Gilmour. *See* Class VII.

1893.

35. J. Laing. Improvements in apparatus for the manufacture of illuminating gas from mineral oils and like bodies. January 2.

295. W. Key. Improvements in apparatus for obtaining cyanides. January 6.

392. T. W. Lees. Improvements in the manufacture of blocks or briquettes of fuel, and machinery or apparatus for the purpose. January 7.

419. N. G. Kimberley. Improved treatment for rendering coke non-hygroscopic, and increasing its calorific power, and for apparatus required for carrying the improved treatment into effect. January 9.

555. W. P. Watson. Improvements in the process of manufacturing gas. Complete Specification. January 10.

632. C. D. Abel.—From The Gas Motoren Fabrik, Deutz, Germany. Apparatus for depriving of unpleasant odour the combustion gases discharged from gas or oil motor engines. January 11.

640. P. Dvorkovitz. Improvements in the manufacture of coke, coal gas, and the obtainment of bye products. January 11.

658. J. Morley. Improved composition for firelighters. Complete Specification. January 11.

681. J. Addie, J. Cunninghame, and W. Macfarlane. Improvements in the treatment of blast furnace and producer gases for obtaining cyanides therefrom. January 12.

682. J. Addie, J. Cunninghame, and W. Macfarlane. Improvements in apparatus for obtaining cyanides. January 12.

874. J. Webster. Improvements in the method of and apparatus for charging gas retorts. Complete Specification. January 14.

Complete Specifications Accepted.

1891.

21,481. O. G. Blunden. Apparatus and method of preparing peat or turf for use as fuel. January 11.

1892.

471. D. Rylands and H. Naylor. Improvements in washing, preparing, and coking smudge, slack, or other coal, and application of the gases resulting therefrom, and apparatus therefor. December 31.

952. W. S. Chenall and W. F. S. Chenall. Improvements in solidifying animal, vegetable, and mineral oils, and volatile and inflammable fluids. January 18.

1647. J. Mitchell. Coke ovens. December 7.

1804. S. Fox. Manufacture or production of water-gas and apparatus therefor. December 7.

2434. J. Swallow and C. West. Artificial fuel. January 18.

3053. G. A. Fuens. Manufacture of coal-dust bricks from bituminous coal, charcoal, coke, ore dross, brown coal, and the like. January 18.

4246. J. Woodward and F. W. Crossley. Apparatus for charging and discharging gas retorts. January 18.

4440. C. Kilpatrick and The Ferric Sewage and Water Purification Co., Lim. *See* Class X.

16,622. J. Bowing. Improvements in coking processes, and in the manufacture of coke and recovery of products. January 11.

19,483. A. W. Wells.—From F. Verruc. A new or improved apparatus for carburetting gas and air for illuminating and heating purposes. December 31.

21,871. H. Fourness. Improvements in valves and apparatus employed in the manufacture of illuminating and heating gas. January 18.

21,914. H. Pazolt. The manufacture of an improved artificial fuel. January 18.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Application.

1893.

280. J. Bueb. Improvement in the manufacture of anthracene. January 6.

IV.—COLOURING MATTERS and DYES.

Applications.

1892.

23,397. J. Y. Johnson.—From The Badishe Analin and Soda Fabrik. The manufacture and production of new basic dyes and of new materials for use in their preparation. December 19.

23,639. S. S. Bromhead.—From Landshoff and Meyer, Germany. Improvements in the production of iron and further amine bases from the ferruginous residue left in the production of amine bases. December 22.

23,672. H. H. Lake.—From Kalle and Co., Germany. Improvements in the manufacture of colouring matters. December 22.

28,893. O. Imray.—From The Farb. vormals Meister. Lucius and Brüning, Germany. Improvements in the production of paramagenta and its homologues from the corresponding leuco bases. December 27.

24,081. J. Rohner. Production of new colouring matters, dyeing cotton without mordant. Complete Specification. Filed December 30. Date applied for July 4, 1892, being date of application in France.

1893.

188. O. Imray.—From The Farb. vorm. Meister, Lucius, and Brüning, Germany. Manufacture of yellow to red-brown colouring matter suitable for dyeing wool. January 4.

437. O. Imray.—From The Farb. vorm. Meister, Lucius, and Brüning, Germany. Manufacture of a novel class of bodies by the action of primary, secondary, and tertiary aromatic bases, and of alkylised and non-alkylised diamines upon ortho-dinitro-anthraquinone, or mono-nitro-anthraquinone or nitro-amido-anthraquinone. January 9.

438. O. Imray. From The Farb. vorm. Meister, Lucius, and Brüning, Germany. Manufacture of novel colouring matters of the anthraquinone series from the products of the action of aromatic monamines or diamines upon ortho-dinitro-anthraquinone, or mono nitro anthraquinone, or nitro-amido-anthraquinone. January 9.

558. H. E. Newton. From The Farb. vorm. F. Bayer and Co., Germany. The manufacture or production of new colouring matters. January 10.

641. J. Y. Johnson. From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of colouring matters. January 11.

788. T. R. Shillito.—From J. R. Geigy, Switzerland. Production of orange colouring matters or dyes. Jan. 13.

825. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The production or manufacture of derivatives of betanaphtho-hydraquinone, or betanaphthoquinone. January 13.

Complete Specifications Accepted.

1891.

19,588. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture and production of new blue mordant dyeing colouring matters. January 18.

19,589. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new blue mordant dyeing colouring matters. January 18.

1892.

3698. I. Roos. Manufacture of a new compound resulting from the reaction of a methylphenylhydrazine and salicylalde. December 31.

4110. A. Bang.—From G. A. Dahl. A black cotton dyestuff, combination of the same, and processes for the production thereof. January 11.

4406. O. Imray.—From The Farb. vorm. Meister, Lucius, and Brüning. Manufacture of beta-amido crotonic anilide and of beta-methylamido-crotonic anilide. January 11.

4407. O. Imray.—From The Farb. vorm. Meister, Lucius, and Brüning. Process for the production of a red colour on textile fibres. January 18.

5540. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of red basic naphthalene colouring matter which yields azocarmine on sulphonation. January 18.

20,423. J. Rohner. Manufacture of new colouring matters of the series of the indulines by the action of the diamido-di-alkylthyoureas on the aromatic amines. December 31.

21,968. A. Lembach and C. J. Wolff. Improvements in and connected with the manufacture of oxyquinoline-phenolsulphonic-oxyquinoline and its homologues. January 11.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

1892.

23,325. A. Campbell. Improvements in the manufacture of linoleum and similar floorcloth preparations. December 19.

23,983. J. S. Farmer, H. L. Storey, and I. H. Storey. Improvements in the manufacture of linoleum, kamptulicon, and other similar floor-cloths, and in the means employed in such manufacture. December 29.

1893.

744. J. J. Weicher. Improvements in machines for extracting fibre from fibrous plants. January 12.

Complete Specifications Accepted.

1892.

18,572. P. Jensen.—From E. Steimer and M. Ziegler. Process of and apparatus for treating vegetable fibres or fibrous substances for producing sheets, roofing, and wall felts, matches, torches, and the like. January 11.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

1892.

23,433. J. H. Walton. An improved process for dyeing yarns and fabrics. December 20.

23,705. T. F. Kyne. Improvements in apparatus for immersing and treating textile goods in liquids or solutions, and for raising and automatically subjecting the goods to centrifugal action so as to expel the moisture therefrom, applicable to dyeing, bleaching, washing, and other analogous operations. December 23.

23,842. R. A. Graefinghoff.—From F. Weyland, Germany. Improvements in apparatus for colouring and sizing paper boards and the like. December 24.

1893.

629. C. D. Abel.—From O. Keferstein, sen., O. Keferstein, jun., and Siemens and Halske, Germany. An improved bleaching process for yarns, piece goods, and other materials. Complete Specification. January 11.

713. The Thornliebank Company, Lim., and W. E. Kay. An improved process for the production of coloured patterns upon aniline black grounds in calico printing. January 12.

729. C. D. Abel.—From O. Keferstein, sen., O. Keferstein, jun., and Siemens and Halske, Germany. Improvements in bleaching yarns, piece goods, and other materials. January 12.

Complete Specification Accepted.

1892.

4984. E. Zillessen, sen. An improved process of dyeing piece goods. January 18.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

1892.

23,342. G. F. Strawson and W. Fream. An improvement in the manufacture of sulphate of copper. December 19.

23,411. B. Paul. A new treatment of hydrated silica, and its alkaline combinations, with a view to the decomposition of marine salt and the transformation of quartz into active silica. December 20.

23,577. H. Weymersch. The manufacture and production of a new material for use in obtaining oxygen from atmospheric air. December 21.

23,616. F. H. Gossage and J. Williamson. Improvements in and connected with the production of caustic soda from sulphide of sodium or sulphydrate of sodium, partly applicable also to the manufacture of bicarbonate of soda and soda ash. December 22.

23,853. H. Watson and J. R. Watson. Improvements in the process of manufacturing soda crystals, bicarbonate of soda, and sodium carbonate. December 27.

23,965. H. H. Lake.—From W. H. Howell and A. Hausel, Canada, and W. J. Higgins, United States. Improvements in apparatus for making bisulphite of lime. December 28.

24,038. J. G. Lorrain.—From J. G. Wetterle, Algeria. A new or improved method of and apparatus for treating phosphates and other minerals occurring in calcareous or argillaceous gangues or matrices. December 29.

24,040. J. Vivian and G. Bell. Improvements in or relating to the manufacture of bi-carbonate of soda by the ammonia-soda-process, and obtaining a certain valuable bye product. December 29.

24,116. J. D. Gilmour. Improvements in the manufacture of cyanide and cyanogen compounds. December 31.

1893.

92. F. M. Spence, D. D. Spence, and G. Sisson. An improvement in the manufacture of sulphate and other salts of ammonia. January 3.

338. M. Lommer. Improvements in salt. January 6.

472. F. W. Petrie. Improvements in apparatus for the making or manufacturing of caustic soda and chloride of lime, being a method of passing the gases to the receivers. January 10.

543. J. E. Fuller. Improvements in and relating to combined ammonia distilling and refrigerating apparatus. Complete Specification. January 10.

544. D. Branson, R. D. Thornburg, and J. E. Starr. Improvements in and relating to a system of underground distribution and recovery of anhydrous ammonia. Complete Specification. January 10.

621. W. S. Kilpatrick. A process for the preparation of lead oxides and lead salts direct from galena and sulphate of lead. January 11.

710. R. C. Wilson. Improvements in or connected with the manufacture of salt from brine. January 12.

824. H. E. Newton. From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new chemical compounds derived from sulphuric acid. January 13.

Complete Specification Accepted.

1891.

22,746. H. C. Bull. *See* Class IX.

1892.

1,548. P. Römer. Manufacture of potassium carbonate from potassium sulphate. December 31.

20,070. W. T. Thorp. Process for treating salt for medicinal and dietetic purposes. January 18.

21,723. H. H. Lake. From L. Sternberg. An improved process of obtaining ammonia and ammonia salts from nitrogenous organic matters. January 18.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

1892.

23,414. J. Shenton. Improved devices for use in supporting ceramic ware whilst being fired. December 20.

23,549. W. Beames. Improvements in or connected with certain kinds of glass and pottery ware, barrels, and jars. December 21.

23,640. W. West. Improvements in the manufacture of moulded clay, earthenware, and ceramic articles, such as flower and other pots, basins, pans, dishes, and the like, and apparatus for that purpose. December 22.

24,002. C. Werfel. Manufacture of elfenite or composition for the production of ceramic fancy ware. Complete Specification. December 29.

1883.

823. J. Davies. Improvements in the manufacture of ceramic or pottery ware crucibles, cisterns, sinks, flags, and cements; also applicable for paving foot paths, roads, and as a filtering medium. Complete Specification. January 13.

Complete Specification Accepted.

1892.

22,376. W. P. Thompson. From R. S. Pease. *See* Class X.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

1892.

23,376. T. R. Ablett. Improvements in the construction of fire-proof floors. December 19.

23,416. G. Maxwell. An improved system of concrete construction. December 20.

23,552. J. Brown. An improved adhesive cement for building constructions and other purposes. December 21.

23,771. A Browne.—From H. Spenle-Legrand and A. Vye-Barminter, France. Improvements in or appertaining to bricks, blocks, ornaments, paving, paving tiles, artificial stone, and the like for building purposes and the like. December 24.

23,975. W. Horne and F. G. S. Ham. Horneham's non-slippery pavement. December 28.

1893.

29. E. L. Garbett. An improvement in the construction of incombustible stairs, floors, and roofs. January 2.

226. A. Patrick. Improvements in the manufacture of Portland cement, and in apparatus therefor, a part of the improvements being also applicable in the manufacture of finely pulverised pigments, and the like. January 5.

249. M. Fawcett, B. A. Elphicke, and J. Hope. Improvements in the construction of fire-proof floors. Complete Specification. January 5.

354. F. A. Beny. Improvements in bricks or blocks, for building purposes. Complete Specification. January 7.

425. G. Burge. Improvements in the construction of cement kilns. January 9.

484. J. Brown and J. T. Curry. Improved method of making bricks, blocks, or stones for building purposes without burning. January 10.

508. J. C. Bloomfield. Improvements in the manufacture of plaster. January 10.

711. J. C. Sellars. Improvements in or connected with applying cement and other granular or pulverulent material to surfaces and producing articles thereof. January 12.

823. J. Davies. *See* Class VIII.

Complete Specifications Accepted.

1891.

22,243. T. Bretherton. Ironcrete pavement. December 31.

22,746. H. C. Bull. Improvements in the production of and apparatus for obtaining carbonic acid gas and lime. December 31.

1892.

4553. J. W. Knights. Improvement in burning Portland cement. December 31.

9209. R. Astley. An improved form and method of construction of fire-proof floors. January 18.

X.—METALLURGY, MINING, Etc.

Applications.

1892.

23,332. E. Nelson. Improvements connected with the utilization of ore smelting furnace bye-products. December 19.

23,476. R. Haddan.—From L. Oliven, Germany. An improved process or method of plating or coating aluminium with tin, zinc, or lead, or alloys thereof. Complete Specification. December 20.

23,477. R. Haddan.—From L. Oliven, Germany. An improved process of soldering applicable to the soldering of aluminium to aluminium, or to other metals. Complete Specification. December 20.

23,491. W. B. Hollingshead and S. H. Carney. Improvements in compound sheet-metal plates, and in the process of producing same. Complete Specification. December 20.

23,506. H. H. Lake.—From La Société pour la fabrication des Munitions d'Artillerie, France. Improvements relating to the pressing, drawing, or otherwise working of plastic metal or other materials for the manufacture of various articles. December 20.

23,507. H. H. Lake.—From H. A. Harvey, United States. Improved sprinkling apparatus for use in the manufacture of armour plates and in similar operations. December 20.

23,534. E H. Saniter. Improvements in the purification of iron. December 21.

23,788. S. O. Cowper-Coles and The London Metallurgical Co., Lim. Improvements in electro-plating. December 24.

23,896. R. Pearce. Improvements in and relating to ore-roasting furnaces. Complete Specification. December 27.

24,025. S. O. Cowper Coles and The London Metallurgical Co., Lim. New alloys. December 29.

24,061. G. Wegner and P. Gührs. A new or improved method of plating or coating aluminium or aluminium alloys. Complete Specification. December 30.

24,144. J. W. Sutton. Improvements in the separation of gold from its chloride solution. Complete Specification. December 31.

1893.

7. J. Stranaghan. Improvements in stoppers for ladles used for casting steel and similar metals. January 2.

17. S. D. Williams and W. J. Clapp. Improvements in means or apparatus employed in the manufacture of iron and steel and other metals. January 2.

51. C. B. Burdon. Improvements in the manufacture and tempering of armour plates, projectiles, and other articles. January 2.

82. W. H. Greene and W. H. Wahl. Improvements in the manufacture of manganese and manganese alloys free from carbon. Complete Specification. January 3.

130. W. E. Koch. Furnaces for heating steel ingots. Complete Specification. January 3.

327. The London Metallurgical Company, Limited, and S. O. Cowper-Coles. Improvements in and relating to the coating of metallic surfaces with zinc. January 6.

498. W. P. Thompson.—From J. L. Thompson, United States. Improvements in or relating to obtaining and separating sulphide of nickel in the treatment of mattes containing copper, nickel, iron, and other metals. Complete Specification. January 10.

499. W. P. Thompson.—From R. M. Thompson, United States. Improvements in or relating to obtaining and separating sulphide of nickel for use in metallurgical operations in the treatment of mattes of copper, nickel, iron, and other metals. Complete Specification. January 10.

512. G. Wegner and P. Gührs. Improvements in soldering aluminium and alloys of aluminium. Complete Specification. January 10.

530. P. C. Choate. Improvements in the art of producing metallic zinc. Complete Specification. January 10.

563. J. M. White. Improvements in the manufacture of iron and steel and in apparatus for the purpose. January 10.

572. B. D. Martin and N. Martin. Improvements in the process or method of casting chilled rolls. January 10.

642. J. D. Ellis. Improvements in the manufacture of armour plates. January 11.

751. C. T. J. Vautin. An improved process for the manufacture of aluminium sulphide. January 12.

822. A. S. Bower. Improvements in means or apparatus for use in protecting iron and steel by producing magnetic oxide thereupon. January 13.

894. W. Colquhoun.—From A. Colquhoun, Mexico. An improved method of precipitating gold from solution. January 14.

Complete Specifications Accepted.

1892.

2241. N. Lebedeff. Manufacture of aluminium alloys. January 18.

3308. M. N. d'Andria. Recovery of hydrochloric acid and ferric oxide from ferrous chloride. December 31.

3844. T. Twynam. Separation of tin from tin scrap. January 11.

4440. C. Kilpatrick and the Ferric Sewage and Water Purification Company, Limited. A new or improved process for the utilisation of oxide of iron obtained as a by-product in the smelting or extraction of copper from cupreous ores, or from spent oxide obtained as a by-product in the purification of gas. December 31.

19,155. W. A. Baldwin and F. G. Wheeler. Method of and apparatus for decarbonising iron. December 31.

21,271. E. Norton. Improvements in the process of tinning iron and steel plates. December 31.

22,376. W. P. Thompson. — From R. S. Pease. Improvements in apparatus for handling or working molten substances, such as metal and glass. January 11.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

APPLICATIONS.

1892.

23,321. L. B. Miller and M. W. Woods. *See* Class I.

23,409. G. A. Washburn. Improvements in storage batteries. Complete Specification. December 20.

23,680. D. G. Fitz-Gerald. Improvements in voltaic cells used as standards and for testing purposes. December 23.

23,733. E. T. Parker. Improvements in and apparatus for the manufacture of chlorine and alkali by electrolysis of compounds thereof, and anodes to be employed therein. December 23.

23,750. A. Hough. An improvement in plates for secondary batteries. December 23.

23,773. R. Niewerth. Improvements in electric smelting, and in furnaces therefor. December 24.

23,824. A. J. Boult.—From Mannheimer Gummi-Guttapercha and Asbestfabrik, Germany. Improvements in electrode-supporting combs for electric batteries. December 24.

23,919. T. Craney. Improvements in and relating to electrolytic apparatus. Complete Specification. December 27.

24,071. E. L. C. Schiff. Improvements in the application of an electric current in the boiling or evaporating of solutions or liquids. December 30.

24,127. F. King. Improvements in secondary batteries. December 31.

1893.

140. G. W. Harris. Improvements relating to storage batteries, and electrodes therefor. Complete Specification. January 3.

259. R. E. B. Crompton and H. J. Dowsing. Improvements in the heating of surfaces for the drying, heating, or other treatment of paints, oxides, or other matters by the aid of electricity, and in the means or apparatus employed therein. January 5.

391. E. Hancock and A. J. Marquand. Improvements in the manufacture of elements for electric or secondary batteries. January 7.

660. H. F. Kirkpatrick-Picard and H. Thame. An improved method of manufacture of elements or plates for secondary batteries. January 11.

736. J. C. Richardson. Improvements in the manufacture of white lead and other compounds electrolytically, and apparatus therefor. January 12.

757. H. T. Barnett. Improvements in platinized electrodes. January 13.

758. H. T. Barnett. Improvements in connection with carbon electrodes. January 13.

813. C. Pollak. Improvements in or connected with the manufacture of electrodes for electric accumulators. January 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1891.

22,856. E. Placet and J. Bonnet. A method of extracting chromium by the aid of electrolytic baths with chromic acid base. December 31.

1892.

982. T. Parker, A. E. Robinson, and C. H. Parker. Improvements in or connected with the manufacture or production of chloride of zinc, and alkaline, or alkaline earths, sulphates, and of zinc and chlorine by electrolysis of solutions thereof. January 18.

3120. P. H. Bertrand. Improvements relating to galvano-plastics or the electro-deposition of metal. December 31.

4190. F. M. A. Laurent-Cely and E. Finot. Electrical batteries. January 18.

4768. S. W. Maquay. Electric batteries. January 18.

8987. P. Germain. Secondary batteries and accumulators. January 18.

14,813. E. P. Usher. Improvements in electric battery plates. December 31.

14,515. E. P. Usher. Storage batteries. December 31.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

APPLICATIONS.

1892.

23,374. J. P. Mullins. A means of producing an emulsified preparation of paraffin for use as (1) a dertergent, (2) as a hair dressing, (3) as a fuel. December 19.

24,153. E. Opderbeck. New process for making consistent fish-fat, train and other oils by means of compressed oxygen. Complete Specification. December 31.

1893.

88. W. S. Mackie. Asbestos soap. January 3.

117. R. Englert and F. Becker. An improved oil for use in the treatment of wool for spinning. January 3.

256. T. Craig and A. E. Raper. Improvements in the treatment of soapy waters from the washing of wool, and the production of useful products therefrom, applicable for lubrication and other purposes. January 5.

386. J. Peacock and W. L. Colls. Improved manufacture or production of soap. January 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

952. W. S. Chenall and W. F. S. Chenall. *See* Class II.

22,039. H. H. Lake.—From G. Schicht. Improvements relating to the manufacture of soap. January 11.

22,605. P. Zacharias and J. Grunwald. Manufacture of soap. January 18.

22,681. S. Stanton.—From E. W. Stanton. Improvements in petroleum or naphtha soap and in the method of and apparatus for producing the same. January 18.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

1892.

23,548. W. S. Kilpatrick. Improved process for the manufacture of litharge, red lead, and cement from galena or other lead ores, or sulphate of lead. December 21.

23,572. S. Ziani de Ferranti and J. H. Noad. Improvements in the manufacture of white lead. December 21.

24,138. H. Hellewell. Improvements in the treatment or purification of certain natural gums to produce a rubber or rubber substitute. December 31.

1893.

226. A. Patrick. *See* Class IX.

259. R. E. B. Crompton and H. J. Dowsing. *See* Class XI.

529. F. Crane.—From W. D. Field, United States. Improvements in or relating to pyroxyline solutions or compounds. January 10.

621. W. S. Kilpatrick. *See* Class VII.

736. J. C. Richardson. *See* Class XI.

849. W. Griffiths. Disinfectants paints. January 14.

Complete Specification Accepted.

1892.

12,732. L. Pflug. Improvements in protective paints or compositions for ships. December 31.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Complete Specification Accepted.

1892.

6104. C. W. Luther. The production of a cement or glue for joining wood. January 11.

XV.—AGRICULTURE and MANURES.

Complete Specification Accepted.

1892.

3301. B. Willcox.—From The Farbwerke vormals F. Bayer and Co. *See* Class XX.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

1892.

25,748. L. Briant and W. H. Walker. Improvements in the utilization of flours which are rich in diastase. December 23.

1893.

525. S. Pratt. Improvements in the treatment of starch-containing substances for use in brewing, distilling, and in in similar operations. January 10.

Complete Specifications Accepted.

1892.

21,939. W. P. Thompson.—From F. Schiaffino. Treatment of raw sugar for purifying and drying the same. January 18.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

1892.

23,894. M. Krouchkoll. Improved process for the manufacture of yeast without alcohol. Complete Specification. Filed December 27. Date applied for October 14, 1892, being date of application in France.

1893.

228. A. Blake. An improvement relating to the process of malting grain. Complete Specification. January 5.

525. S. Pratt. *See* Class XVI.

606. R. M. McDougall. Improvement in "Coffey's" still for making spirits from mixed grain or malt. January 11.

Complete Specifications Accepted.

1892.

13,980. A. J. Boult.—From F. L. Hume. Improvements in or relating to the purifying of spirituous liquor and other liquids, applicable also to the separation of cream from milk. January 18.

20,317. A. Kerschbaum, F. J. Z. B. Strassnicky, and R. Schmeidel. Manufacture of malt liquor. December 31.

20,825 H. Stock. Improvements in germinating apparatus. December 31.

21,284. H. H. Leigh.—From B. C. Batcheller, S. D. Schuyler, and W. M. Cramp. Improvements in process and apparatus for drying brewer's grains and like material. January 18.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

1892.

24,068. C. O. Harz and G. Deisenhofer. Improved process for sterilising and preserving liquids and perishable matters, and in apparatus therefor. December 30.

1893.

143. G. H. Kemp. Improvements in the manufacture of bread. January 3.

739. W. C. Leechman. An improved preparation of tea and the process of making the same. January 12.

B.—Sanitary Chemistry.

1893.

91. F. M. Spence and D. D. Spence. A filtering material for use in the filtration of water, the filtration of the effluent from sewage precipitation works, and the filtration of other liquids. January 3.

670. W. Weaver. Weaver's improved furnaces and apparatus for the treatment of town's refuse. January 12.

C.—Disinfectants.

1892.

23,601. C. A. Burghardt. An improved preparation or compound for the treatment and purification of sewage or other foul water. December 22.

1893.

631. H. Noerdlinger. Improvements in disinfectants. January 11.

3933. G. Kraemer. Process for the preparation of sulphonate salts from phenylised ethane derivatives and the preparation of disinfectants therefrom. December 31.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

3592. P. McArdle. The preserving of fresh eggs. December 31.

B.—Sanitary Chemistry.

1891.

22,546. W. Lawrence. Improvements in the clarification, purification, and softening of water, contaminated water, or sewerage, in the preparation of reagents, and in apparatus for use therein. December 31.

1892.

1567. A. Levieux. Improvements relating to the treatment of sewage and other refuse, and to apparatus therefor. January 18.

17,815. V. J. C. Boulengier. Improvements relating to the disinfection of cesspools and the utilisation of the disinfected matter. January 18.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

1892.

23,518. T. Thornley. Improvements in and connected with digesters and boilers used in the preparation of wood pulp, and for other similar purposes. December 21.

23,603. W. Ibbotson. Coating or covering paper with aluminium and its alloys. December 22.

XX.—FINE CHEMICALS, ALKALOIDS ESSENCES, AND EXTRACTS.

Applications.

1892.

23,449. H. Byk. Improvements in the method of obtaining phenols and naphthols, commonly called "salols," from salicylic acid, &c. December 20.

1893.

71. J. Wetter.—From J. D. Riedel and Co., Germany. Improvements in the treatment of cresols, to render them soluble in water, or to prepare aqueous solutions of the same. January 2.

Complete Specifications Accepted.

1892.

3301. B. Willcox.—From The Farbwerke vormals F. Bayer and Co. Improvements in or means for the treatment of trees or plants for destroying caterpillars of Liparis monacha and other insects injurious to plant life.

3435. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Improvements in the manufacture and production of pharmaceutical compounds. December 31.

3698. I. Roos. *See* Class IV.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

1892.

23,716. E. T. Powell. Means or apparatus whereby photographers can retouch their negatives or prints with the aid of artificial light. December 23.

23,942. G. W. Morgan. Magnesium arc light for photography. December 28.

1893.

741. W. H. Walker. Improvements in and apparatus for the manufacture of films especially intended for the production of transparent films for photographic purposes. January 12.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

1892.

23,377. O. Imray.—From J. Storer, Australia. Improvements in the manufacture of explosives. Complete Specification. December 19.

23,625. W. Pearson. Improvements in fog-signals. December 22.

24,094. J. Macnab. Improvements in and relating to explosives for military and naval purposes. December 30.

1893.

580. B. J. B. Mills.—From C. E. Munroe, United States. Improvements in explosive material and in the manufacture thereof. Complete Specification. January 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

1868. H. H. Lake.—From V. Groendahl and J. Landin. Manufacture of ammonium nitrate. December 31.

18,277. H. J. Haddan.—From the American Carrier Rocket Co. An improved dynamite rocket. December 31.

18,572. P. Jensen.—From E. Stiemer and M. Ziegler. *See* Class V.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

1892.

23,398. C. Weitenkampf. A new or improved process for separating solid or fluid substances dissolved in alcohol, ether, or chloroform, without evaporation of the solvent. Complete Specification. December 19.

23,399. C. Weitenkampf. New or improved apparatus for separating solid or fluid substances dissolved in alcohol, ether, or chloroform, without evaporation of the solvent. Complete Specification. December 19.

PATENT UNCLASSIFIABLE.

APPLICATION.

1893.

560. H. J. Sedway. A preparation of natural productions to be known as "Kowtrath." Complete Specification. January 10.

THE JOURNAL

OF THE

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FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

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NOTICES.

The Annual General Meeting will be held in Liverpool on the 12th, 13th, and 14th July next. Full particulars will appear in a subsequent issue.

The Council, having resolved to form a Committee to deal with the whole question of Patent Law Revision, has invited each Section to nominate three members to serve on that Committee. The following have also been nominated:—The President, Sir H. E. Roscoe, M.P., Mr. L. Mond, and Mr. E. Rider Cook, Hon. Treasurer. Extracts from the United States Patent Law will be found set out on page 190 of this issue.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer 5*s.* apiece for copies of the Society's Journal for January 1883 in saleable condition.

LIST OF MEMBERS ELECTED, 23rd FEBRUARY 1893.

Bateman, John, Chester Street, Saltney, Chester, manager of candle and sulphuric acid works.

Boyce, Frank, c/o Goodall, Backhouse, and Co., White Horse Street, Leeds, chemist.

Briggs, J. F., c/o Parry and Co., Madras, India, sugar works chemist.

Brothers, H. E., Victoria Institute, Tunstall, Stoke-on-Trent, analyst.

Cannon, J. C., 70, Ham Park Road, Forest Gate, Essex, analyst.

Cowan, W. J., 77 Trinity Road, Wood Green, N., fine colour manufacturer.

Crowther, Edw., Woodland Dyeworks, Headingley, Leeds, dyer.

Delahaye, Philibert, 65, Rue de Provence, Paris, gas engineer.

Dunn, W. H., jun., 1, Belle Vue Terrace, Gateshead-on-Tyne, analytical chemist.

Edwards, Vincent, 44, Victoria Avenue, Upton Park, Essex, manure company's chemist.

Gardiner, H. J., c/o J. Pattison and Co., 11, Bothwell Street, Glasgow, traveller.

Gendall, W. H. S., Gas Works, Elton, Bury, gas engineer.

Gibbs, Wm. T., Buckingham, Province of Quebec, Canada, analytical and manufacturing chemist.

Green, F. C., Chihuahua, Mexico, mining superintendent and manufacturer.

Guthrie, John A., 34, Lancaster Park, Richmond, Surrey, chemical merchant.

Hendrichs, Frank H., Imperial Wharf, 46, Bankside, S.E., chemical merchant.

Isaac, Jno. F. V., 18, Montserrat Road, Putney, S.W., research chemist.

Jackson, Jas.. Dominion Cotton Mills Company, Magog, Province of Quebec, Canada.

Johnson, Ben H., Caroline Cottage, West Grove Road, Woodford, Essex, contractor.

Jones, David S., Wilson Terrace, Coatbridge, N.B., analytical chemist.

Lawton, Thos., Calthorpe House, Aldridge Road, Perry Bar, Birmingham, chemical works manager.

Lloyd, Herbert, Gloucester, N.J., U.S.A., chemist and electrician.

Loughton, J. P., Washington Chemical Works, co. Durham, chemist.

Mather, Colin, Salford Iron Works, Manchester, engineer.

Oswell, Benj. L., 71, Spring Terrace Road, Burton-on-Trent, brewer's analyst.

Perkins, T. S., 39, Garden Place, Brooklyn, N.Y., U.S.A., technical chemist.

Pilley, Thos. W., Crescent Lodge, Camberwell Grove, S.E., analytical chemist.

Reekie, J. A., 5, Simmondley Lane, Glossop, Derbyshire, assistant colour mixer.

Ritchie, Geo., c/o Beardmore and Co , Parkhead Forge, Glasgow, analytical chemist.

Saltmarsh, J. G., 147, Shrewsbury Street, Brooks Bar, Manchester, works chemist.

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Smith, Edgar B., c/o Burt, Boulton, and Haywood, Selzaete, Belgium, chemist.

Stewart, Alexander F., Box 1283, Johannesburg, S.A.R., chemist and assayer.

Sträuli, Emil, Winterthur, Switzerland, soap and candle manufacturer.

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Bell, P. Carter, l/o Fleetwood ; c/o Mersey Rubber Co., Bank Quay, Warrington.

Berry, E. C., Journals to Casa Balestra, Bordighera, Italy.

Bowrey, J. J. ; (subscription only), 62, Penshurst Road, South Hackney, N.E.

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Colwell, W.E., c/o B. P. Clapp Ammonia Company, Cincinnati, Ohio, U.S.A.

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SESSION 1892-93.

Monday, March 6th:—
Mr. C. C. Hutchinson. "A Convenient Form of Experimental Apparatus for Filtrations and other Determinations."
Mr. Watson Smith. "The Composition of the Petroleum-like Bitumen of Japanese Coal."
Discussion on Mr. R. Warington's Paper on "The Detection and Estimation of Lead in Citric and Tartaric Acids."
Monday, April 10th.—Messrs. Cross and Bevan.
Monday, May 1st.—Mr. E. A. Cowper. "The Application of Hot-Blast Stoves to Chemical Industries."

Meeting held Monday, 6th February 1893.

MR. WM. THORP IN THE CHAIR.

ON THE DETECTION AND ESTIMATION OF LEAD IN TARTARIC AND CITRIC ACID.

BY R. WARINGTON, F.R.S.

THE manufacture of tartaric and citric acid has usually been largely conducted in leaden vessels; lead has particularly been used for the evaporating baths in which the liquors are concentrated to the crystallising point, and for the vessels in which crystallisation takes place. The sulphuric acid used to decompose the tartrate and citrate of calcium has also served to introduce lead. Small quantities of lead have thus been generally present in commercial citric and tartaric acid, and in recent pharmacopœias the presence of lead is mentioned as a possible impurity, and methods given for its detection.

I am not aware that any cases of lead-poisoning have been traced to the use of tartaric or citric acid, but as these acids are largely used in the preparation of lemonade, ginger beer, and effervescing medicines, and tartaric acid is a large ingredient of all baking-powders, it is clearly desirable that lead should either be absent, or exist in a proportion so small as to be insignificant.

Public attention has been called to this matter frequently during the last few years. A threatened prosecution for the sale of lemonade containing traces of lead has led some makers to abandon the use of citric or tartaric acid altogether and to employ phosphoric acid instead.

In July last a prosecution was instituted by the Woolwich Local Board of Health against an oil and colour-man in their district for selling tartaric acid containing 0·0026 per cent. of lead, which their analyst, Dr. W. R. Smith, stated to be a poisonous quantity.[*] This prosecution failed, the magistrate holding that the small amount of lead present became unavoidably mixed with the acid during the process of manufacture. Dr. W. R. Smith has since published in the *Journal of State Medicine*, October 1892, 57, determinations of lead made by him in numerous samples of tartaric and citric acid.

Public attention has also been called to the subject in France during the past year, owing to the refusal of a delivery of tartaric acid by the Government on the ground of its contamination with lead. M. Ch. Buchet, director of the Pharmacie centrale, has in consequence made an examination of the tartaric and citric acids of commerce, and has published his results in *L'Union pharmaceutique*, May 1892, 203.

It is now about two years since the firm of J. B. Lawes and Co., of Millwall, London, determined to introduce improvements into their manufacture of tartaric and citric acid, with the view of preparing these acids free from lead. Having many years ago been chemist to this firm, I was asked by Sir J. B. Lawes to assist in the work, and especially to find, if possible, a satisfactory method for determining the amount of lead present in tartaric and citric acid, as much uncertainty appeared to exist on this point. The present paper is to be regarded as a report on this special branch of the investigation.

As to the process now employed at Millwall for obtaining acid free from lead, I need only say that the manufacture is conducted in the usual way in leaden vessels up to the first crystallisation, and that the acid is then redissolved, purified from lead with hydrogen sulphide, and the liquor subsequently evaporated and crystallised in lead-free vessels: this mode of proceeding was adopted as requiring the least disturbance to the factory plant. After many trials to ascertain the best mode of working, the process has proved quite successful.

For the purposes of this paper we have to consider: 1. The detection of lead; 2. The quantitative determination of lead in tartaric and citric acid; 3. Proposed standards or purity. A few words must first be said as to the condition of the lead present.

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[*] That so small a proportion of lead could be injurious was not substantiated by the evidence of other experts at the hearing.

Both tartaric and citric acid crystals occasionally contain visible fragments of metallic lead. The manager at the Millwall factory, Mr. Berry, tells me that these fragments are probably fine scrapings of lead left by plumbers when making or mending the leaden vessels.

M. Buchet has determined the proportion of metallic lead in the samples of tartaric and citric acid he has examined (page 103 of this paper); it is of course very irregular. To determine metallic lead, M. Buchet dissolves 200 grms. of the acid in 600 cc. of water, adds ammonia in slight excess, and after 24 hours collects undissolved matter on a small filter, and, after washing, dissolves the lead in nitric acid, and determines its quantity in the usual way with sulphuric acid and alcohol.

Besides metallic lead, both tartaric and citric crystals have occasionally attached to their base, where they have been in contact with the leaden vessel, patches of an opaque whitish substance, which turns black when moistened with solution of hydrogen sulphide. This substance is evidently a portion of the corroded surface of the lead removed by the crystal. This lead compound does not entirely dissolve when the acid is placed in water, but it dissolves with great rapidity if an excess of ammonia is added to the acid solution. M. Buchet found in one bad sample of French tartaric acid 0·0082 per cent. of lead soluble in water, but when the acid was neutralised with ammonia the lead found was 0·0363 per cent. Instances of this kind are, however, exceptional; I have not found that citric and tartaric acid generally contain lead compounds undissolved by water.

Metallic lead is clearly less poisonous and less objectionable than soluble lead; the determination, moreover, of its quantity presents no special analytical difficulties. I have therefore confined my attention to the detection and estimation of the soluble lead contained in the acids.

Before passing to my own results it will be well to give a summary of the tests for lead in tartaric and citric acid prescribed by the various pharmacopœias. These directions, though often of little scientific value, occupy a position of public authority, and are often referred to in legal questions as affording trustworthy definitions of purity.

PHARMACOPŒIA TESTS.*

a. Tartaric Acid.

1. *With Hydrogen Sulphide alone.*—The aqueous solution is not altered by hydrogen sulphide (British, Belgian, Italian).

An aqueous solution, 1 in 10, is not coloured by solution of hydrogen sulphide (Netherlands).

A concentrated aqueous solution is not blackened at the line of contact when a solution of hydrogen sulphide is floated on it (United States).

The powdered acid is not altered by solution of hydrogen sulphide (Hungarian).

The test under this head is the only one prescribed by the British, Belgian, and Hungarian Pharmacopœias; the other Pharmacopœias have additional tests under the following heads. The strength of the tartaric acid solution is not mentioned by the British, Belgian, and Italian Pharmacopœias. The British Pharmacopœia describes a solution of tartaric acid in the Appendix made by dissolving 1 oz. of tartaric acid in 10 oz. of liquid.

2. *With Hydrogen Sulphide and Ammonia.*—An aqueous solution, 1 in 10, nearly neutralised by ammonia, is not altered by solution of hydrogen sulphide (German).

An aqueous solution, 1 in 2, is not altered by solution of hydrogen sulphide even when ammonia is added (Austrian).

An aqueous solution, saturated with ammonia, is not altered by ammonium sulphydrate (Italian).

An aqueous solution, 1 in 10, saturated with ammonia, is not altered by ammonium sulphydrate (Netherlands).

3. *By examination of Ash.*—The ash is not to turn blue when treated with solution of ammonia, nor to blacken by a further addition of ammonium sulphydrate (United States).

b. Citric Acid.

1. *With Hydrogen Sulphide alone.*—The aqueous solution is not altered by hydrogen sulphide (British, Belgian, Italian, United States).

An aqueous solution, 1 in 3, is not altered by solution of hydrogen sulphide (Hungarian).

The powdered acid is not altered by solution of hydrogen sulphide (Netherlands).

As in the case of tartaric acid, the above test is the only one prescribed by the British and Belgian Pharmacopœias, while the remaining pharmacopœias have additional tests. The British, Belgian, Italian, and United States Pharmacopœias do not prescribe the strength of the solution which is to be tested.

2. *With Hydrogen Sulphide and Ammonia.*—An aqueous solution, 1 in 10, nearly neutralised with ammonia, is not altered by solution of hydrogen sulphide (German).

An aqueous solution is not altered by solution of hydrogen sulphide, even when ammonia is added (Austrian).

An aqueous solution, 1 in 3, is not altered by solution of hydrogen sulphide, even when saturated with ammonia (Hungarian).

The powdered acid is not altered by solution of hydrogen sulphide, even when ammonia is added (Netherlands).

An aqueous solution, saturated with ammonia, is not altered by ammonium sulphydrate (Italian).

3. *By examination of Ash.*—The ash should not turn blue by treatment with solution of ammonia, or blacken by the further addition of ammonium sulphydrate (United States).

On glancing through these directions we are at once struck by their diversity. A test adopted by one pharmacopœia is excluded by another; and where the same test is employed considerable differences are introduced by the variations in the strength of the solution to be tested. In short, a sample of acid which will pass the rules of one pharmacopœia will be rejected by the rules of another; this will become still more evident further on.

The pharmacopœias concern themselves solely with combined lead, though probably the preparation of the ash directed by the United States Pharmacopœia would result in the oxidation of any metallic lead present, and this oxide would be subsequently blackened by the ammonium sulphydrate. Most of the pharmacopœias regard solely the lead soluble in an aqueous solution of the acid, but those of Italy and the Netherlands apparently include any lead compounds which will dissolve in ammonium tartrate.

NEW INVESTIGATIONS.

1. *The Detection of Lead.*

Several of the most characteristic tests for lead, as sulphuric and chromic acid, are not available for the detection of lead in tartaric or citric acid, owing to the solubility of salts of lead in these acids. A soluble chromate may be added to a solution of citric acid without any reduction of the chromic acid taking place; a considerable amount of lead may, however, be present without giving rise to any precipitate. The tests practically available for the detection of lead are the sulphides, employed either in an acid or alkaline solution.

The whole of the trials as to the respective delicacy of different methods have been performed with solutions of pure tartaric and citric acid, to which known amounts of lead had been added. The same standard lead solution was used for the whole investigation.

The Standard Lead Solution employed was made of recrystallised lead nitrate, dried over sulphuric acid; it contained 1 grm. of metallic lead in 1,000 cc.; 1 cc. thus contained 0·001 grm. of lead. From this solution a second was prepared of one-tenth the strength. If such solutions are to remain constant in composition it is essential that they should contain a little free nitric acid; if this is absent a basic salt is gradually deposited.

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* The editions referred to are as follows:—British Pharm. 1885; United States, 1883; German, 1890; Austrian, 1889; Hungarian, 1888; Italian, 1892; Belgian, 1885; Netherlands, 1889. The French Codex (1884) does not contain any description of tests.

Effect of Hydrogen Sulphide as Gas.

Tartaric Acid.—The delicacy of the test is very largely influenced by the strength of the tartaric solution.

With a strength of 50 grms. in 100 cc. the gas produced no change when passed for half-an-hour, though lead equal to 0·0072 per cent. of the acid was present. When the proportion of lead was raised to 0·0080 per cent. a very distinct grey turbidity was produced.

With a strength of 25 grms. in 100 cc. a considerable dark grey turbidity was produced in two minutes when the acid contained 0·0036 per cent. of lead, and a slight grey turbidity was produced in half an hour when the lead amounted to 0·0030 per cent. No reaction was obtained with 0·0024 per cent. of lead.

With a strength of 10 grms. in 100 cc. a distinct grey turbidity was produced in ten minutes when the acid contained 0·0020 per cent. of lead, and a very slight reaction (quite distinct, however, when compared in a favourable light with a similar solution free from lead*) was produced in half an hour when the acid contained 0·0015 per cent. There was perhaps a trace of reaction when the lead was still further reduced to 0·0010 per cent.

Citric Acid.—The reaction with hydrogen sulphide in the presence of this acid is far more delicate than in a tartaric solution; the strength of the acid has, as before, a great influence upon the result.

With a strength of 50 grms. in 100 cc. a dark purple turbidity having a red reflection was produced in three minutes when the acid contained 0·0032 per cent. of lead, and a distinct purple turbidity in 20 minutes when the lead was 0·0020 per cent. A very slight turbidity appeared in 25 minutes when the lead was reduced to 0·0016 per cent.

With a strength of 10 grms. in 100 cc. a distinct turbidity was produced in ten minutes when the acid contained 0·0010 per cent. of lead, and a very slight reaction appeared in half an hour when the lead was reduced to 0·0005 per cent.

Effect of Hydrogen Sulphide in Solution.

An aqueous solution of hydrogen sulphide is a much more delicate test for lead in tartaric and citric acid than hydrogen sulphide used as gas, and the appearance it produces is often much more striking, the solutions being generally deeply coloured, while the gas gives rise in most cases to a finely-divided precipitate. The coloured lead solutions produced by a solution of hydrogen sulphide probably contain the lead as a sulphydrate.

The solution of hydrogen sulphide employed was always saturated with the gas, and quite free from suspended sulphur. This reagent is best prepared in bottles nearly filled with water. When the water is saturated, the air is displaced with hydrogen sulphide, the stopper introduced, and the bottle laid on its side.

Tartaric Acid.—When 50 cc. of tartaric acid solution are mixed with 50 cc. of solution of hydrogen sulphide, the final strength being 25 grms. of acid in 100 cc., a slight grey turbidity is generally produced on standing when the acid contains 0·0012 per cent. of lead, and a more distinct turbidity is immediately produced when the lead amounts to 0·0016 per cent. As the proportion of lead increases the appearance produced by the reagent changes. The smallest visible result is a grey turbidity; with more lead the turbidity appears as a very finely-divided purple-grey precipitate; with a further increase in lead a bronze tint appears; with still more lead the solution acquires a dark smoky-brown colour, and there is no longer any suggestion of a precipitate.

When the solution of tartaric acid is of such a strength that after adding its own volume of solution of hydrogen sulphide the mixture contains 10 grms. of acid in 100 cc., a distinct grey turbidity is almost immediately produced when the acid contains 0·0010 per cent. of lead. With 0·0007 per cent. of lead a slight distinct turbidity is produced after some time. If 10 grms. of the tartaric acid are dissolved in 20 cc. of water and the liquid brought to 100 cc. by the addition of solution of hydrogen sulphide, a slight distinct turbidity may be seen when the lead in the acid is only 0·0005 per cent.

Citric Acid.—As in the experiments with the gas, the delicacy of the test is found to be much greater with citric than with tartaric acid. The series of tints produced is different in the case of citric acid.

When the citric solution is mixed with its own volume of solution of hydrogen sulphide, and the mixture finally contains 25 grms. of the acid in 100 cc., a clear, bright brown colour is immediately produced when the acid contains 0·0016 per cent. of lead. With 0·0008 per cent. of lead a cinnamon-tinted turbidity is immediately produced. With 0·0004 per cent. the solution soon acquires a slight pinkish turbidity. A solution of acid containing 0·0002 per cent. of lead gave no distinct reaction.

When the solution of citric acid receives its own volume of solution of hydrogen sulphide, and the final mixture contains 10 grms. of acid in 100 cc., an immediate clear brown tint is produced when the acid contains 0·0010 per cent. of lead. With 0·0005 per cent. of lead a distinct brownish turbidity soon appears. With 0·0003 per cent. a slight turbidity appears after some time. With 0·0002 per cent. no appreciable reaction took place. When, however, the 10 grms. of citric acid were dissolved in water to 20 cc. and the whole diluted to 100 cc. with solution of hydrogen sulphide, a slight turbidity was produced when the acid contained 0·0002 per cent. of lead, and even with 0·0001 per cent. of lead a reaction was thought to be appreciable.

Hindrance to the Action of Hydrogen Sulphide.—While engaged in the present work I came across a singular fact. When tartaric liquors have been purified from lead with hydrogen sulphide, the liquor concentrated, and a crop of crystals obtained, the mother-liquor contains a soluble sulphur compound which is capable of preventing the precipitation of lead by hydrogen sulphide. To such a mother-liquor, which was of a dark straw colour, slightly turbid, and had a marked garlic odour, I was able to add lead up to 0·0048 per cent. of the tartaric acid present without being able to detect it by subsequent treatment with a solution of hydrogen sulphide. If this amount of lead was exceeded the hydrogen sulphide produced a brown colour. When this mother-liquor was treated with a small quantity of an oxidising agent its peculiar characters disappeared, and it behaved in a normal manner with lead and hydrogen sulphide.

This fact is of little importance to the public analyst, as the crystal from such liquors contains but a trace of this compound, and we shall presently see that by testing in an alkaline solution its prejudicial influence can be almost or entirely removed.

Effect of Hydrogen Sulphide in a nearly Neutralised Solution.

The German Pharmacopœia directs that both tartaric and citric acid shall be tested for lead with a solution of hydrogen sulphide after the acid has been nearly neutralised with ammonia, and German analysts apparently lay great stress on this point as essential to a searching application of the test. We have just seen that 0·0005 per cent. of lead in tartaric acid, and 0·0002 per cent. of lead in citric acid may be detected without any neutralisation of the acids, and we shall presently see that still smaller amounts may be plainly detected when the acids are treated with ammonia in excess; what, then, is to be gained by the intermediate treatment of incomplete neutralisation? The object of leaving the solution feebly acid is, apparently, to avoid any darkening of the solution due to the formation of iron sulphide.

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* To detect a very slight turbidity comparison must be made with a similar mixture of tartaric acid and solution of hydrogen sulphide containing no lead; the solutions must stand between the observer and the light, and be viewed against a dark background.

If a small quantity of a ferrous salt be added to a solution of pure citric acid, and the whole nearly neutralised with ammonia, a solution of hydrogen sulphide may be added without any darkening taking place. The case is quite otherwise with tartaric acid. If a solution of tartaric acid is taken containing a salt of iron in distinct quantity, and ammonia is gradually added, a precipitate is first formed of the acid ammonium tartrate, which dissolves as more ammonia is introduced. If the solution is to be left acid, the addition of ammonia must stop before the resolution of the acid tartrate is completed. If now a solution of hydrogen sulphide be added to this feebly acid liquid, the characteristic green and black tints of iron sulphide at once appear. It is of no use to attempt to increase the acidity of the liquid by adding hydrochloric acid, for the only effect of this acid is to throw down a great precipitate of the acid ammonium tartrate, the solution remaining no more acid than before, and the iron sulphide being left unaffected. The formation of iron sulphide can only be prevented by having the solution of tartaric acid so weak that no precipitation of the acid ammonium tartrate can occur. With a solution so weak no gain in delicacy when testing for lead can be expected. The direction of the German Pharmacopœia is thus valueless, so far as tartaric acid is concerned.

If soda be substituted for ammonia, there is no precipitation of iron when solution of hydrogen sulphide is added to a nearly neutralised tartaric solution.

A considerable practical difficulty is met with in attempting to test for lead in neutralised solutions; this consists in the great scarcity of pure reagents. I have been unable to obtain sodium hydrate which did not give a brown colour with solution of hydrogen sulphide; the soda from sodium, prepared by Messrs. Hopkin and Williams, was useless from this cause. Ordinary ammonia is equally useless. I have obtained ammonia ("puriss") from Messrs. Hopkin and Williams which gives no colour with hydrogen sulphide; and from Messrs. Burgoyne and Burbridges and Co. I have obtained sodium carbonate which is almost equally pure. When looking for traces of any substance an analyst should, of course, test all his reagents.

The presence of iron in tartaric or citric acid is best ascertained by adding potassium ferrocyanide to the aqueous solution of the acid. The quantity of iron present is usually very minute; we shall see presently that its presence need not interfere with the testing for lead even when the solution is made alkaline with ammonia.

Effect of Sulphides in an Alkaline Solution.

The pure tartaric and citric acids I have employed, when dissolved and treated with an excess of pure ammonia, remain entirely unaffected by ammonium sulphydrate. This is the most extreme test for lead in these acids with which I am acquainted. If to either of these acids lead equal to 0·0001 per cent. (1 per million) be added, the addition of 1 drop of ammonium sulphydrate to a strong ammoniacal solution produces at once a very slight, distinct, clear brown tint. It is possible to detect even half this amount of lead. The greater delicacy of this mode of testing is, in part, due to two causes: (1) the greater concentration of the solution, as but one drop of ammonium sulphydrate is needed instead of dilution with an equal volume of solution of hydrogen sulphide; (2) the clear brown colour produced, which admits of easier recognition than a faint grey turbidity.

The amount of iron present in commercial tartaric and citric acid is, as far as my experience goes, too small to interfere with the test for lead just described; ammonium sulphydrate is not in fact by any means so delicate a test for iron as potassium ferrocyanide. If iron should be present in considerable quantity this will be at once indicated by the abnormal blackish colour given by the ammonium sulphydrate. In this case the solution of tartaric or citric acid, made alkaline with ammonia, should be treated with a few drops of a solution of potassium cyanide, and heated to near boiling; when cool the testing is made with ammonium sulphydrate, the iron now giving no reaction having been converted into ferrocyanide.*

In testing by this method the presence of copper is revealed by the blue colour produced when the acid is treated with excess of ammonia; this blue colour is discharged, and the subsequent formation of copper sulphide prevented, by adding a little potassium cyanide* to the ammoniacal liquid.

The testing for lead in an alkaline solution has one further advantage, namely, that the sulphur compound which may possibly be present in small quantity in acid which has been purified with hydrogen sulphide does not in this case prevent its detection.

2. *The Quantitative Estimation of Lead.*

Gravimetric methods for the determination of lead in tartaric and citric acid have been described by M. Buchet (*loc. cit.*), and by M. Guillot, *Jour. de Pharmacie et de Chimie*, 1892, 541; these methods are apparently identical. Dr. W. R. Smith (*loc. cit.*) has also described his method.

M. Buchet dissolves 200 grms. of the acid in 600 cc. of water, and adds ammonia in slight excess. After standing for 24 hours, insoluble matter, containing the metallic lead, is separated by decantation and filtration, the solution is slightly acidified with hydrochloric acid, and hydrogen sulphide gas passed through the liquid to saturation. After standing 12 hours the precipitated sulphide is collected on a filter, washed, redissolved in nitric acid, concentrated to a small volume, and the lead precipitated by sulphuric acid, with the addition to the liquid of twice its volume of alcohol. No experiments are mentioned proving that hydrogen sulphide gas will precipitate all the lead under the conditions named.

Dr. Smith is content to work on 50 grms. of the acid; this is burnt to a carbon-free ash in a muffle, the ash is dissolved in nitric acid, the solution evaporated to dryness, the residue dissolved in dilute acetic acid with sodium acetate, the lead precipitated as chromate, collected on a "Gooch" asbestos filter, and weighed. There is said to be "a possible error of 2 per cent. of the total amount of lead present in the sample." How the latter fact is arrived at is not mentioned; there is no reference to any experiment in which a known amount of lead was present.

In approaching the subject with the view of arriving at a good commercial method, I desired that the method selected should, if possible, be volumetric instead of gravimetric, hoping thus to insure the economy of time, which, if accuracy can be preserved, is always so desirable.

A good many chemists have tried to find a volumetric method for the determination of lead in tartaric and citric acid by matching the tint produced in these acids by a solution of hydrogen sulphide with the tint produced by the same reagent in a similar volume of water containing a known quantity of lead. When such methods are tested by employing tartaric and citric acid containing known amounts of lead they are found to be entirely fallacious; the effect produced by a solution of hydrogen sulphide in a dilute solution of a lead salt is indeed profoundly altered by the presence of tartaric or citric acid. Of this fact any chemist may assure himself by performing the following simple experiments:—

Prepare solutions of pure tartaric and citric acid containing 25 grms. in 50 cc., place these solutions in glass cylinders, and in a third cylinder place 50 cc. of water. To each cylinder now add 1 cc. of the standard solution of lead nitrate already mentioned, and mix thoroughly; the tartaric and citric acid now contains 0·0040 per cent. of lead. To each cylinder 50 cc. of solution of hydrogen sulphide is next added, and the whole rapidly mixed. The contrasts presented by these solutions, each containing the same quantity of lead, are certainly astonishing; their appearances may be thus described:—

Water—Quite pale olive-brown, clear.
Citric acid—Deep red-brown, pretty clear.
Tartaric acid—Deep smoky-brown, much more opaque.

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* Dr. F. L. Teed has already called attention to this use of potassium cyanide in *The Analyst*, August 1892, 141.

If now the experiment is repeated, but the lead reduced to one-fourth of the previous quantity, the appearances will then be—

Water—Very slight brown tint.

Citric acid—A deeper brown, more opaque.

Tartaric acid—No colour, clear, or a slight grey turbidity.

It is quite obvious that any matches of colour made among solutions in which the reaction proceeds so differently are worthless as evidence that an equal quantity of lead is present in each case.

Dr. W. R. Smith has published (*loc. cit.*) determinations of the soluble lead present in 11 samples of tartaric and citric acid; he thus describes the method which he employed:—

"A convenient quantity of the sample for examination was dissolved in 50 cc. of water, a little dilute hydrochloric acid added, and then a measured quantity of saturated sulphuretted hydrogen water. The tint thus produced is matched by a standard solution of acetate of lead, just as in Nesslerising. The conditions are kept rigorously parallel, whether they apply to the volume, to the quantity of dilute hydrochloric acid, or the amount of sulphuretted hydrogen water. By these means the amount of soluble lead present is ascertained."

In this method we have an additional element introduced—the addition to each solution of an equal volume of dilute hydrochloric acid. Nothing is said as to the object of this addition, or as to what is to guide the analyst in selecting a proper quantity of hydrochloric acid. I presume that the object in view is to equalise the tints produced by the hydrogen sulphide. If a certain amount of hydrochloric acid is mixed with each of the comparative solutions in the first of the two series of experiments just mentioned, the quality of tint produced on the addition of the solution of hydrogen sulphide will be the same in every case; each of the three cylinders will in fact yield a lavender-grey precipitate. Unfortunately the improvement stops here. It is possible by adding hydrochloric acid in equal quantity to each solution to make the precipitates of lead sulphide in water and in solutions of tartaric and citric acid comparable in the quality of their colour, but it does not help us to make them equal in quantity, although the same amount of lead may be present in each case.

It is clear from the foregoing remarks that the only way in which the appearance of the lead sulphide in a solution of tartaric or citric acid can be accurately used as a means of determining the quantity of lead present is by comparison with the appearance in solutions of pure tartaric or citric acid of the same strength, to which known amounts of lead have been added. I have employed two methods for the estimation of lead: I will describe them in the order of adoption.

The Glycerol Method.—The smoky, opaque tints produced by a solution of hydrogen sulphide in solutions of tartaric acid containing a considerable amount of lead are very unfavourable for comparisons of colour. If, however, a certain amount of glycerol be mixed with the tartaric acid before the addition of the hydrogen sulphide the tint becomes lighter in tone, and the liquid much more transparent.

For the purpose of this method there is required a stock of solution of tartaric acid free from lead, containing 50 grms. of acid in 100 cc. Also the lead nitrate solutions already described, contained in small 10 cc. burettes graduated to tenths of a cubic centimetre.

Of the tartaric acid to be examined 75 grms. are dissolved in water, made up to 150 cc., and filtered. In the case of obstinate turbidity in the acid it is well to introduce a little filter-paper pulp before filtering.

A preliminary experiment is first made to ascertain what volume of the tartaric solution will yield a suitable depth of tint, the error unavoidable in colourmetric work being a much smaller proportion of the matter to be determined when a full but not excessive depth of colour is observed. The desired mixture is prepared in a graduated cylinder. 20 cc. of glycerol are first introduced, and then 30 cc. of the tartaric acid solution; the mouth of the cylinder is then closed with an india-rubber stopper, and the contents well mixed. An equal volume of a clear saturated solution of hydrogen sulphide is then added, the whole again mixed, and transferred to a cylinder of clear glass standing on a sheet of white paper. The appearance of the liquid enables the chemist to decide whether more or less of the tartaric acid should be taken to obtain a convenient tint; 10 cc.—50 cc. is the range which I have found necessary. When the proportion of lead is small, 10 cc. of glycerol will suffice. The selected mixture is made exactly as just described, the volume of solution of hydrogen sulphide employed being equal to the volume of liquid already in the cylinder.

When the selected mixture has been prepared, the next step is to match its colour with a similar mixture containing a known amount of lead. The same amount of glycerol and of a pure tartaric acid solution are introduced into the cylinder as in the former experiment, with a few tenths of a cubic centimetre of the stronger of the two solutions of lead nitrate, and the whole is well mixed; the solution is then brought to the same volume as the former mixture by the addition of solution of hydrogen sulphide. A comparison of the tints of the two mixtures will at once show whether too much or too little lead has been used, and new experiments are made with varying quantities of lead until an equality of colour is reached. When an approximate equality is attained it is best to start three mixtures as simultaneously as possible, one a repetition of the selected mixture of the acid under examination, the other two containing slightly varying quantities of lead, the object being that the colour yielded by the acid under examination shall lie somewhere within the range of colour in these two experiments. The observer, having now a scale before his eye, is enabled to make a very close estimate of the quantity of lead corresponding to that contained in the acid to be analysed. One reason for making a fresh mixture of the acid to be examined is that the tint obtained becomes more turbid on standing.

In using this method care must be taken as to the quality of the glycerol employed. The first glycerol I made use of proved worthless, as it contained some metal (tin or arsenic) giving a yellow precipitate with hydrogen sulphide. The glycerol was unaffected by a solution of hydrogen sulphide unless an acid was also added, but the presence of tartaric, acetic, or especially of hydrochloric acid at once determined a yellow turbidity, which became in time an actual precipitate. I obtained at last from Messrs. Hopkin and Williams a glycerol nearly free from this impurity.

I have found the glycerol method a satisfactory one for determining lead in tartaric acid; it cannot, however, be used with advantage if the proportion of lead falls below 0·0020 per cent. We have already noticed that in the case of tartaric acid a remarkable break occurs in the series of tints produced by a solution of hydrogen sulphide with rising quantities of lead, the appearances produced by the smallest quantities of lead being mere grey turbidities, which change to a bronze and brown colour as the amount of lead increases. A break occurs in the same part of the scale when glycerol is present, and below this point varying amounts of lead have no considerable influence upon the colour produced.

It is evident that, with the method just described, the matter derived from the corroded surface of the leaden vessels will, if present, partially escape detection. It would probably be easy, after pouring off the solution of tartaric acid, to act on any residue with a little sodium carbonate, then to dissolve the lead carbonate in some of the tartaric solution, and finally add this to the main bulk. I have not, however, experimented in this direction, as the next method I have to mention gets over all difficulties of this description.

The glycerol method has not been employed for citric acid, though I know of no reason against its application. The need for the use of glycerol is, however, less in the case of citric acid, as the tints of lead sulphide in citric acid are far clearer than in tartaric; the scale of tint is also more continuous.

The Ammonium Sulphydrate Method.—We have already mentioned that ammonium sulphyurate applied to an ammoniacal solution is a far more delicate test for lead in tartaric and citric acid (especially in the former) than solution of hydrogen sulphide. The tint produced is also of the same quality throughout a long scale, and is very free from turbidity. The reaction is, in short, admirably adapted for use as the basis of a colourmetric method.

The depth of tint produced, for the same quantity of lead present, is far greater in an ammoniacal tartrate or citrate solution than in the same volume of water; it is quite essential, therefore, if equality of tint is to interpreted as equality of lead, that all comparisons should be between two citrate or tartrate solutions, and not between one of these and water.

To carry out the method it is therefore necessary to have in stock solutions of lead-free tartaric and citric acid supersaturated with pure ammonia; these solutions should develop no colour when treated with ammonium sulphydrate. A convenient strength is 100 grms. of acid in 300 cc. of final solution.

Of the tartaric or citric acid to be examined 40 grms. are taken and dissolved in a little water; warm water is most convenient for crystal and cold for powder; the solution is preferably conducted in a flask. To the cold solution pure strong ammonia is gradually added till it is in slight excess; the final point is indicated in the case of tartaric acid by the solution of the acid ammonium tartrate first formed; in the case of citric acid it is conveniently shown by a fragment of turmeric paper floating in the liquid. When an excess of ammonia is reached the liquid is cooled, if necessary, diluted to 120 cc., and filtered.

As a preliminary experiment 10 cc. are taken, diluted to 50 cc. in the measuring cylinder, and placed in a Nesslerising glass, one drop of ammonium sulphydrate solution added, and the whole well stirred: the colour developed indicates what volume of solution should be taken for the determination, this volume may range from 5 cc. to 50 cc. If less than 50 cc. are taken the volume is brought to 50 cc. with water, and one drop of ammonium sulphydrate is then added.

The tint thus adopted has now to be matched with the pure solutions. A volume of the pure ammoniacal tartrate or citrate, identical with that taken of the acid under examination, receives a measured quantity of lead solution from the burette, the volume is brought to 50 cc., it is placed in a Nesslerising glass, and receives one drop of ammonium sulphydrate; the experiment is repeated till a match is obtained. As in the previous method, the best comparison of tints is obtained by making finally three simultaneous experiments, one with the acid under examination, the other two with slightly varying amounts of lead, the aim being that the tint given by the acid to be analysed shall lie within this narrow scale. In following this method considerable use has to be made of the weaker of the two lead solutions already mentioned.

The whole time required for a determination of lead by either of the methods now given is about 1½ hour; this time will be somewhat shortened as the operator becomes familiar with the tints produced by varying proportions of lead.

We have already noticed the steps which should be taken if copper is present, or if iron is in sufficient quantity to disturb the result.

In a few cases the same sample of tartaric acid has been analysed both by the glycerol and ammonium sulphydrate method; the agreement of the results was good.

The Amount of Lead present in Commercial Acids.

In Table I. will be found determinations of lead in commercial tartaric acid, and in Table II. similar determinations in citric acid, made by the methods just described; the figures obtained by the glycerol method are marked *g*. The aim has been to analyse a sample of the acid made by each manufacturer; the collection made of foreign acids is, however, very imperfect. Where more than one sample has been obtained from any maker the results are bracketed. The object has been to show the composition of unpurified acid; all samples known to have been purified from lead have been excluded; it is possible, however, that some of the best of the foreign acids have undergone some purification.

I. LEAD IN TARTARIC ACID.

No.	——	Per Cent.	Grains per Lb.
	English Makers.		
1	Crystal	0·0190 *g*	1·330
2	„	0·0087 *g*	0·609
3	„	0·0063 *g*	0·441
4	„	0·0111	0·777
5	„	0·0047 *g*	0·329
6	Powder	0·0033 *g*	0·231
	French Makers.		
7	Powder	0·0190 *g*	1·330
8	Crystal	0·0033 *g*	0·231
9	„	0·0008	0·056
10	„	0·0086	0·602
11	„	0·0013	0·091
	German Makers.		
12	Powder	0·0084 *g*	0·588
13	Crystal	0·0087	0·609
14	„	0·0050	0·350
15	„	0·0043	0·301
16	„	0·0020 *g*	0·140
17	„	0·0035	0·245
18	„	0·0029 *g*	0·203
	Unknown.		
19	Crystal*..................	0·0113 *g*	0·791
20	Powder	0·0036 *g*	0·252
21	Crystal	0·0032 *g*	0·224
	Mean of 21 samples....	0·0066	0·463

II. LEAD IN CITRIC ACID.

No.	——	Per Cent.	Grains per Lb.
	English Makers.		
1	Powder	0·0240	1·680
2	Crystal	0·0195	1·365
3	Powder	0·0141	0·987
4	Crystal..................	0·0069	0·483
5	„	0·0105	0·735
6	„	0·0096	0·672
7	Powder..................	0·0066	0·462
8	Crystal	0·0018	0·126
	French and German.		
9	Crystal	0·0029	0·203
10	„	0·0006	0·042

* Contained a distinct amount of copper.

United States.

No.	——	Per Cent.	Grains per Lb.
11	Crystal	0·0063	0·441
12	„ *.................	0·0030	0·210
	Mean of 12 samples....	0·0088	0·617

* Contained a trace of copper.

The mean amount of combined lead found in tartaric acid is thus 0·0066 per cent., and in citric it reaches 0·0088 per cent. The variations are very great, even in different samples from the same factory, as appears by comparing the tartaric acids Nos. 1, 2, 3 ; 4, 5, 6 ; 7, 8, 9 ; or the citric acids 3 and 4. Probably all excessive amounts of lead are due to contaminations from the corroded surfaces of the crystallising vessels.

Large crystals of tartaric acid are apparently somewhat purer than small crystals from the same sample. Two samples were divided into large and small crystals, and the percentage of lead determined in each, with the following result :—

——	No. 1.	No. 2.
Large crystals...........	0·0026	0·0052
Small „	0·0033	0·0073

This is possibly owing to the fact that in a small crystal the contaminated base in contact with the leaden vessel forms a larger proportion of the whole than in the bigger crystal. We have also to remember that as crystallisation advances the proportion of lead in the mother-liquor increases, so that the later-grown portion of a crop is probably richer in lead.

That tartaric acid may be partially purified from lead by crystallisation was proved by a laboratory experiment. A tartaric liquor, in which the lead was 0·0126 per cent. of the tartaric acid, was concentrated in a porcelain basin, and a crop of crystal obtained by granulation. The crystal contained 0·0030 per cent. of lead, while the lead in the mother-liquor amounted to 0·0220 per cent. of the tartaric acid present.

In the next table will be found the results of M. Buchet's examination of 11 samples of tartaric acid from eight makers, and of three samples of citric acid from three makers.

The mean amount of metallic lead present is seen to be 0·0034 per cent. The acids were apparently, with two exceptions, unusually free from combined lead.

M. Guillot (*loc. cit.*) found in one sample of tartaric acid 0·0063 per cent. of metallic lead, and 0·0053 per cent. of combined lead.

3. *Proposed Standards of Purity.*

Having now information before us as to the delicacy of the qualitative tests for lead in tartaric and citric acid, and also a quantitative method capable of determining proportions of lead as small as one part per million of the acid, we have finally to say a few words as to the amount of purity which may fairly be expected in commercial acids.

No authoritative standards of purity exist, so far as I am aware, save those contained in the various pharmacopœias. A pharmacist should clearly not be contented with a degree of impurity greater than this. If acids of this purity can be obtained, of which there is now no doubt, health officers and magistrates will probably think that all tartaric and citric acid used in the preparation of articles of food or drink should be equally pure. This seems as far as the manufacturer should be required to go at present. The pharmacopœia tests are, however, so various and imperfect that a revision of them may be looked for; we must, however, at present, take them as they stand.

III.—Lead in Tartaric and Citric Acid.*
(M. Ch. Buchet.)

——	Combined Lead.	Metallic Lead.
	Per Cent.	Per Cent.
Tartaric acid	0·0363	0·0064
„	0·0081	0·0011
„	0·0012	Trace.
„	0·0029	0·0071
„	0·0028	0·0018
„	0·0027	0·0025
„	0·0025	0·0058
„	0·0022	0·0055
„	0·0020	0·0021
„	0·0018	0·0018
„	0·0017	0·0064
Citric acid	0·0027	Trace.
„	0·0021	0·0070
„	Trace	None.
Mean of all	0·0051	0·0034

* These analyses have been already published in the *Chemist and Druggist*, but by an error in the conversion of grms. per kilo. into per cent. the proportions of lead were made 100 times too high.

The British Pharmacopœia directs that an aqueous solution of tartaric acid shall not be affected by sulphuretted hydrogen. In the case of citric acid the word "darkened" is substituted for "affected." The pharmacopœia does not name the quantity of acid, or the strength of the solution to be tested. If its language is strictly interpreted the test must be taken in an absolute sense, and an acid will not pass the test if *any* aqueous solution of it is affected by hydrogen sulphide.

The pharmacopœia is also silent as to whether hydrogen sulphide gas or its solution is to be employed, and a lawyer might be ready to argue that if the solution was unaffected by hydrogen sulphide gas, the acid fulfilled the requirements of the pharmacopœia. Supposing this granted, we learn from the experiments I have already recorded that tartaric acid containing 0·0020 per cent. of lead will certainly not pass the test, but it will depend somewhat on the skill, and also upon the severe or easy temper of the analyst, whether an acid containing 0·0015 per cent. is passed or not. In the case of citric acid, the presence of 0·0010 per cent. of lead will certainly prevent it passing the test, but with 0·0005 per cent. the result will be doubtful.

If, however, hydrogen sulphide producing no effect is to be understood as hydrogen sulphide employed to the best advantage, the analyst will prepare his solution by dissolving 10 grms. of the acid in 20 cc. of water, and then diluting to 100 cc. with a saturated solution of hydrogen sulphide. Examined by this test, tartaric acid containing 0·0008 per cent. of lead will certainly be rejected, and it is doubtful whether acid containing 0·0005 per cent. will be allowed to pass. With citric acid the presence of 0·0004 per cent. will ensure rejection, while 0·0002 per cent. may be reckoned a doubtful proportion.

The Chemical Committee of the London Chamber of Commerce have had under consideration the question: what test should be adopted as a standard of commercial purity with regard to the contamination of tartaric and citric acid by lead? At a meeting held in November last, they provisionally adopted the form of test just mentioned, that is, the solution of 10 grms. of acid in 20 cc. of water, and the dilution to 100 cc. with a solution of hydrogen sulphide. This test, being virtually based upon the directions of the present British Pharmacopœia, is undoubtedly in many respects convenient, but it cannot be considered as final for several reasons.

1. The solution of the acid being made in water, cases will sometimes arise in which a part of the combined lead remains undissolved and escapes detection. 2. The form of the test is unfortunate, for the analyst has to certify that the acid will *not* produce a certain reaction, and there will be plenty of cases in which it will be difficult for different analysts to agree unless every condition, including the time that the mixture is to stand, the height and thickness of the column of solution, and its position with respect to light, is strictly defined. 3. The test introduces (unintentionally) a different standard for tartaric and citric acid.

A much more satisfactory standard of purity would be the fixing of a proportion of lead which must not be exceeded in tartaric and citric acid, the determination to be made by the ammonium sulphydrate method already described. I would suggest that if this is done, the proportion of lead which is not to be exceeded be fixed at five parts per million of the acid. The analyst in using the ammonium sulphydrate method must, of course, employ pure ammonia, and must be aware what steps he should take to prevent the interference of iron and copper.

It is clearly more just to the manufacturer to define a limit of impurity which must not be exceeded, than to expect from him an article of absolute purity, a result difficult to attain under the most favourable conditions of work.

Appendix.

Since the above was read determinations of lead have been made in some effervescing powders, in which, as is well known, tartaric acid is a principal constituent. Two of the powders were popular preparations of well-known names.

Lead per Cent. in Effervescing Powders.

——	Lead Soluble in Water.	Total Combined Lead.
1	0·0040	0·0042
2	0·0004	0·0012
3	0·0002	0·0032

The lead compounds not dissolved by water were brought into solution by the action of an alkaline solution of ammonium tartrate. A solution of pure sodium tartrate, of the same specific gravity as the solution of the powder, was used in making the comparisons of tint. When ammonium tartrate had been added to the powder, it was also added to the compared solution. Potassium cyanide was in all cases employed.

An examination of baking-powders has also, as was to be expected, revealed the presence of lead.

Discussion.

Mr. Ling asked what reasons there were for concluding that the impurity due to the precipitation of the lead in the mother-liquor was a sulphur compound, and whether the author intended to investigate it, or had any notion as to its nature, as it seemed a very interesting body.

Dr. Teed asked whether the author found the same difference of tints in tartaric and citric acid when using rather more dilute solutions. He appeared to be using the acids in a very concentrated form. He was glad to see use made of the cyanide reaction, having got rid of the copper difficulty. Another question was as to where the author got his pure citric and tartaric acid from. He himself had searched for some months diligently, but could never succeed in getting any, and so was obliged to content himself with the ordinary water comparisons, using dilute solutions in order to minimise the action of the acids on the lead precipitate as far as possible. He thought the author would find it an advantage to work, as Wanklyn recommended, in porcelain dishes instead of in cylinders. One could see the colour by that means much more distinctly than in a glass cylinder on a white plate. He should very much like to know if the author had tried more dilute solutions.

The Chairman said it was a curious thing that one milligramme of lead in citric or tartaric acid should give a dark colour, but one-fourth of a milligramme should practically give no colour at all. That was a thing no one could have foreseen.

Mr. Warington in reply said that, so far as the sulphur compound was concerned, he had not the least idea what its composition was, but as it only occurred in those liquors which were treated with hydrogen sulphide, and was entirely destroyed when he introduced anything capable of oxidising sulphur, and as it possessed a strong garlic odour, it left no doubt on his mind that it was a sulphur compound. With regard to the pure tartaric and citric acid, in his earlier experiment he prepared pure tartaric acid himself, but such acids could now be procured from more than one maker in London. With regard to the dilution of these tartaric and citric solutions, he had not used a solution more dilute than 10 per cent., because that was the strength mentioned in the pharmacopœias. With a very weak solution there was so little lead present that one was confronted with difficulties on that account. He had not found, however, that down to 10 per cent. there was any difference in the character of the tints.

Further discussion on this paper was then adjourned until next meeting.

A REACTION OF THE LIGNOCELLULOSES AND THE THEORY OF DYEING.*

BY C. F. CROSS AND E. J. BEVAN.

The red solution obtained by mixing aqueous solutions of ferric chloride and an alkaline ferricyanide, which may be regarded as containing ferric ferricyanide, reacts as is well known with the more easily oxidisable "organic" compounds, oxidising them and being itself reduced to the lower mixed cyanides, *i.e.* Prussian blue and similar compounds (Watts. Dic., Vol. 2, 248). The reactions of this solution with the lignocelluloses, and notably jute, are remarkable and characteristic. Not only is the conversion into the blue pigment very considerable in proportion to the weight of fibre substance, but the colouring matter is deposited within the fibre in such a way as to give the effect of a homogeneous dye. Thus if this particular fibre, suitably purified by previously boiling in dilute alkaline solutions and washing, be plunged into a $\frac{1}{2}$ decinormal solution of the reagent (prepared by mixing decinormal solutions of the reagents in equal volumes) the fibre substance rapidly dyes to an intense blue-black with a gain of weight of from 20 to 50 per cent; and the dyed fibre examined under the microscope is of an intense transparent blue with all the characteristics, that is to say, of a "solid solution" of the colouring matter.

This reaction affords a contribution, as we shall presently show, to the theory of dyeing; but before discussing it from this aspect, we will briefly record the results of quantitative observations. In our first series of observations we used a solution of ferric chloride containing Fe_2Cl_6, equivalent to 0·0976 Fe_2O_3 in 10 cc., and an equivalent solution of ferri cyanide. Five equal portions, each weighing 2·762 grms. of jute fibre were treated with the mixture of the above solutions in equal volumes, in the proportions and with the results given in the subjoined table.

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* Owing to insufficient time, this paper was taken as read.

Vols. of Solution.		Increase of Weight.	Increase per Cent. of Fibre.	Fe_2O_3 added as Fe_2CN_6	Fe_2O_3 fixed as Blue Cyanide.
Ferric Chloride.	Ferri-cyanide.				
Cc.	Cc.				
10	10	0·185	6·7	0·195	0·123
20	20	0·489	17·7	0·390	0·230
30	30	0·768	27·8	0·585	0·373
40	40	1·025	37·1	0·781	0·510
50	50	1·161	42·0	0·976	0·601

It will be noticed that the Fe_2O_3 fixed by the fibre is proportional to the quantity taken, viz., approximately two-thirds in each experiment; but the corresponding increase in weight of the fibre due to the blue cyanide fixed is somewhat variable. The cyanide, in fact, is shown by analysis to vary in composition slightly in the ratio Fe:CN, more considerably no doubt in its condition of hydration. The ash left on ignition of the dyed fibre we find to contain no soluble basic constituents, therefore no K_2O appears to be fixed.

Analysis of Blue Cyanide fixed by the Fibre.—A specimen of fibre, dyed blue under the above conditions and weighted to approximately 20 per cent., was analysed, the total Fe being determined as Fe_2O_3, the CN as NH_3.

$$Fe_2O_3 = 6\cdot1 \text{ per cent.} = 4\cdot27 \text{ Fe}; \; N = 3\cdot15 \text{ per cent.} = 5\cdot85 \text{ CN}.$$

Whence the ratio—

$$\frac{4\cdot27}{65}:\frac{5\cdot85}{26} = 0\cdot076:0\cdot225.$$

or—

$$Fe:CN = 1:3.$$

A portion of the fibre was further treated until the increase of weight amounted to 40 per cent., and then analysed with the following result:—

$$Fe_2O_3 = 14\cdot0 \text{ per cent.} = 9\cdot8 \text{ Fe} \quad N = 9\cdot3 \text{ per cent. CN}.$$

$$Fe:CN = \frac{9\cdot8}{56}:\frac{9\cdot3}{26} = 0\cdot175:0\cdot357 = 1:2.$$

By the continued interaction of the fibre substance and the ferric ferricyanide the Fe''' appears to be deoxidised, and in exhausting the fibre substance with dilute alkali in the cold ferricyanide is dissolved, as of course is to be expected.

It is obvious that we are dealing with an aggregate and the product of a mixed reaction; the ratios $Fe_2(CN)_6$ and $Fe_3(CN)_6$ determined as above for the product in successive stages are therefore not to be taken as more than approximate indications of the composition of the colouring matter deposited in the fibre.

The mechanism of the reaction and the question of the composition of the resulting blue cyanide is further elucidated by the following experiments:—

Equivalent solutions were prepared as above, and in two experiments with equal weights of fibre the solutions were mixed in the proportions:—

A. 3 of ferric chloride to 2 of ferricyanide;
B. 2 „ „ 3 „

The results observed, which were somewhat unexpected, are given below:—

Increase of Weight in Fibre.	Analysis of Dyed Product.		
	Fe_2O_3	N.	Ratio Fe:CN.
Per Cent.	Per Cent.	Per Cent.	
20	9·6	4·8	$Fe_2(CN)_6$
17	8·4	4·0	$Fe_4(CN)_{11}$

The N in these analyses was determined by the Kjeldahl method, in the previous cases by the soda-lime combustion.

It appears, therefore, that the blue cyanide deposited in the earlier stages of the reaction is fairly constant in composition notwithstanding considerable variations in the proportions of the reagents in the solution from which it is abstracted by the fibre; and the ratio of Fe to CN in the fibre cyanide complex is approximately 1:3. By the last-cited experiment it is also shown that the rearrangement of the Fe and (CN) which takes place within the fibre substance is to a certain extent independent of the condition of the Fe in the solution, *i.e.*, whether added as basic Fe or as in the ferricyanogen complex.

The main points of the reaction have been sufficiently elucidated by the results described, and it is unnecessary to put on record a large number of quantitative results which merely confirm those already given. It should be noted, however, that the limit of the reaction has not been investigated: on occasions we obtained increases of weight of 50 and even 80 per cent., but at this degree of loading the natural lustre of the fibre had given way to the dull and dusty look of a fibre weighted to excess.

We have now to consider the mechanism of the reaction which has been in some measure elucidated by further experiments.

To explain it as the result of reduction of the ferric iron ether of the chloride or the ferricyanide by the fibre substance will be found to be inadequate. The following experiments show that either reagent taken singly is but slightly affected by prolonged contact with the fibre substance.

Equal weights (2·835 grms.) of the purified fibre were placed—

(*a*.) In a solution (30 cc.) of $FeCl_3$ – 1·6 grms. per 100 cc.
(*b*.) In a solution (30 cc.) of K_3FeCy_6 – 3·3 grms. per 100 cc.
(*c*.) In a solution prepared by mixing the above (30 cc. of each).

After standing some hours (*a*) and (*b*) were squeezed and interchanged, and left some minutes. The fibre from each was then washed off, dried, and weighed with the following results:—

	Weight of Dyed Fibre.	Increase of Weight.	Colour.
		Per Cent.	
(*a*.)	2·931	3·3	Indigo-blue.
(*b*.)	2·846	0·3	Medium-blue.
(*c*.)	3·550	25·2	Blue-black.

It appears, therefore, that the lignocelluloses absorb but little* oxide from a neutral solution of ferric chloride, and there is only partial reduction of the oxide so fixed: and also that ferricyanide is slightly reduced by the fibre substance in neutral solution and without sensible combination with the ferricyanogen or ferrocyanogen group.

The reaction in question is therefore specific as between the ferric ferricyanide and the fibre substance.

That the formation and fixation of the blue product is not the result of reduction in the liquid is further shown by the fact that it is not appreciably affected by the presence of oxidising agents such as chromic acid.

The alternative conclusion is that it is due to a coagulation or precipitation of the ferric ferricyanide by the fibre substance, in the first instance, followed by a rearrangement of its constituents by specific combination with the fibre constituents.

Collateral evidence in support of this view is afforded by the behaviour of the ferricyanide with another typical colloid, viz., gelatin. Solutions of gelatin give with the ferric ferricyanide a voluminous coagulum of a greenish colour, and the reaction is approximately a quantitative one, but of course depending to some extent upon the conditions of precipitation. The following relations were determined:—

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* The maximum we have observed to be taken up from a normal solution of the chloride is 0·4 per cent., and that after 48 hours immersion.

One series of experiments—

A white gelatin (containing 16·5 per cent. hygroscopic moisture and 2·86 per cent. ash constituents) was weighed out in quantities of 2 grms. (= 1·613 dry and ash-free gelatin) and dissolved. The solutions were variously diluted and treated with half decinormal solution of the ferric ferricyanide added from a burette.

(1.) To completely precipitate in the cold 23 cc. were required.

(2.) To completely precipitate at 50° C. 24·5 were required.

(3.) To a third quantity 32 cc. of the ferricyanide solution were added.

The precipitates were collected, dried, and weighed; the weights were: (1.) 1·990; (2.) 2·031; and (3.) 2·077 respectively. The mean weight 2·032 shows an increase of weight of 21·6 per cent. An estimation of Fe_2O_3 in the product gave 6·0 per cent., the proportion being rather lower than in the case of the fibre-cyanide product, which, with the same gain in weight, contains 7 per cent. Fe_2O_3. The coagulum is in this case, however, only slightly blue, darkening gradually on standing. On treatment with a reducing agent such as dilute sulphurous acid, the coagulum swells to a deep blue transparent jelly.

This interaction of gelatin and ferric ferricyanide is therefore rather of the character of a simple coagulation or combination of colloids by dehydration.

We have reason for assuming a similar relationship between the fibre-colloid and the ferricyanide as the first cause of the precipitation. The conversion of the colourless into the coloured cyanide may be then accounted for by what we know of the constitution of the fibre substance. In the lignocelluloses we have associated with cellulose of the ordinary type a pentose or pentacellulose containing an aldehydic group, and the characteristic lignone or quinone containing a CO group and OH groups having functions similar to those of the phenols (Chem. Soc. J. 55, 199; Chem. News, 1891 (2), 63.

We have in this complex all the conditions (1) for a deoxidation of Fe‴, (2) for union with ferric and ferrous oxides, and (3) combination with HCN.

Such changes as would be determined by these relations, when brought into play, are of the minor order and consistent with the characteristics of the product, *i e.*, an intimate molecular union of the complex fibre substance, slightly oxidised at the expense of ferric oxide, and the ferroso-ferric cyanide.

It remains now to connect this reaction with the theory of dyeing, so far as it is at present developed.

Some years ago one of us discussed this subject in the columns of a technical journal (The Dyer, 1886, p. 41 *et seq.*), and the view then taken of the phenomena of "colour affinity" has been arrived at independently by our friend Prof. O. N. Witt (Theorie des Färbeprocesses, Färber Zeitung, 1890—91, Vol. I.). As was pointed out (*loc. cit.*), "It is scarcely necessary to premise that the dyeing of fibre and tissues is only a particular case of the absorption of substances from solution, or still more generally of transference from one liquid medium to another."

Witt expresses this conclusion more concisely in regarding a dyed fibre as a *solid solution* of the colouring matter in the fibre substance, concurring in the view also taken by E. Knecht (J. Soc. Dy. Col. 1889, 77). We speak of this as a conclusion, but in regard to a theory of dyeing it is rather the beginning; it is in fact a postulate which it appeared necessary to formulate as a closure to the somewhat barren speculations which have had to do duty for a theory of dyeing. It is a matter of no moment whether we regard the cause as "physical" or "chemical" (so-called); this is purely a matter of terms; but it *is* important to have cleared the ground for specific lines of research. This has been done. The theory of dyeing must be included in the general theory of the nature of solution, and its special features will be defined by the specific and reciprocal relationships of colouring matter to fibre and tissue substance.

Vignon concludes (Compt. Rend. 110, 286; 112, 623), from a careful and exhaustive survey of dyeing phenomena, including the action of mordants, that they depend, without exception, upon the interaction of groups of opposite chemical function, viz., basic and "acidic," present in the colouring matter or mordant, and the substance with which it combines. No doubt this is a statement which will be found to cover the greater number of dyeing effects at present known, and it is a satisfactory attempt to define the reciprocal or combining relationship between fibre substance and colouring matter by referring it broadly to chemical constitution. But we do not think it will give an adequate explanation of the remarkable features of the combination of the lignocelluloses with Prussian-blue under the conditions described in this paper. There are distinctive features in this effect which mark it off as especially deserving of study in relation to the theory of dyeing. These distinctive features are associated, as we have already shown, with well-marked and characteristic features in the chemical constitution of the interacting substances. The connection we hold to be a causal one, and we are prosecuting the investigation for the purpose of bringing this still more clearly to light.

No doubt also we may be able to include considerations drawn from Dr. Armstrong's theory of the constitution of colouring matters (Proc. Chem. Soc. 1888, 27, 1892, 101). It is a fair hypothesis, for instance, that in these complex cyanides we have to do with a C_6 ring, and that their colour may in fact be referable to a "quinonoid" constitution. Further, it is a fair assumption that the "affinity" of the lignocellulose for the cyanide is specifically related to the "aromatic" constitution of the former, and we take it as a working hypothesis that the phenomena we have been discussing may depend upon a reciprocal relationship of C_6 groupings in both fibre substance and colouring matter. This hypothesis is not without foundation in previous experience and practice. The well-known process of dyeing "weighted blacks" in silk may be cited in direct bearing on this point. In this process the silk is first heavily loaded with ferric oxide, this is then converted into blue in an acid-bath of ferrocyanide, and then follow the further weighing with astringents—catechu, gambier, &c.—and dyeing out with logwood. The active constituents of these substances are all of "aromatic" constitution, and their being deposited upon a foundation of the Prussian-blue—the lustre of the original silk being maintained throughout—is evidence of a reciprocal constitutional "affinity."

Although we are not in a position to push these considerations to a specific conclusion, they are too suggestive to be left unmentioned, and they indicate the directions in which these researches will be developed.

In the meantime we have given this brief account of the reaction, as it has an interest of its own apart from the bearings upon the general question of the absorption of substances from solution.

It constitutes another and perhaps the most characteristic reaction of the lignocelluloses, and will be found useful in identifying fibres of this class.

Other compound celluloses, notably those which make up the cell wall of cuticular tissues, exhibit the reaction, but in lesser degree. Generally the reagent (ferric ferricyanide) will be found of use in differentiating vegetable tissues in the course of microscopic investigation.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

March 1:—
F. Hurter, Ph.D. "Coke-Towers and Similar Apparatus."
T. L. Bailey, Ph.D., and P. W. Jones. "The Pink Colouration of Calcium Chlorate Liquor."
April 5th:—J. W. Kynaston. "Suggestions as to the Treatment of the Waste Gases of the Chance-Claus Sulphur Recovery Process."
May 3rd:—Geo. Tatè, Ph.D. "The Relation of Bacteriology to Industries."

Meeting held Wednesday, January 11th, 1893.

MR. HENRY BRUNNER IN THE CHAIR.

THE CAUSE OF THE RED COLOURATION OF PHENOL.

BY CHARLES A. KOHN, PH.D., B.SC., AND A. F. FRYER, B.SC.

THE cause of the turning red of phenol has, from time to time, been the subject of investigation, but the published results are few, conflicting, and vague—surprisingly so in consideration of the commercial importance of the solution of the problem. That even the purest carbolic acid of commerce becomes coloured on keeping or on exposure to light has long been observed, and yet a deep-rooted opinion has always prevailed that this colouration is to be traced to some impurity or other contained in the phenol.

According to Hager (Pharm. Centr., 1880, 77), the reddening is due to the formation of rosolic acid, which is produced by the oxidation of phenol in presence of ammonia. Yvon inclines to the same view, whilst Mylius (Pharm. Centr., 1887, 72), has shown that traces of the caustic alkalis and of the alkaline carbonates, as well as of ammonia, produce a red colouration, which he also regards as identical with rosolic acid. The formation of rosolic acid under either of these conditions is traced to the oxidation of the phenol. A more general view has been that it is the presence of a small quantity of cresol rather than of ammonia or of other alkali which allows the formation of the colour, since a methane residue must be supplied from some source to form a triphenylmethane derivative such as rosolic acid. H. Müller (Dingl. Polyt. J. **179**, 461), bases his process for the purification of phenol upon this view; the phenol before being finally distilled is brought into intimate contact with the air by frequent stirring in shallow pans, whereby the impurities are completely oxidised in presence of the phenol, with the formation of rosolic acid, which latter is left behind on subsequent distillation. Kremel (this Journal, 1886, 160) concludes that a large number of metals and their oxides, especially copper, lead, silver, and zinc, are the cause of the colouration, all of which form one and the same body, which dissolves in phenol with a red colour, but which he does not regard as identical with rosolic acid. Ebell (Repert. Analyt. Chem. 1884, 17) looks upon the impurities as volatile and colourless bodies which are changed by the action of light rather than by that of heat or air to non-volatile red or yellowish-brown substances; whilst Sicha (this Journal, 1882, 397) traces the reddening to the presence of copper salts or of metallic copper, and states that phenol repeatedly distilled from glass vessels remains white when exposed to sunshine for months. Meyke (Jahresberichte, 1883, 513), on the other hand, regards lead as the contaminating impurity; whilst Lunge ("Coal-tar and Ammonia," p. 385) says that base metals must be strictly avoided in the last distillation of phenol, because the smallest trace of copper, iron, or lead, &c. colours the product, whence arises the necessity for carrying out the last distillation in glass retorts. Ebell, however, points out, in direct opposition to Sicha, that even the acid distilled from glass vessels often colours very strongly, although free from traces of metals. These various and discordant results have one point of agreement — that the reddening is due to the presence of some impurity. This view appears to receive confirmation from Bidet's experiments (Bull. Soc. Chem. 1891, **5**, 13, and this Journal, 1891, 693) on the simultaneous action of air and light on organic compounds, which go to show that many aromatic substances which become coloured or darken in colour when exposed to light, remain unalterable when prepared in a state of special purity, such as is attained in the case of phenol by careful sublimation.

A more careful and systematic investigation of the cause of the reddening of phenol has recently been carried out by E. Fabini (Pharm. Post. 1891, **24**, 2, 25, 41, 105, 185; and this Journal, 1891, 433, 800), whose results deal both with the conditions under which the colouration takes place and with the nature of the coloured product formed, to which he has given the name of "*Phenerythrene*." This body is produced by the action of hydrogen peroxide upon phenol containing metallic salts in presence of ammonia. All three reagents — hydrogen peroxide, metallic salts, and ammonia—are requisite for the production of the colour. No colouration results either with hydrogen peroxide alone or in presence of ammonia, or with metallic salts and hydrogen peroxide in absence of ammonia, provided the sample of phenol be pure. But in presence of traces of hydrogen peroxide and of ammonia, one part of a salt of iron or of copper to 300,000 parts of phenol is sufficient to impart a distinct colouration to the latter. According to Fabini the ammonia first forms ammonium phenate, which in presence of the copper or iron salt is transformed into the phenate of the heavy metal, which then undergoes oxidation by the hydrogen peroxide with the formation of phenerythrene and the simultaneous separation of the free metal, copper or iron. This method of formation explains, it is stated, why the colouring matter is always to be found in the liquified portions of phenol. The phenerythrene itself is described as a black, brittle body, soluble in alcohol and in ether, with a red colour, and having an exceptional tinctorial power—one part of the colouring matter being capable of giving a distinct red colouration to 300,000 parts of phenol. It gives a blue colouration with sulphuric acid—a reaction previously observed by Kremel with the red colouring matter he obtained from phenol.

It was in the repetition of some of these reactions by one of us as a lecture experiment that the present investigations took their rise. The preliminary results differed so markedly from Fabini's that it was considered worth while to examine the subject, and this with a two-fold object in view. On the one hand, to establish the accuracy or reverse of Fabini's work, and on the other hand to determine and, if possible, to eliminate the impurities which are supposed to give rise to the colouration in the commercial product.

That oxidising agents, alkalis—especially ammonia—and metallic salts play an important part in the turning red of phenol, is so very evident from all the work that has been done on this subject, that we first studied the action of these and similar reagents upon phenol of varying degrees of purity.

EXPERIMENTAL WORK.

The phenol used was that known as "*absolute phenol*," which is regarded as the purest commercial product. It is sold in the form of crushed crystals and kept in blue glass bottles. Details as regards its manufacture beyond what is to be found in the text-books we are unable to give, as the purification is carried on with a considerable degree of secrecy. Some samples of this "absolute phenol" when melted were seen to contain a number of dark specks distributed regularly through the mass, and which subsided to the bottom when the whole had melted. These were found on analysis to consist of metallic particles composed chiefly of zinc, with a little iron and a trace of lead, evidently chippings of metal that had got into the phenol during some stage in the process of purification. The phenol was always carefully separated from these metallic particles before use.

The colour reactions given by ammonia, caustic potash, hydrogen peroxide, or metallic salts were carried out by placing a little of the melted phenol, 2—3 cc., in a test-tube and then adding one or two drops of the reagent or mixtures of the reagents. The reagents were used in different strengths as follows:—

Ammonia.

1. Concentrated ammonia, sp. gr. 0·880.
2. Concentrated ammonia diluted with 10 times its volume of water (1 : 10).
3. Concentrated ammonia diluted with 100 times its volume of water (1 : 100).

Caustic Potash.

1. Concentrated solution containing 1 part of caustic potash to 2 parts of water.
2. The above concentrated solution diluted with 10 times its volume of water (1 : 10).
3. The above concentrated solution diluted with 100 times its volume of water (1 : 100).

Hydrogen Peroxide.

1. 20-volume hydrogen peroxide.
2. 20-volume hydrogen peroxide diluted with 10 times its volume of water (1 : 10).
3. 20-volume hydrogen peroxide diluted with 100 times its volume of water (1 : 100).

These strengths of solution refer to all the series of experiments. Where not otherwise stated the solutions were exposed to light during the progress of the experiments.

First Series of Experiments.—Colour Reactions with "Absolute Phenol."—The action of the above reagents was first tried with the view of ascertaining their relative effects upon the purest commercial phenol. Although the results are of little importance in comparison with the subsequent series, they are of interest inasmuch as they show that the "absolute phenol" of commerce is really a practically pure and homogenous product. The following were the results obtained:—

Ammonia in strong solution gave a violet colouration after a few hours' exposure, which deepened on standing, becoming dark indigo-blue in a week; with weaker solutions of ammonia (1 : 10 and 1 : 100) the colour varied from yellow-red to purple, but in all cases a colouration resulted.

Hydrogen peroxide.—A distinct colouration, varying from yellow and orange to red, was always formed after two to six hours' exposure, even with very dilute solutions (1 : 100); on prolonged standing the colour turned to a fine red.

Caustic potash also developed brownish-yellow colours, the tint being darker the stronger the solution of alkali added; on standing, the colouration became red in all cases, but took longer to develop than in the case of hydrogen peroxide or of ammonia.

Hydrogen peroxide and ammonia in strong solution produced an almost immediate yellow colouration, which deepened to a fine red, finally becoming quite black after a few hours. With weaker solutions the same changes take place, but more slowly, whilst with hydrogen peroxide and caustic potash the colours gradually deepened to a fine crimson-red, but not beyond.

Heating on the water-bath or in the Bunsen flame considerably accelerates all the reactions.

The "absolute phenol," with which the above experiments were made, will apparently retain its pure white colour when preserved in the dark in stoppered blue glass bottles, but when it has once been melted in the air or exposed to the air this is not the case. A sample so melted and kept in an open tube, either exposed to the light or in the dark, turned pink in the course of a few weeks. Also some of the original product which had not been melted became coloured dark red after being kept in an open vessel in the dark for six months. A considerable quantity of moisture had been absorbed by the phenol during this interval, and the colour was confined to the liquid portions of the product.

Second Series of Experiments.—Colour Reactions with six-times-distilled Phenol.—The first conclusion drawn from the above experiments, which show that any one of Fabini's three reagents readily produces a colouration with phenol, naturally was that the product was impure, and that if Fabini's view of the cause of the colouration be true, the phenol must have contained all the three sources of contamination—hydrogen peroxide, ammonia, and a metallic salt, or, assuming the oxygen of the air could play the part of the hydrogen peroxide, at any rate, the two latter must be present in "absolute phenol." The sample was therefore carefully distilled six times successively from a glass retort and the distillate collected in a glass receiver. The first portion of the distillate was always rejected, and a small residue left in the retort in each distillation. The residues left in the retort always possessed a dark pink tinge, which darkened rapidly on exposure, even in blue glass bottles.

In the following table the colour reactions obtained with ammonia, hydrogen peroxide, and with a mixture of the two reagents is given, the phenol, both after one and after six distillations, being tested under analagous conditions.

TABLE No. 1.

Comparison of the Colour Tests after 1 and 6 Distillations (Exposed to Light).

—	After 5 Hours.		After 24 Hours.	
	Once distilled.	6 times distilled.	Once distilled.	6 times distilled.
NH_4OH (Sp. Gr. 0·880)	Violet	..	Deep violet.	Violet.
H_2O_2 (20 vols.)........	Light red	..	Light red.	Slight colour.
$NH_4OH + H_2O_2$......	Deep brown.	Yellow-brown.	Brown-black.	Brown-black.
NH_4OH (1:10).......	Deep purple.	..	Deep purple.	..
H_2O_2 (1:10).........	Red	..	Red	Yellow.
$NH_4OH + H_2O_2$ (1:10)	Purple-red.	Yellow-brown.	Purple-red.	Brown.
NH_4OH (1:100)......	Pink	..	Pink.	..
H_2O_2 (1:100).........	"	..	Red.	..
$NH_4OH + H_2O_2$ (1:100)	Deep red	..	Deep red.	Yellow-red.

These results show that the phenol, after being distilled six times, reacts in an exactly similar manner with the reagents employed, to the once-distilled phenol, although the colouration take somewhat longer to form.

Third Series of Experiments.—Colour Reactions with nine-times-distilled Phenol.—A portion of the six-times-distilled phenol was subjected to three further fractionations from glass vessels under the same conditions as above, and tested with the same reagents, in order to have a complete comparison to show whether the impurities, if any were really present, were eliminated by the distillation. The nine-times-distilled product melted at 40° C., and turned pink upon standing in the air.

The results are tabulated below:—

Table No. 2.

Colour Reactions with Nine-times-distilled Phenol (Exposed to Light).

—	Under 1 Hour.	1 Hour.	18 Hours.	24 Hours.	2 Days.	6 Days.
NH_4OH (sp. gr. 0·880)	..	..	Pale blue	Pale violet	Violet	Deep blue.
KOH (1 : 2)	..	..	Very pale yellow	Pale yellow	Yellow	Brown-yellow.
H_2O_2 (20 vols.)	..	..	Yellow-brown	Yellow-red	Deep red	Deep red.
$NH_4OH + H_2O_2$	Yellow-brown immediately.	Greenish-brown	Black	Black	Black	Black.
$KOH + H_2O_2$	Slight colour in 5 minutes.	Light yellow	Yellow-brown	Red-brown	Red-brown	Deep red-brown.
NH_4OH (1 : 10)	..	..	Very pale blue	Very pale violet	Pale violet	Violet.
KOH (1 : 10)	..	..	..	..	Pale red	Yellow-red.
H_2O_2 (1 : 10)	..	..	Pale yellow	Orange	Red	Deep red.
$NH_4OH + H_2O_2$ (1 : 10)...	Yellow in 5 minutes.	Pale red-brown	Red-brown	Red-brown	Brown	Deep brown.
$KOH + H_2O_2$ (1 : 10)	..	..	Pale yellow	Pale yellow	Pale brown	Yellow-brown.
NH_4OH (1 : 100)	..	..	..	..	Pink	Pale red.
KOH (1 : 100)	..	..	..	..	Pale red	Red-brown.
H_2O_2 (1 : 100)	..	..	..	..	Pale yellow	Orange.
$NH_4OH + H_2O_2$ (1 : 100) ..	Slight colour in 10 minutes.	Pale yellow	Pale brown	Pale red	Red	Red.
$KOH + H_2O_2$ (1 : 100)	..	..	..	..	..	Pale yellow.

The addition of a drop of a dilute solution of a copper or of an iron salt to the phenol readily produced a colouration. In the case of copper sulphate the colour was first red, then deep brown; with ferric chloride the colour was more inclined to brown at first, but on standing turned to a fine red. In presence of dilute caustic potash both copper and iron salts developed a fine red colouration rapidly, but exactly the same colour resulted with alkali alone, only it took longer to develop. Ammonia also gave the red coloration both in the presence of iron and of copper salts. In all these cases the copper salts aid the reaction most and give the finer colouration. The addition of hydrogen peroxide to this purified phenol, in presence of ammonia and of a copper or iron salt, also produced a red coloration. Heated on the water-bath with metallic copper or with metallic iron, brownish-red colours were produced in the phenol in 20 minutes and 40 minutes respectively, whilst the same colourations were given after three minutes heating in the Bunsen flame.

The colour reactions with ammonia, hydrogen peroxide, and with caustic potash were found to be very much more rapidly developed either by heating on the water-bath or over the Bunsen flame, as in the case of the "absolute" phenol.

A comparison of Tables 1 and 2 shows clearly that little had been gained by the method of purification adopted—for to judge from the colour reactions obtained, the original impurities still remained. The only other conclusion to be drawn was that the phenol was practically pure in the start, and that the nine-times-distilled, as well as the original product, gave characteristic and independent colorations with ammonia, hydrogen peroxide, caustic potash, copper and iron salts, and, above all, itself became coloured when exposed. The original "absolute" phenol had been tested for metallic impurities in the start, but owing to the decisive nature of the results obtained with the nine-times-distilled phenol, we deemed it advisable to make a specially careful series of tests for impurities with this product. The results proved the phenol to be quite free from iron, copper, ammonia, and alkali. It is not an easy matter to detect very small quantities of such impurities in an organic body, which has (except in the case of ammonia) to be first carbonised before the presence of inorganic constituents can be tested for. Still, by employing a good quantity of the phenol and making careful blank experiments with the reagents used in all the cases, we feel fully convinced that the product was quite free from the impurities tested for. In this connexion it appeared of interest to try the effect of distilling phenol in presence of metals and of metallic salts. We tried distilling phenol both with metallic copper, copper sulphate, and with ferric chloride, with the result that, although the metal is readily taken up by the phenol, not the least trace of it distils over; it all remains behind in the residue left in the retort.

Fourth Series of Experiments.—Colour Reactions with Sublimed Phenol.—As already mentioned, Bidet found that phenol purified by sublimation remained white on exposure. To test the accuracy of this statement a portion of the nine-times-distilled phenol was carefully sublimed, fine prisms 2—3 in. in length being obtained. These on exposure to air and light gradually turned pink, although less rapidly than the unsublimed product, a fact in all likelihood due to their more dense and crystalline state, for, when melted and then exposed, the red colouration was noticed to take place as readily as before. Treated with ammonia or with ammonia and hydrogen peroxide they gave similar colourations to those got with the distilled product, as is shown in the following table:—

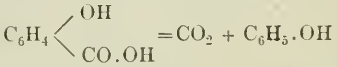
Table No. 3.

Colour Reactions with Sublimed Phenol (Exposed to Light).

—	Immediately.	2 Hours.	24 Hours.	1 Month.
NH_4OH (sp. gr. 0·880)	..	..	Blue	Indigo blue.
$NH_4OH + H_2O_2$ (20 vols.)	Greenish	Black	Black	Black.
NH_4OH (1 : 10)	..	..	Pale blue	Blue.
$NH_4OH + H_2O_2$ (1 : 10)	Yellow	Brown-black.	Black	Black.
NH_4OH (1 : 100)	..	..	..	Red.
$NH_4OH + H_2O_2$ (1 : 100)	..	Pale yellow.	Red	Dirty red.

Sublimed phenol therefore reacts exactly similarly to the redistilled product, and there is no ground for regarding it as in any way purer than the latter.

Fifth Series of Experiments.— Colour Reactions with Phenol prepared from Gaultheria Oil.—It is generally recognised that it is very difficult to eliminate all traces of impurity from a volatile product by distillation or by sublimation, and consequently the possibility of the phenol used in the above experiments being still contaminated by the presence of foreign bodies in so small quantity as to defy their detection by qualitative analysis, made it desirable to further check the correctness of the results obtained. To effect this phenol was prepared from the natural product —gaultheria oil—the methyl ester of salicylic acid, which is, beyond a doubt, free from the sources of impurity—metals, alkali, or ammonia—to the presence of which the turning red of phenol is attributed. The ester was first fractionated and then saponified by caustic soda. The resulting salicylic acid was carefully purified by recrystallisation from water, after being separated from the alkaline solution by the addition of hydrochloric acid. The only impurity that could possibly remain with the salicylic acid under these conditions would be sodium chloride, but the repeated recrystallisations must have eliminated this. Phenol is readily obtained from salicylic acid by heating with hydrochloric acid, when the following change occurs:—



$$C_6H_4\left\langle\begin{matrix}OH\\CO.OH\end{matrix}\right. = CO_2 + C_6H_5.OH$$

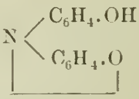
Specially purified hydrochloric acid was employed for this reaction, but the resulting phenol was always dark-coloured. It was found, however, that the decomposition is readily effected by water in sealed tubes at 180°—200° C., the heating being continued for 11—12 hours. Owing to the pressure due to the carbon dioxide evolved in the reaction it is advisable to open the tubes once or twice during the heating, and then to re-seal them. The resulting solution of phenol was almost colourless, and was got quite colourless by distillation. The quantity thus prepared was only small and not sufficient to allow of its being worked up to the dehydrated solid state, for which reason the colour reactions were tried with solutions of the purified product, and with the following results:—

TABLE No. 4.

Colour Reactions with Phenol prepared from Gaultheria Oil (Exposed to Light).

—	Immediately.	1 Hour.	12 Hours.
NH_4OH (sp. gr. 0·880)	..	Greenish	Blue
H_2O_2 (20 vols.)........	..	..	Red-yellow
$NH_4OH + H_2O_2$......	Yellow-red	Deep red	Red to greenish-red.

A more extended series of experiments with the phenol thus prepared would have been advantageous, but the preparation of a quantity in the laboratory involves much labour. Still the results are ample to show that the phenol from this source gives the same colourations with ammonia and with hydrogen peroxide that the redistilled "absolute" phenol does, and consequently that Fabini's view of the cause of the red colouration is not correct. Further the complete concordance in the behaviour of the phenol obtained from two such different sources shows that the redistilled "absolute" phenol is in reality a pure product, and that the colour reactions observed with it are not to be traced to the presence of hidden impurities. The results tabulated above show that in all the tests applied to phenol two characteristic and different reactions are to be observed. On the one hand there is the blue colouration produced by ammonia alone; this always results with strong solutions of ammonia. Very dilute ammonia, on the other hand, in common with hydrogen peroxide, caustic potash, hydrogen peroxide in presence of ammonia or of caustic alkali, metals or metallic salts, with or without hydrogen peroxide, causes the formation of a red colouration. The intensity and tint of the colour produced by these different reagents varies considerably from the yellow to brown colourations obtained with caustic potash to the red, deepening to black, formed by the joint action of ammonia and hydrogen peroxide. In most instances, however, as shown especially in Table No. 2, the colouration inclines to red, the colour usually formed in commercial phenol, although brownish colorations are to be also observed with this product. Whilst it is not likely that these colours are identical, it is probable that they are closely-allied bodies, and the conditions of their formation show that they are undoubtedly oxidation products of phenol. We have not as yet studied the chemical nature of these substances, since our experiments deal only with the conditions under which the colourations are produced. The blue colour formed by the action of ammonia upon phenol is in all probability identical with the "phenol-blue" described by Phipson (Ber. **6**, 823), as formed by the action of the oxygen of the air on a mixture of phenol and ammonia, and to which he assigned the empirical formula C_6H_5NO or $C_6H_7NO_2$. Nothing is, however, known as regards the chemical constitution of the body. The colour is turned red by acids, and this red solution is decolourised by zinc, the colour reappearing on standing in the air after the addition of ammonia. This behaviour reminds one of the indo-phenol colours formed by the oxidation of para-amido-phenols in presence of phenol, and it is of interest to note that by the action of ammonia and hydrogen peroxide upon phenol, preferably in presence of hydroxylamine, Wurster (Ber. 1887, **20**, 2934) prepared a colour which from a qualitative comparison he considers identical with the indo-phenol, phenol-quinone-imide—



$$N\left\langle\begin{matrix}C_6H_4.OH\\C_6H_4.O\end{matrix}\right.$$

We hope to deal with the nature of this colouring matter on a future occasion; for the present, what we especially wish to emphasise is that ammonia alone forms a distinctive colour with phenol, a fact that appears to have been quite overlooked by Fabini.

Sixth Series of Experiments.— With 15-times-distilled Phenol.—The combined results of the previous series of experiments show that distillation from glass vessels is really an effectual means for completely purifying phenol. For our further experiments we therefore distilled "absolute" phenol under the conditions already described, and in order to be well on the safe side 15 successive distillations were made. The final product, which was quite colourless, melted at 41° C. It remained colourless when kept in a closed flask unexposed to light, but when exposed to air and light it turned pink. During the distillations the residue in each case turned pink, and on standing became red. The reddening in all cases was accompanied by the absorption of moisture, and was always most noticeable in those portions of the phenol which had been partially liquified by such absorption. This is a point which may always be noted with reddened phenol, and which, according to Fabini, is due to an alkaline phenate being formed as already mentioned; as a matter of fact, however, the explanation is a much simpler one, as will be seen.

The action of ammonia, of hydrogen peroxide, and of a mixture of the two reagents, was tried on this 15-times-distilled phenol with the following results, which fully confirm all previous observations.

The conclusions drawn from these experiments may be summarised as follows:—

1. Pure phenol, when exposed to ordinary moist air, becomes coloured, the colour gradually deepening in tint from pale pink to a deep red. The colouration is always accompanied by the absorption of moisture.

2. Since the colouration is always accompanied by the absorption of moisture, the presence of moisture is most probably intimately associated with the formation of the colour.

TABLE No. 5.

Colour Reactions with 15-times-distilled Phenol (Exposed to Light).

—	Immediately.	2 Hours.	24 Hours.	1 Month.
NH_4OH (sp. gr. 0·880)	..	Pale violet.	Blue	Indigo-blue.
H_2O_2 (20 vols.)........	..	Red-yellow.	Red	Deep red.
$NH_4OH + H_2O_2$......	Greenish	Black	Black	Black.
NH_4OH (1 : 10).......	..	..	Blue	Indigo-blue.
H_2O_2 (1 : 10)..........	..	Red-yellow.	Red	Red.
$NH_4OH + H_2O_2$ (1 : 10)	Slight colour.	Brown-black.	Brown-black.	Black.
NH_4OH (1 : 100)......	..	..	..	Red.
H_2O_2 (1 : 100).........	Not tried.			
$NH_4OH + H_2O_2$ (1 : 100)	..	..	Pale red	Red.

3. Hydrogen peroxide, either in presence or absence of alkalis, produces a similar colouration with phenol, whence this colouring matter is to be regarded as an oxidation product of the phenol.

4. The presence of small quantities of certain metals, especially of copper, either in the metallic form or as salts, accelerates the formation of the colouration.

5. Ammonia produces a blue colouration with phenol—the "phenol-blue" of Phipson, which is quite distinct from the red-coloured oxidation product.

6. The formation of both of the above colours is aided by gentle heating.

Seventh Series of Experiments.—On the Conditions under which Pure Phenol turns Red when exposed to Air.—Having ascertained that pure phenol when exposed to ordinary moist air turns red, it remained to determine the conditions under which this colouration takes place, *i.e.*, to find out whether of the three active agents—air, moisture, and light, one, or more than one, are essential for the oxidation to be effected. The following experiments were carried out for this purpose:—

1. *Action of Light upon Phenol in Absence of Air and Moisture.*—Two tubes were partially filled with pure phenol and then exhausted. One of these was exposed to the light, the other kept in the dark for six months. In both cases the phenol remained perfectly white, showing that light is without action in absence of both air and moisture.

2. *Action of Dry Air upon Phenol.*—A current of perfectly dry air was passed over melted phenol placed in a tube, the ends of which were subsequently sealed. The contents of the tube remained colourless after seven months exposure to light. Hence in absence of moisture no colouration takes place. On opening a tube thus prepared, in which the phenol had kept colourless for four months, and allowing it to remain exposed to ordinary moist air, the red colouration was formed in a few days, the phenol at the same time becoming moist, and partially liquified.

3. *Action of Moisture upon Phenol in Absence of Air.*—Two tubes containing phenol, together with a few drops of water, were exhausted, sealed, and then exposed to light for six months. The phenol remained colourless. On opening one of these tubes and allowing it to remain exposed to ordinary air the phenol was seen to darken appreciably even in a few hours, and at the end of a week had assumed the usual red tint.

From these results it is perfectly clear that both air and moisture are necessary for the oxidation of the phenol to take place. In respect to the action of light a series of experiments showed that the coloration is produced in the dark, although slowly, and therefore that light acts as an accelerator of the change only—an action of which there are many other instances, such as the gradual decomposition of hydriodic acid in presence of air into iodine and water.

The similarity between the coloured product formed by the action of moist air upon phenol and that produced by hydrogen peroxide naturally lead one to look to the latter body as the real factor in the oxidation. Some experiments made with the view of establishing the truth of such an hypothesis, in which phenol was exposed to moist air in presence of ether and of turpentine—substances which have been shown to favour the formation of hydrogen peroxide—gave, however, negative results. We therefore prefer to desist from adding to the reactions with which theory alone has already sufficiently overburdened the peroxide of hydrogen. That the action is much aided by the presence of metals is quite in accordance with our conclusions, for that their presence will assist in the oxidation of phenol is clearly shown by the action of metallic salts upon aniline and upon dimethylaniline with the production of aniline-black and of methyl violet respectively. The reason why the colouration is always observed in those portions of the phenol that have liquified is also clear, for the absorption of moisture and consequent liquifaction of the phenol is necessary before the red colouring matter can be produced by the action of the atmospheric oxygen.

Since the completion of this work a paper has appeared by W. Hankó (Ber. 1892, **25**, Abstracts, 386), whose results are quite in accordance with our own. He also traces the colouration to the oxidation of the phenol itself, and not to the action of any contained impurities. The colour formed he describes as a dark red, sticky body, of great tinctorial power, and he points out that the presence of certain metals, such as copper, iron, and lead, and especially of their salts, also of ammonia and of ammonium chloride, hastens the colouration.

Bearing of the Experiments upon the Commercial Preparation of Pure Phenol.—The great aim of manufacturers of pure phenol has always been to obtain a product that will not redden on keeping, and amongst the secrets of the trade are to be classed the variety of methods adopted with this end in view. We started these investigations with some little hope of being able to achieve this long-desired result, but our experiments have led us to other conclusions with which the manufacturer has no reason to be displeased. During the past two or three years a product known as "synthetic phenol" has been prepared in Germany from coal-tar benzene either by converting the latter into benzene monosulphonic acid and then fusing with alkali, or by first making aniline and subsequently diazotising, the diazobenzene salt being converted into phenol by boiling with water. This synthetically-prepared product aroused considerable interest at first, as it was supposed to be purer than ordinary coal-tar phenol, and, despite its higher price, found a market. According to a recent extract from one of Gehe and Co.'s reports, however, the interest in and sale of this phenol has considerably abated since it became clear that it shared with ordinary phenol "the fatal defect of reddening." From other sources we have also learned that this product reddens quite as easily, if not more so, than ordinary carbolic acid. Since it must now be recognised that it is impossible to prepare phenol that will not turn red on being kept, the attention of the manufacturer must be directed to the exclusion of those bodies which aid the colouration. A final distillation from glass vessels, as now practised, serves to remove metallic contaminations, and the exclusion of moisture is aided by agitating the phenol with strong sulphuric acid, as is done in Lancashire, according to Mr. Watson Smith. Distillation over strong sulphuric acid or other suitable dehydrating agent would help further towards obtaining the phenol in an anhydrous condition, and the necessity of collecting the distillate in perfectly dry vessels is also obvious. On the other hand, the employment of an oxidising agent, such as potassium bichromate and sulphuric acid, to be mixed with the phenol during the distillation, rests upon the erroneous assumption that the colouring matter can be once and for all formed thereby owing to the oxidation of impurities, and then eliminated by subsequent distillation. The colouring matter is certainly non-volatile, for a colourless product can always be obtained by distilling reddened phenol from glass vessels, but the distilled product will, of course, colour again under the conditions already discussed. Perfectly dry phenol, kept in well stoppered bottles, will remain colourless until brought into use, when, by the repeated opening of the stopper, it will gradually turn red owing to the oxidation effected by ordinary moist air, and no previous treatment of the phenol can obviate this result. Whether there is any special advantage in employing blue glass bottles, as are generally used, we have not tried. It is sometimes the case that the less refrangible rays of light act as oxidising agents, the more refrangible as reducing agents, and perhaps this holds in this instance. There is one other point of interest to the manufacturer of phenol, as also to the medical practitioner, and that is, whether the colouring matter produced by the oxidation of phenol has any injurious therapeutic action. Even if it should have, however, the quantity present in reddened phenol is so small that it is extremely unlikely that any prejudicial effects would result from its presence.

Discussion.

The **Chairman** remarked that for his own part he could only say that what he had learned from Dr. Kohn's paper would have been extremely useful to him 34 or 35 years ago, and would have saved him a good deal of trouble. At that time he was very busy with the manufacture of carbolic acid, and was unable to ascertain the cause of colouration.

Dr. F. **Hurter** said that the subject of the investigation was one of those colouring matters which now and then turned up in small quantities and were a great source of trouble to manufacturers. He congratulated Dr. Kohn on his discovery that the reddening of carbolic acid was really a property of pure phenol and was not due to an accidental impurity.

Dr. Kohn had incidentally mentioned the difficulty of heating certain mixtures in sealed tubes. It was really not difficult to heat such tubes, if after sealing them they were placed within an iron pipe hermetically closed after having been partially filled with water. By doing this the glass tube was exposed to pressure from outside as well as from inside, and had only to bear the difference of pressure and not the whole.

Dr. **Campbell Brown** said that while the majority of people assumed that the colouration was due to the impurity in the phenol, yet, on the other hand, some manufacturers persistently maintained that very pure carbolic acid was more apt to show colour than ordinary commercial pure carbolic acid containing a small quantity of impurity; and that buyers made a double mistake in paying the extra prices for extremely pure carbolic acid, which was worse for their purpose. They now to some extent understood from those researches how to avoid colour, and under what circumstances colour could not be avoided. To supply that information in so elaborate and complete a way was a good piece of work which everyone would appreciate.

Mr. **Graesser** said he had manufactured carbolic acid for 25 years, and it had been one of his efforts to determine the cause of colouration and whether it could be avoided. His results entirely agreed with Dr. Kohn's with one exception: he had found that moisture was not essential to make carbolic acid turn red when exposed to air and light, but perhaps Dr. Kohn's experiments were more carefully done. No doubt carbolic acid, whether more or less pure, would colour easily when exposed to light and air, and the higher price paid for pure carbolic acid crystals when required for medicinal purposes was not so much for its property of keeping white longer as for its freedom from cresylic acid, which when taken internally or used for dressing wounds was injurious. One important point to be observed in handling carbolic acid when required to keep white as long as possible was that all vessels be clean and the surrounding air pure, especially free from ammonia. When carbolic acid was prepared in detached crystals it kept white much longer than the ice, though offering more surface to the action of light and air; he could not explain this fact. Carbolic acid distilled with a small addition of oxide of lead and bicarbonate of soda would be found to keep white longer under any circumstances than when distilled without any additions.

Mr. **Carey** asked whether the carbolic acid would colour in that way if the air were filtered. Was it not possible that impurites of dust might set on foot that colouration? Should not the air be filtered with as much care as in physiological experiments in the case of organic germs?

Dr. **Kohn** in replying thanked Dr. Hurter for calling his attention to the method of heating glass tubes by luting down the iron casing in which the tube was placed; he (Dr. Kohn) had been of opinion that the process was dangerous when a gas such as carbonic acid was evolved in the tube, owing to the results that might ensue on opening the luted iron tube in case the inner glass tube had burst. It was very satisfactory to learn from Mr. Graesser that his long experience in the manufacture of carbolic acid had led him to practically the same conclusions as they had obtained. Their experiments pointed beyond doubt to the necessity of the presence of moisture as well as of air for the colouration to be effected; very little moisture will suffice, and perhaps its presence was the cause of Mr. Graesser's different result. His (Dr. Kohn's) experience with sublimed phenol pointed, as mentioned in the paper, to its being less sensitive to colouration than the distilled product, as Mr. Graesser also found; this difference could only be attributed to its physical condition. Sublimed phenol was also less hygroscopic than the distilled product; this property would comparatively further hinder the colouration in ordinary moist air. The process of purification mentioned by Mr. Graesser, of distillation over sodium bicarbonate and oxide of lead might be specially advantageous as a means of removing any sulphur compounds which might aid in the colouration of the phenol. In reply to Mr. Carey, they had not filtered the air. In many cases the phenol was distilled into stoppered bottles, the stoppers of which were only removed once or twice during the time they were exposed, and in all instances the phenol turned pink. Also in the case of vacuous tubes containing moistened phenol, which coloured on being opened, the open end was plugged at once with cotton wool, so all the air beyond the small amount originally admitted was filtered. He (Dr. Kohn) therefore did not consider it likely that the impurities floating in the air had been the cause of their results. It might be of interest to mention that Schnitzler had expressed the view that the colouration of purified phenol was due to dust particles floating in the air, but the only evidence offered was that the product coloured when exposed in an open glass.

THE ESTIMATION OF OXIDE OF IRON AND ALUMINA IN MINERAL PHOSPHATES.

BY ALFRED SMETHAM.

During the past 20 or 30 years the use of mineral phosphates has largely extended in this country, and as the native supply of coprolites is now and has been for some years practically at an end, it follows that large quantities are imported from various parts of the globe. These supplies vary very much in composition and in physical structure, from the hard crystalline apatite to the soft, powdery, phosphatic guano; but from whatever source obtained the value is regulated chiefly by the percentage of phosphate of lime present.

In England, whatever may be the course adopted elsewhere, nearly the whole of the imported mineral phosphates is used for the manufacture of superphosphate, by which means the insoluble, and in the coarse state practically inert, phosphate is changed into the soluble condition by treatment with sulphuric acid in proper proportions. The change which takes place is partly the formation of monocalcic tetrahydric phosphate and partly the liberation of free phosphoric acid, the calcium combining with the sulphuric acid to form gypsum, which acts as a drying material. It would thus seem a pretty simple operation to manufacture a superphosphate in which the whole of the phosphoric acid would be soluble in water; but in practice a difficulty is met with in thus converting the whole of the phosphoric acid from the insoluble into the soluble condition, owing to the presence of impurities in the raw material.

Of these impurities, those which are found to have the most detrimental effect are oxide of iron and alumina, as these, especially on keeping, form compounds with phosphoric acid insoluble in water, causing the superphosphate to "go back" or "revert." Hence, as in England the price of superphosphate is fixed solely by the percentage of soluble phosphate which it contains, it is important to the manufacturer to obtain his raw phosphates as free as possible from oxide of iron and alumina.

For this reason it has of late years become customary in certain grades of phosphate to estimate their value not only by the percentage of phosphate of lime contained in them, but also to take into account the percentage of oxide of iron and alumina, it being generally considered that these substances will prevent double their weight of phosphate from becoming soluble. As, however, it is impossible to find any mineral phosphates free from these impurities, a limit of 3 per cent. is usually allowed, beyond which amount the excess counts double as against the phosphate. For example, a sample of phosphate testing in the dry condition 80 per cent. phosphate of lime and 3 per cent. oxide of lime and alumina together, would be charged for on the basis of 80 per cent., while a similar phosphate containing 4 per cent. would be invoiced at only 78 per cent. It will thus be seen that the accurate estimation of these two substances is a matter of the greatest possible commercial importance to all those dealing in these commodities, whether as buyers or sellers; and, unfortunately, as is often the case in newly-developed necessities, the results have been anything but satisfactory.

In framing a contract it is now customary to allow a margin of 1 per cent. on the phosphate of lime and $\frac{1}{2}$ per cent. on the aggregate of the oxide of iron and alumina between the analyses of the two chemists nominated by the two parties, and if any greater differences occur the matter has to be referred to a third chemist previously agreed upon; the mean of the two most nearly-agreeing results to be taken for the purposes of valuation.

As greater care is now exercised in the taking of samples, it is not often that those specially engaged in the analyses of phosphates are found to differ beyond the stipulated 1 per cent. in the phosphate of lime, but it can scarcely be said that the same uniformity exists with regard to the estimation of the oxide of iron and alumina. During the last few years, and especially since a conference appointed by the Chemical Manure Manufacturers' Association to consider the subject, much greater uniformity has prevailed, and among English chemists the wide discrepancies which were formerly very common are now of rare occurrence; but it is to be regretted that the same agreement is not observed between our tests at home and those made by some leading Continental and American analysts.

The accuracy of some of my estimations of oxide of iron and alumina having been called in question, I determined to put the processes I have in use to a critical examination, and with this end in view I started the series of experiments which I wish to bring before your notice.

Of the large number of processes described with greater or less exactitude in the various books on chemical analysis, few yield accurate results or are adapted to the requirements of a busy laboratory. Practically the processes used by those chemists who devote their attention specially to phosphate analysis may be classed under two heads—1st the acetate of ammonia process; and 2nd, the Glaser method and its modifications—and it will be to a discussion of these that I shall limit myself.

The first or acetate method is based upon the fact that phosphate of iron and phosphate of alumina are insoluble in a cold solution of acetic acid, while phosphate of lime is soluble. It would thus appear at first sight that a ready and simple means was at our disposal to effect a perfect separation, but unfortunately, as is often the case in seemingly simple operations, sources of error arise which render the accurate estimation of the oxide of iron and alumina a matter of considerable difficulty, the chief cause of danger being the fact that phosphate of alumina is appreciably soluble in excess of acetic acid. Although this fact has long been known to some analysts, and was clearly pointed out by W. C. Young in *The Analyst* of 1890, pp. 61 and 83, it has been very widely overlooked, even by those whose duty it is to analyse phosphates almost daily, and it is to this neglect that many of the discrepancies between the results of eminent men are attributable. It is true that the paper just referred to did not treat directly of the estimation of alumina in phosphates, and it may be partly for that reason that its teachings have remained in certain quarters so long unheeded.

Another source of error in working the acetate method has been the widespread assumption that the acetate of ammonia precipitate consisted solely of phosphates of iron and alumina, and that these phosphates were normal orthophosphates. This was an error which received some sort of semi-official sanction in a report issued in 1878 by a committee appointed by the British Association to investigate the methods in use for the estimation of phosphoric acid in commercial phosphates, and, in spite of a warning which I gave in a letter to the *Chemical News* of August 23rd of that year, I fear the assumption of the purity of the precipitates was too widely relied upon and the percentage of alumina obtained by deducting the $FePO_4$ calculated from the amount of Fe_2O_3 found in the precipitate from the total weight, no account being taken of the solubility of $AlPO_4$ in the excess of acetic acid used, nor of the presence of lime in the precipitate, nor of the fact that the phosphates present are not necessarily normal. Hence results obtained in this manner were at best but a balancing of errors, and sometimes errors of considerable magnitude. It is not to be wondered at, therefore, that with such possibilities of error the results obtained by different chemists were widely divergent, and were such as to call forth from dealers in phosphate a vigorous protest, and an attempt, by means of the conference before alluded to, to remedy what was undoubtedly a crying shame to the analytical profession. Fortunately, the publication of the Glaser process gave to the world an alternative method, which enabled chemists to place an effective check upon the results obtained by the older acetate process. If matters had then gone on to what should have been the natural termination of such a discussion, and if the information obtained had spread to other countries, there can be little doubt that greater uniformity in results would have occurred; but unfortunately such was not the case, and we still have to deplore too frequently wide variations in analysis, especially between the English tests and those made for the shippers abroad.

It therefore seemed to me eminently desirable that the processes we have in use should be put to a critical examination in order to ascertain to what extent they are reliable.

With this object in view, I have made test experiments under known and well-defined conditions, with practically three distinct processes—first, the Glaser in a modified form, which depends for its success on the complete insolubility of sulphate of lime in alcohol acidified with sulphuric acid and the solubility of phosphates of iron and alumina in the same menstruum; second, the acetate method, as I have been in the habit of using it for many years past, and thirdly, the acetate method as described by Dr. F. Wyatt in a book recently published (1892) in New York, entitled "The Phosphates of America."

As this process is evidently largely in use among chemists in the United States, and as it is in this direction that discrepancies are often observed, I have examined it in the same way as I have done the other two processes.

Before, however, giving the test experiments for each of these methods it will be necessary to describe in detail the processes as carried out by me in actual practice; and this will perhaps best be done under the three heads given above.

The Glaser Method.—This process as now practised by me is substantially the modification given by my friend Mr. H. H. B. Shepherd in the Chemical News 63, 251, and is as follows:—2·5 grms. of the finely prepared sample, previously dried at 100° C., are treated with from 20—30 cc. of pure strong HCl in a beaker, and the solution, when effervescence has ceased, is evaporated to hard dryness in a water-bath. By this means the fluorine present is expelled, and any soluble silica converted into the insoluble condition. The mass is then dissolved in about 10 cc. of of dilute HCl (1—4), and when all but the silicious matters has dissolved the contents of the beaker are washed into a 250 cc. flask *with the least possible quantity of hot water.* It should here be noted that aqua regia, either for the original attacking of the phosphate, or the subsequent solution is not admissible, as it decomposes any pyrites which may be present, and thus includes in the oxide of iron, the iron combined with the sulphur, which, being unattacked by the sulphuric acid in the manufacture of superphosphate, has no detrimental effect. When the solution of phosphate is cooled, 10 cc. of pure sulphuric acid are added and the contents of the flask shaken by a rotatory motion, and the mixture allowed to cool. When cold the flask is filled up with alcohol (redistilled methylated spirit will do) to the mark on the neck, and the whole well shaken. When the contraction is complete the liquid in the flask is again adjusted by the addition of more alcohol, and allowance is made for the volume of the precipitated sulphate of lime. It is again well shaken and put aside for the sediment to settle, when it is passed through a dry filter into a 200 cc. flask. The 200 cc. (= 2 grms. of substance) are then evaporated in a platinum basin at a low temperature, and the evaporation is continued until vapours of sulphuric acid are given off, and the whole of the organic matter present (obtained either from the substance or from the spirit used) *thoroughly charred.* This is very important, otherwise there is a danger of a portion of the oxide of iron and alumina being held in solution by the organic matters in the subsequent precipitation. When cold the residue is washed into a beaker, bromine or peroxide of hydrogen is added in good excess, and the liquid is heated nearly to boiling for some time. Ammonia is then added to the liquid to distinctly alkaline reaction, it is then boiled gently for a short time, a few drops more of dilute ammonia added and the precipitate filtered and washed with boiling water, to which preferably an ammonium salt has been added. This precipitation needs considerable care, as on continued boiling the sulphate of ammonia in solution is resolved into an acid sulphate which dissolves more or less of the precipitated phosphates. It is important therefore, even when the instructions I have just given are followed, to test the filtrate by adding a little more ammonia and warming to ascertain that the whole is precipitated. Unless an ammonium salt be used in the washing there is a tendency for the precipitate to split up into a basic phosphate, and a portion of the iron and alumina may wash through the filter.

An alternative method of precipitation, which I have lately adopted with advantage, and which obviates entirely the necessity of searching for magnesia in the precipitate, is as follows:—After the bromine has been expelled the liquid is made distinctly alkaline with ammonia, a little solution of acetate of ammonia is added, and the solution made slightly acid with acetic acid, and then well boiled. When precipitated in this way the mixed phosphates filter more rapidly and the washing is easier, while at the same time there is no risk of loss by solubility, as in the ordinary method of precipitation.

The precipitate, which consists of oxide of iron and alumina in combination with phosphoric acid, contains, if the instructions I have given are implicitly followed, no lime whatever, but if precipitated with ammonia only may contain a trace of magnesia. As the composition of this precipitate varies in almost every analysis, it is not, in my experience, safe to calculate the percentage of oxide of iron and alumina for the weight of the whole, but it must in every instance be carefully analysed. The method I employ is as follows:—After ignition, the precipitate is weighed, dissolved in dilute HCl, when a perfectly clear solution should be obtained, citric acid added (usually about 2 grms.), and the solution made ammoniacal, so that about one-quarter of the bulk shall be strong ammonia (0·880 sp. gr.). If sufficient citric acid has been added, the liquid should retain its light yellow colour and remain clear for some time. It is then set aside, with occasional stirring, for at least an hour, when, if no precipitate forms, magnesia is absent, or present only in negligible quantity. If magnesia is present, the solution is again well stirred, and after settling, the precipitate must be filtered off, washed with dilute ammonia (1 in 4), and ignited to $Mg_2P_2O_7$. To the filtrate or solution, magnesia mixture in moderate excess is added, the liquid well stirred for a period of not less than two hours, and the precipitate collected in the manner described for the magnesia, if present. (There is no need to redissolve this precipitate, as there are no impurities which can come down with it and contaminate it. If there was any doubt as to whether lime was present and oxalate of ammonia has been used, the phosphate precipitate must be dissolved and reprecipitated with ammonia.) To the filtrate, sulphide of ammonium is added in small excess, the liquid warmed, and the precipitated FeS collected with the ordinary precautions, and it can then be burnt directly to Fe_2O_3. By subtracting the weight of the phosphoric acid and magnesia (if present) from the total weight, the weights of the oxide of iron and alumina are readily obtained. The process is a long one, but with due care very satisfactory results are obtained.

In testing this and the other processes I prepared standard solutions of iron and alumina by dissolving known quantities of steel wire and alumium foil in acid—the aluminium foil being carefully analysed to correct for the impurities which were contained in it in small quantity. Solutions were also prepared of phosphate of lime (or phosphoric acid and chloride of calcium) and of chloride of magnesium.

The following are the results obtained:—

Taken.	Found.	
	First Determination.	Second Determination.
1·25 grm. $Ca_3P_2O_8$	..	..
0·092 grm. Fe_2O_3	0·091 Fe_2O_3	0·992 Fe_2O_3
0·115 grm. Al_2O_3	0·134 Al_2O_3	0·140 Al_2O_3

In these two cases the excess of alumina found was due to the fact that the liquid, before the addition of alcohol, measured 80 cc., and, on testing, lime was discovered in the precipitates. I give these results, however, by way of enforcing the necessity of keeping the liquid in small bulk before adding the alcohol to the flask.

Taken.	Found.
0·565 P_2O_5	..
2·2 $CaCl_2$	..
0·087 Fe_2O_3	0·085
0·089 Al_2O_3	0·091

In this case the total liquid, irrespective of the sulphuric acid, measured only 35 cc., a quantity which in practice should, I find, not be much exceeded. With a little care there is no difficulty in conveying the whole of the solution to the flask with this amount. In this case the precipitate was quite free from lime.

The next test was similar to the last, but with the addition of chloride of magnesium. The results were:—

Taken.	Found.	
	Precipitation with Ammonia.	Precipitation with Ammonia, Acetate of Ammonia, and Acetic Acid.
0·565 P_2O_5	..	..
2·000 $CaCO_3$	..	..
0·087 Fe_2O_3	0·087	0·087
0·089 Al_2O_3	0·087	0·088
0·095 $MgCl_2$	..	..

When ammonia only was used the precipitate was found to contain 0·007 grm. of MgO, a fact which shows the necessity of searching for it in every analysis. In the second case no MgO was present.

A long series of duplicate tests by the Glaser method and by the acetate process about to be described has convinced me that with due care and a close observance of the conditions I have stated will enable duplicate tests by the two processes to agree usually within 0·1 per cent. on the total material taken. I prefer to have my duplicate tests by the two methods, especially as the primary separations are so dissimilar.

Acetate of Ammonia Process.—Under this head I propose to treat only of the process as I have been accustomed to use it for many years past.

Two grms. of the finely-prepared sample are evaporated with strong HCl in the same manner as in preparing the solution for the Glaser process, the residue is taken up with about 10 cc. of dilute HCl, digested until the whole is soluble, diluted with water, and the silicious matter filtered off. The solution is then boiled with peroxide of hydrogen, or bromine, to be quite sure that the whole of the iron is as peroxide; the solution is allowed to cool, and dilute ammonia is added until a slight permanent precipitate is obtained. Dilute HCl is then added, drop by drop, until the liquid is again quite clear, and then sufficient acetate of ammonia solution, with an inclination to acidity rather than alkalinity, to form chloride of ammonia with the whole of the free HCl. An excess of acetate of ammonia does not affect the accuracy of the results. After well stirring, the beaker is set aside for some time, and the precipitate is then collected, washed first with cold and then with hot water, dried, burnt, and weighed. By this means the solution contains free acetic acid equal to only the quantity of free hydrochloric acid necessary to keep the phosphates of iron and alumina in solution, and in this solution the alumina is not appreciably soluble. The precipitate thus obtained consists of phosphates of iron and alumina, and varying quantities of phosphate of lime, and it is, therefore, necessary that a careful analysis of it be made, in order to arrive accurately at the percentage of alumina. This I prefer to do as follows:—The precipitate is dissolved in dilute HCl, citric acid added, and then oxalate of ammonia in slight excess. The solution is boiled, and then dilute ammonia added, drop by drop until the liquid is neutral to litmus paper and then acetic acid to distinctly acid reaction. The liquid is then kept simmering for some time to ensure the complete precipitation of the whole of the lime; it is then filtered, the precipitate washed with hot water, dried, and burnt to carbonate, care being taken to keep the temperature sufficiently low to prevent the formation of any caustic lime. In the filtrate the phosphoric acid is precipitated with magnesia mixture, the solution well stirred, and preferably allowed to stand overnight. The supernatant liquid is then passed through a filter, the filter washed into the original beaker, and the precipitate dissolved in the least possible amount of dilute HCl, and then reprecipitated with strong ammonia. It is then allowed to stand for at least an hour with occasional stirring, collected, washed with dilute ammonia, dried, ignited separately from the filter, and weighed as $Mg_2P_2O_7$.

To the filtrate sulphide of ammonium is added in slight excess, the solution warmed, and the iron estimated with the usual precautions.

The $CaCO_3$ is calculated to CaO; the $Mg_2P_2O_7$ to P_2O_5; the iron is weighed as Fe_2O_3 and the Al_2O_3 is obtained by difference.

The following experiments will show the necessity for a close observance of every detail:—

Taken.	Found.
1 grm. $Ca_3P_2O_8$	..
0·092 Fe_2O_3 (as ferrous chloride)	0·060 Fe_2O_3
0·115 Al_2O_3	0·115 Al_2O_3

In this case the oxydation previous to precipitation was purposely avoided, with the result that a large proportion of the iron escaped precipitation. On standing overnight a second precipitate, containing 0·23 Fe_2O_3 was formed, but the filtrate from this still contained iron. It will thus be seen that previous oxydation is absolutely necessary for success.

The next experiment was carried out exactly as in practice—

Taken.	Found.
1 grm. $Ca_3P_2O_8$	..
0·092 Fe_2O_3	0·091
0·115 Al_2O_3	0·116

The filtrate from a similar test was evaporated to dryness with the addition of hydrochloric acid, the residue was taken up with a little dilute HCl, and washed with the least possible quantity of water into a 250 cc. flask, and treated by the Glaser method. On adding ammonia and boiling for some time no trace of any precipitate was observed, from which it may be concluded that no alumina is soluble.

The weak point of both the Glaser and the acetate processes is that the alumina has to be obtained as the difference in the analysis of a comparatively complex precipitate, which renders the nicest work necessary to obtain strictly accurate results; but after having made a very great number of experiments to obviate this fault, I am free to confess that I have failed to hit upon any plan wholly without objection, and I still believe the difference method to be the best at present at our disposal.

Bearing upon the formation of phosphate of lime in combination with the iron and alumina, the following results, although not obtained under quite similar conditions to the acetate of ammonia precipitation, may prove of interest, as showing the tendency which exists for lime to be precipitated in preference to iron and alumina.

0·087 grm. Fe_2O_3 was precipitated in the presence of 0·565 P_2O_5 with ammonia, the solution boiled, and the resulting precipitated weighed in the usual manner. After weighing, it was dissolved in HCl, diluted, $CaCl_2$ 2·2 grms. added, and the solution again precipitated with ammonia, dissolved in HCl, and precipitated with ammonia. The following were the results obtained:—

Taken.	Calculated.	Found by Analysis.
1st ppt. weighed 0·171	Fe_2O_3 0·087 P_2O_5 0·084	.. ..
2nd „ „ 0·238	Fe_2O_3 0·087 P_2O_5 0·084 CaO 0·067	0·086 Fe_2O_3 0·082 P_2O_5 0·067 CaO

A similar experiment with 0·089 of Al_2O_3 in place of the Fe_2O_3 gave—

Taken.	Calculated.	Found by Analysis.
1st ppt. weighed 0·221	Al_2O_3 0·089 P_2O_5 0·132	.. ..
2nd „ „ 0·270	Al_2O_3 0·089 P_2O_5 0·132 CaO 0·049	0·089 0·120 0·061

A repetition of these experiments, so far as the precipitations were concerned, gave substantially the same results. It would seem from the results of the analyses of the final precipitates that, whereas there is little tendency on the part of phosphate of iron to part with phosphoric acid on washing, in the corresponding phosphate of alumina a considerable loss (0·012 grm.) has taken place.

The fact that the whole of the alumina and lime precipitate dissolved readily in very dilute HCl in the cold, and that a considerable portion (more than $\frac{2}{3}$) of the iron and lime was soluble, renders it very probable that the precipitates are, chiefly at all events, double phosphates of the two bases.

The Wyatt process.—This process as described by Dr. Wyatt is as follows :—

"Fifty cc. of filtrate (substance dissolved in *aqua regia*) from the siliceous matter, equalling 1 grm. of the phosphate, are placed in a beaker and made alkaline with ammonia.

"The resulting precipitate is redissolved by the addition of just sufficient hydrochloric acid, and the liquid is again made alkaline with ammonia in very slight excess. 50 cc. of concentrated and pure acetic acid are now added; the mixture is stirred and allowed to stand in a cool place *until perfectly cold.* It is then filtered on an ashless filter and the beaker and residue are carefully washed twice with boiling water. The flask containing the filtrate is then removed from beneath the funnel and replaced by the beaker in which the first precipitation was made. The substance on the filter is now carefully dissolved in a little hot, 50 per cent. solution of hydrochloric acid and the filter is washed twice with hot water. The filtrate in the beaker is next made alkaline with ammonia in slight excess, then made strongly acid with pure concentrated acetic acid, well stirred up and again allowed to stand until absolutely cold. The flask containing the first filtrate is now replaced under the funnel, the liquid in the beaker is filtered into it, the filter is washed twice with cold water containing a little acetic acid and then three times with boiling distilled water. The contents are calcined and weighed as *phosphates of iron and alumina in 1 gramme of the material.* In one-half of this precipitate the phosphoric anhydride is determined by the molybdate method. The remaining half is reduced and titrated with $\frac{1}{50}$ N. permanganate solution."

In the experiments, the details of which follow, I religiously pursued the process as here given, except so far as that relating to the analysis of the mixed phosphates.

Taken.	Found.	
	Without Oxidation.	With Oxidation.
1·25 grm. $Ca_3P_1O_3$	..	..
0·092 Fe_2O_3 (as ferrous chloride).	0·040	0·093
0·115 Al_2O_3	0·109	0·099

It will be seen that from these results that previous oxidation of the iron salts is absolutely necessary ; but as Dr. Wyatt gives instruction to use *aqua regia* in dissolving the material it is obvious that the deficiency in iron must not be attributed to any defect in the process as described by him. The loss of alumina is, however, in most cases serious.

Taken.	Found.	
	1st Determination.	2nd Determination.
1 grm. P_6O_5	..	..
2·2 $CaCl_3$	..	..
0·095 $MgCl_2$	..	..
0·087 Fe_2O_3	0·087	0·087
0·089 Al_2O_3	0·078	0·087

As only 1 grm. is taken in the analysis by Dr. Wyatt's process any deficiency in alumina makes a very appreciable difference in the results.

In conclusion I have to thank my assistant, Mr. J. B. Ashworth, for the help he has given me in carrying out these experiments.

* * *

RESUMÉ OF TWO RECENTLY-PUBLISHED PAPERS ON THE PROBABLE ORIGIN OF NATURAL DEPOSITS OF CARBONATE OF SODA, WITH REMARKS THEREON.

BY H. BRUNNER.

Abstract.

In the Chemiker Zeitung of 2nd and 9th November last, there appears under the title "Briefe aus Egypten," an article, in two parts, by Prof. E. Sickenberger of Cairo, describing a visit to the Wady Atrun (Natron or Soda Valley) in Egypt, and containing a theory of the manner of the formation of the carbonate of soda contained in the water of the lakes there, and in the salt deposit which covers their banks.

At Kafr Dawar station, on the left Nile railway, large heaps of the natron brought there on camel-back, and containing 60 per cent. and upwards of carbonate of soda, are accumulated for further transport, the Egyptian Government receiving annually on contract about 500 tons of the material.

The valley lies on the left bank of the Nile, and about 36 miles from it, and 60 miles from the Mediterranean. Its level generally is below that of the Nile and of the sea. It forms a long trough covered at intervals by ridges of drift sand. Its edges are formed of rounded sand hills, and nearly in the middle there projects a solitary rock (El Melouk), whose naked sides show alternate layers of limestone, ferruginous clay containing loose well-defined crystals of rock-salt and gypsum, and chalky sandstone, and judging from the levels the probability is that the edges of the valley below the sand would show a continuation of these strata.

It has been generally assumed that the formation of the Egyptian sesqui-carbonate takes place in the following manner :—The water of the Nile on its way underground to lakes lying at a lower level passes through strata containing sodium chloride, calcium sulphate, and calcium carbonate. Under the influence of the water mutual decomposition takes place, the water becomes charged with sodium carbonate, and issuing in the form of springs which supply the lakes, leaves on evaporation an impure sodium carbonate behind.

The springs supplying six of the lakes—there are 16 lakes altogether—were examined, and not one of these showed an alkaline reaction. They were neutral. They gave off no gas, the taste was pure bitter, slightly salt, with no trace of alkali, and tests showed the presence of sulphates and chlorides. The springs frequently form at their outflow small basins, and both springs and basins are filled with algae, consisting of a small proportion of an oscillatoria and much of a green conferva. Soon after issuing from the ground the water begins to evolve hydrogen sulphide. The smell of it becomes very strong, and is quite lost again as the distance from the point of outflow increases, while at the same time the algae assume a currant-red, then a brown colour, and gradually dying, change into a brown mud which at last becomes deep black. The black colouring matter is iron sulphide. This mud covers the bottom of the lakes under the crystallised soda. In proportion as the hydrogen sulphide was dissipated and algæ and mud assumed a red colour, alkalinity appears, faint at first, but gradually becoming stronger and attaining its maximum where the mud was black and the water of a red colour. On stirring the red or black mud with a stick, numerous large bubbles of gas ascended which proved to be carbonic acid. Microscopical examination showed the presence in the red, brown, or black mud of large numbers of a micrococcus; and samples of the mud in which the confervæ were dead, when mixed with water, fermented with evolution of much carbonic acid and considerable increase of the micrococcus, showing its importance as a producer of carbonic acid in the formation of the sodium sesquicarbonate.

The process, therefore, is probably completed as follows :—The water of the Nile on filtering through strata containing calcium carbonate, gypsum, and rock-salt, becomes charged with sodium sulphate. This is decomposed by the algæ (in order to supply their requirement of oxygen) into sodium sulphide, and this again under the influence of the carbonic acid produced by the micrococcus, is converted into sesquicarbonate, hydrogen sulphide being driven off.

The sodium chloride, in so far as it has not been previously converted into sulphate, takes no part in the reaction, and crystallises on evaporation of the water in the lakes, forming an upper crust, separate from the sesquicarbonate of soda.

This view of the formation of the sesquicarbonate in this valley is supported by the fact that it is entirely a superficial one. The ground below the covering of iron sulphide is without any alkaline reaction, and plants such as halfa-grass grow here in a soil the surface of which is covered to the depth of several inches with sand often containing as much as 80 per cent. of sodium carbonate, because, owing to the rainless climate, that salt is not washed down to their roots, which are further protected by the covering of iron sulphide at the bottom of the springs and lakes.

Prof. Sickenberger promises further information as to the possible use to be made of these deposits, and the industries to which they may eventually give rise.

In the "Berichte der Deutschen Chemischen Gesellschaft" of January 9th of this year, E. W. Hilgard has a paper on "The mode of formation of alkaline carbonates in nature." In this he bases his conclusions apparently on observations made chiefly in California and in Western America generally. Beginning by recalling the fact that simple carbonate is never found in nature, but always sesquicarbonate, he concludes that it is formed by mutual reaction between the neutral salts, sodium sulphate or chloride and calcium carbonate, in presence of an excess of carbonic acid. In this way, from sodium sulphate and calcium carbonate, gypsum and sodium bicarbonate are formed, and on evaporation and exposure to the air the latter would remain behind as sesquicarbonate.

The reaction may be shown by passing carbonic acid gas at the ordinary temperature into a solution in which calcium carbonate is suspended. The change takes place also with sodium chloride, and in that case calcium chloride and sodium bicarbonate are found in the solution existing side by side.

Hilgard shows that in very dilute solutions—up to 1 grm. of sulphate per litre—both potassium and sodium sulphate are completely converted into their bicarbonates, but in stronger solutions the conversion becomes less and less complete as the strength of the solution increases, so that at 8 grms. per litre only about 25 per cent. of the sulphate is so converted.

After filtering these solutions to remove the excess of calcium carbonate and any calcium sulphate which may have been formed, and on evaporation in the laboratory, it is found that a reverse action takes place between the calcium sulphate in solution and the bicarbonate, and in the dry residue only one-tenth of the bicarbonate is to be found, nine-tenths on the average reappearing again as sodium sulphate together with calcium carbonate.

Hilgard says, however, that "undoubtedly if the evaporation were effected at ordinary temperature this reverse action would not take place," and that therefore a residue of bicarbonate, gradually becoming converted into sesquicarbonate, would remain.

But he gives no reason for this belief, and it is not easy to imagine his grounds for it. In any case, in view of his experiments, it would be next to impossible to conceive the formation, in the manner indicated by him, of deposits containing absolutely more carbonate than sulphate, except under the supposition that after the formation of the deposit, water has again acted upon it in such a manner as to remove the excess of sulphate and leave the less soluble sesquicarbonate behind. And natural deposits containing as much as 80 per cent. of carbonate, and therefore little sulphate, are not uncommon.

One interesting fact mentioned by Hilgard, tends, I think, much to the destruction of his theory. It is, that in certain districts of Western America, where the presence of alkaline carbonate in the soil renders its cultivation impossible, he has succeeded in improving this condition by the application of gypsum as a manure. Under the influence of water—say after irrigation—calcium carbonate and the neutral and harmless sodium sulphate are formed, thus showing that at ordinary temperature the "reverse action" between calcium sulphate and sodium sesquicarbonate actually does take place.

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Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893.

Meeting held Friday, 3rd February 1893.

MR. IVAN LEVINSTEIN IN THE CHAIR.

AN EXPERIENCE WITH PYROXILINE.

BY CARL OTTO WEBER, PH.D., F.C.S.

It is a well-known fact that in the manufacture of gun-cotton, as well as of the lower nitrated pyroxilines, the greatest attention must be paid to remove, in the washing following upon the nitration, every trace of free acid, otherwise the nitrocellulose is liable to explode spontaneously during the drying. The complete removal of the free acids is a rather tedious operation, and in preparing one of the lower nitrocelluloses some time ago it occurred to me that the washing out of the last traces of acid might be dispensed with by finally treating the cotton in water containing a very small quantity of ammonia. Carrying this idea out I observed the pyroxiline to assume a slightly yellowish tinge, a sure sign of alkalinity prevailing. The pyroxiline was then removed from the water. and as much as possible dried between filter-paper. To dry it completely the substance was put in an oven at 70° C., when after about three hours a terrific explosion ensued, literally tearing to pieces the strong copper oven, the fragments of which were hurled all over the room. The quantity of the pyroxiline was about 1 oz.

This explosion is remarkable from two points of view. In the first instance the pyroxiline was dinitrocellulose, which is scarcely considered an explosive; and further, the temperature at which the explosion occurred was very much below the temperature at which even gun-cotton (hexanitrocellulose) ignites, which temperature, according to Cross and Bevan, lies at from 160° to 170° C. I have since tried the ignition-temperature of dinitrocellulose by placing test-tubes, filled to about one-fifth with mercury, in a sand-bath. In the test-tubes were placed thermometers, the bulbs of which were submerged in the mercury. By throwing in these test-tubes little balls of dinitrocellulose at varying temperatures the ignition-point can be estimated with perfect safety and great accuracy. Thus I found that dinitrocellulose, if pure, ignites at from 194° to 198° C.

It is therefore evident that that explosion must be due to the treatment of the partially-washed dinitrate with ammonia, and I believe that its explanation is given by an observation I made some years ago, and which I believe to be new, as I never saw it recorded anywhere. If we take a concentrated solution of nitrate of ammonia, add to it a little acetic acid, and then proceed to evaporate the solution on the water-bath, as soon as a certain concentration is reached the whole mass ignites spontaneously, and the reaction is so violent that it might almost be called an explosion. The explanation in this case is a very easy one, that reaction being simply the ignition of the hydrogen of the ammonia at the expense of the oxygen of the nitric acid. The reaction, although perhaps a new one in this form, is very largely employed for the practical purpose of freeing sulphuric acid from traces of nitric acid by adding to it a small quantity of sulphate of ammonia.

This reaction, I believe, also explains the explosion of the dinitrocellulose under the above conditions. In treating the partially-washed product with the dilute ammonia, a certain quantity, although very small, of nitrate of ammonia was formed, and subsequently dried upon the nitrocellulose in a state of very fine sub-division. The faintest trace of acid would then be sufficient to bring about the above-described ignition of the nitrate of ammonia, which in this manner would act upon the dinitrocellulose like a fuse. Where that trace of acid to start the explosion came from, whether from the pyroxiline or from some extraneous source, I am not prepared to say, but it is quite apparent that the presence of nitrate of ammonia in nitrocellulose of any description is a very great danger in itself.

ON THE DYEING OF WOOL IN COPPER PANS.

BY CARL OTTO WEBER, PH.D., F.C.S.

Large quantities of woollen and other goods are dyed in copper pans or apparatus, and it is well known that in many cases the copper has a more or less deleterious effect upon the brightness of the shades dyed. In this respect it matters very little whether the dyeing is done with acid or alkaline baths, as is shown by the fact that many of the substantive dyes, which are dyed in neutral or alkaline baths, suffer very much if in contact with copper during the process of dyeing. Of course this drawback of copper vessels can be avoided by giving them a substantial coat of tin on the inside. But this is, with large apparatus, very expensive, and when the tin is worn off it is also often very inconvenient to have the vessels re-tinned.

This difficulty has now successfully been overcome in a most inexpensive manner. The remedy simply consists in bringing in contact with the copper a number of strips of sheet zinc of such dimensions that about one-fifth of the surface of the copper is in contact with the zinc. The two metals form an electric couple, which absolutely prevents any copper from getting in solution and injuring the dye. As the zinc strips wear out they are replaced by new ones, an operation which can always be performed within a minute or so. I anticipate that this simple remedy will become of considerable importance in all these mechanical dyeing processes which are carried out in machines constructed of metal.

ON THE OXIDATION OF COTTON IN ALKALINE BATHS.

BY CARL OTTO WEBER, PH.D., F.C.S.

As far as our knowledge of the chemical constitution of cellulose goes at the present time, we only know with certainty that it is an aldehydic body, and from this point of view its chemical properties, as far as the dyer is concerned in them, will have to be considered. One of the most elementary properties of aldehydes and aldehydic substances is their readiness to undergo oxidation, and we have therefore to expect that under suitable conditions oxidation will be noticeable in many of the processes cotton is subjected to in dyeing and printing. Nor is there much novelty in this statement, as in bleaching, the cotton, under the oxidising influence of the chlorine, is always partly converted into oxycellulose. The same conversion of the cotton fibre takes place, only in a minor degree, by steaming it in the presence of air, and probably the use which is made of steaming for the fixing and developing of the colours after printing will also bring into play the weak aldehydic and acid properties of the cotton fibre.

Generally speaking the necessity to guard cotton manufactures against oxidation is better known to the bleacher than to the dyer. The former knows very well that as soon as his goods in the process of kiering are exposed to the atmosphere, the exposed parts become rotten from oxidation. That on prolonged exposure to the air cotton fabrics are eventually converted into oxycellulose is also an established fact, and that such an oxidation, when permitted during the process of kiering, where the material is immersed in a strongly alkaline bath, can within a few hours almost destroy the fibre, is not astonishing if we remember that the oxidation of all those substances which thereby are converted into acid bodies proceeds most rapidly in the presence of alkalis. The reasons for this behaviour are well known and fully explained by the thermo-chemical conditions of these reactions.

That such an oxidation may also occur in dyeing cannot be doubted, although there is scarcely any positive information yet on this point. At the last meeting, however, Mr. W. Crippin, in his paper on the advantages of cop-dyeing, stated the fact that between yarns dyed in the cop and yarns dyed in the hank he always observed a difference in favour of the former amounting to 5 per cent. in the weight of the dyed yarns. This statement is certainly surprising, and as Mr. Crippin's observations all referred to such cases where the yarns had been dyed in alkaline baths, it occurred to me that this difference might be caused through the yarns, which are dyed in open becks, being for a considerable time exposed to the oxidising action of the air, while the dyeing of the cops is performed in vacuo.

Whether my explanation of the above observation was not clear enough I do not know, but it met with little favour on the part of the meeting, and in order to substantiate my remarks, I have since then made a number of experiments with regard to the oxidation of cotton in alkaline baths. I exposed cotton during six hours to the action of oxygen and air under such conditions as would obtain in actual dyeing, *i.e.*, the cotton was immersed at boiling-point in baths containing 5 per cent. of various alkalies and alkaline salts.

100 *Grms. of Scoured and Bleached Cotton, dried at 85° C.*

5 Per Cent. of	Loss in Per Cent. with			
	Oxygen.	Steam and Oxygen.	Air.	Steam and Air.
$NaOH$	11·05	17·3	5·2	9·2
KOH	22·8	29·8	8·4	11·7
Na_2CO_3	8·2	10·1	3·9	5·4
K_2CO_3	13·7	16·4	5·8	6·9
$Na_2B_4O_7$	5·9	6·8	2·2	2·8
Na_2HPO_4	3·1	3·5	2·05	2·3

In the first instance I wish to point out that the loss shown by the balance is only what I may term the practical loss, but does not represent the total loss, as the cotton, while on the one hand losing substance through oxidation, takes up oxygen on forming oxycellulose. As a matter of fact the cellulose was found in every case to be converted more or less into oxycellulose, the fibre in every case having lost in tensile strength, and in some instances being practically destroyed. Very striking in the above tables is the difference between the loss through oxidation in the presence of caustic soda and caustic potash respectively, which difference is also noticeable, though in a minor degree, in the losses observed by working with the carbonates of these two bases. I may, however, remind you that a similar difference has been observed in the manufacture of oxalic acid from lignocellulose, where it was found that by fusing and oxidising the sawdust together with caustic potash a far greater yield of oxalic acid was obtained as by employing caustic soda. Very remarkable throughout the above tables is also the increase in the loss in weight of the cotton by acting upon it with oxygen or air and steam simultaneously. The conditions under which these experiments were carried out being identical with those occurring in dyehouses in the dyeing of cotton with the substantive colours, an important part if not the whole of the loss in weight observed in dyeing in the hank is explained by the above results.

DISCUSSION.

Mr. **Carter Bell** said that Dr. Weber's observation appeared to him to be corroborated by results obtained as early as in 1874 by P. Jeanmaire (Chem. Centr. 207), who, on heating cotton with alkaline solutions of various oxidising agents, observed a very considerable tendering of the fibre. The same investigator also spoke of the deteriorating action of soaps or other alkaline liquors upon linen goods in the process of bleaching.

Dr. **Weber**, in reply to observations on the three previous notes, said :—Referring to Mr. Terry's remarks, the estimation or separation of the cotton and wool in unions by treating fabrics in alkalies was not exactly to be recommended, inasmuch as the same end was obtained in a much safer way by treating the fabric with acids. If, however, it should be desired to destroy the wool by treating the union fabric in alkalies, no oxidation of the cotton need be feared, as by immersing the fabric in a 15 per cent. solution of caustic soda or potash at a temperature of about 50° C. the wool was almost destroyed immediately, and could be easily washed out. The fabric, while in contact with the alkaline liquor, not being exposed to the air, it was evident that the cotton contained in it could not suffer from oxidation in this treatment. In reply to Dr. Schunck, he had not estimated the amount of oxygen taken up by the cotton, the time at his disposal being too short for an investigation of this difficult point. It must not, however, be forgotten that part of the oxidised cotton was in solution, and part remained after the treatment in the form of more or less deteriorated fibre. That a great amount of oxygen was taken up there was no doubt, because in all cases, with the exception of those where phosphate of soda and borax were used, the tuft of cotton after treatment appeared greatly disintegrated, and, as tests proved, was more or less completely converted into oxycellulose. As to the amount of oxygen taken up by the cotton in the course of bleaching, no information was available, although the fact that the cotton was partly transformed into oxycellulose by the action of the chlorine could not be doubted. The structure of the cotton was not altered or injured in any way in the process of bleaching if judiciously carried out. In reply to the Chairman, the conditions under which his experiments had been carried out were identical with those under which yarns in the hank were dyed with the substantive dyes ; and the hanks in this process of dyeing must lose in weight through oxidation, although he did not mean to say that the losses observable in practice would be anything like the figures he had quoted that night. In reply to Mr. Wilson, the results he had obtained were in strict accordance with what has been known to a certain degree for a long time to every dyer, printer, and bleacher, especially the latter. Every dyer knew that bleached cotton had a much greater affinity for the basic dyes than grey cotton in direct proportion to the amount of oxycellulose formed in the bleaching process. On the other hand, every bleacher knew very well that if in the process of kiering his goods were exposed to the air, they would become rotten through oxidation, and on examination the rotten parts would be found to be converted into oxycellulose. If, however, Mr. Wilson had any doubt, as it seemed to him, in regard to the existence of oxycellulose, he might refer him to the publications of Messrs. Cross and Bevan and Koechlin on this subject. As to the use of glass-lined pans he was rather doubtful whether they could be practically employed, as it seemed to him highly probable that owing to the different expansion co-efficients of glass and copper the former would be bound to crack.

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T. W. Stuart.
John Watson.

Hon. Local Secretary and Treasurer :
Dr. J. T. Dunn, The School, Gateshead.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Next meeting, March 9th, when Mr. T. W. Hogg will read a paper on "Segregation in relation to Steel Ingots."

Meeting held in the Durham College of Science, Newcastle, on Thursday, January 26th, 1893.

MR. A. ALLHUSEN IN THE CHAIR.

Dr. **Bedson** gave a demonstration of a method of detecting and estimating the amount of free hydrochloric acid in presence of organic acids such as lactic acid, which depended upon the neutralisation of the acid by standard caustic soda solution, using eosin as an indicator.

ON THE ESTIMATION OF ARSENIC AND PHOSPHORUS IN IRON ORES, &c.

BY JOHN PATTINSON, F.I.C., AND H. S. PATTINSON, PH.D., F.I.C.

Some iron and manganese ores contain very notable quantities of arsenic, and in estimating phosphorus in such ores, by either the ammonium molybdate or the magnesia process, it is necessary first of all to remove the arsenic ; otherwise some of this substance is precipitated along with the phosphorus and makes the phosphorous determination too high.

The usual procedure in estimating phosphorus in ores, &c. containing arsenic is to dissolve the mineral in hydrochloric acid, evaporate the solution to dryness, to render the silica insoluble, then to take up the residue again with a minimum quantity of hydrochloric acid, filter from the silica, and reduce the ferric chloride in the filtrate to the ferrous state, after which sulphuretted hydrogen gas is passed through the solution until it is saturated, in order to remove the arsenic. The solution is then allowed to stand for some hours or over night, and at the end of that time the precipitate of arsenic trisulphide is filtered off. The phosphorus is now determined in the filtrate, which is free from arsenic. There are many methods of estimating the phosphorus, but one of those most frequently used is to oxidise a small quantity of the ferrous iron in the solution, or to add a few drops of a solution of ferric chloride to it and, after neutralising the excess of acid present with ammonia, to precipitate the phosphorus as ferric phosphate by the addition of ammonium acetate. The precipitate which contains the whole of the phosphorus is then filtered, and the phosphorus determined in it either by the ammonium molybdate or the citric acid and magnesia method.

This process is tedious and consumes much time. By introducing three modifications into it we have succeeded in shortening very considerably the time required for making a determination of phosphorus in iron ores, &c. that contain arsenic. These three modifications are: 1. The reduction of the ferric chloride solution with *sodium thiosulphate* (hyposulphite); (2) the precipitation of the arsenic with *zinc sulphide;* and (3), the precipitation of the phosphorus as ferric phosphate with *calcium carbonate.*

In carrying out our process we dissolve 3 grms. of the ore in hydrochloric acid, evaporate to dryness to render the silica insoluble, and take up the residue with as little excess of hydrochloric acid as possible. We then rinse the cover and sides of the beaker with hot water, taking care not to let the total volume of liquid exceed 30—50 cc. We now reduce the ferric chloride by adding gradually to the cold solution a solution of sodium thiosulphate, made by dissolving about 500 grms. of this salt in a litre of distilled water. This solution may be added somewhat rapidly at first, but towards the end of the reduction it should be added slowly drop by drop until one drop fails to produce any violet colour of ferric thiosulphate. If the thiosulphate has been added very rapidly, a brownish-yellow colour often remains in the liquid, even after the iron has all been reduced to the ferrous state, but this colour is of no importance and gradually disappears if the solution is allowed to stand for a few minutes. If the thiosulphate be added somewhat more slowly at the end of the reduction the solution is usually colourless, or has merely the greenish colour of a solution of ferrous chloride.

If a large excess of hydrochloric acid has been present, a considerable evolution of sulphurous acid occurs during the addition of the thiosulphate, but if, as should be the case, there is only a small excess of acid, very little sulphurous acid is evolved.

After the iron has been reduced, if the volume of the liquid be less than 50—60 cc., it must be diluted to this volume, and it is then boiled to expel the whole or the greater part of the sulphurous acid retained in the liquid. If care has been taken not to add too much thiosulphate in excess, and only a moderate quantity of hydrochloric acid is present, the sulphurous acid is expelled after only a few minutes boiling. If the solution be allowed to boil too long, so that it becomes much more concentrated, or if it be not diluted to about 50—60 cc. before boiling, sulphur will often separate. This does not affect the accuracy of the process, but it sometimes makes the subsequent filtrations rather slower. But usually no sulphur separates, and the sulphurous acid having been expelled, the solution is then cooled and 5 cc. of concentrated hydrochloric acid added to it. We prefer to have the bulk of liquid, after addition of the 5 cc. of acid, about 60—80 cc., and it should not at the most be more than 100 cc. A little powdered zinc sulphide (about 0·1 grm.) is now shaken from the point of a spatula into the cold, strongly-acid liquid. If arsenic be present an immediate precipitate of arsenic trisulphide forms and collects together on gently agitating the liquid. The sulphuretted hydrogen in the beaker should be blown out, and if after agitating the liquid a strong smell of the gas is not felt, a little more zinc sulphide should be added. If all the sulphurous acid has been boiled off, no sulphur precipitates on adding the zinc sulphide, and in this case very minute quantities of arsenic trisulphide can be detected, as little as 0·001 grm. being distinctly observable. If sulphurous acid be present the sulphur that separates masks the precipitate of small quantities of arsenic tripulphide. The expulsion of the SO_2 is not essential, but if much be present, the expulsion of at least the greater part is to be recommended, as often any time saved by not boiling it off, is afterwards lost by the slower filtration due to separated sulphur. But if the arsenic has to be determined, the boiling of this concentrated ferrous chloride solution ought not to be prolonged beyond three or four minutes, as on long continued boiling there is a loss of arsenic due to volatilisation of As_2Cr_6. With a little practice the reduction can readily be effected so that practically the whole of the SO_2 is expelled by boiling for less than this time. It must also be noted that when the arsenic has to be determined in ores containing ferrous oxide, such ores must be oxidised before evaporating to dryness, otherwise arsenic is lost during the evaporation. If copper be present this, too, is precipitated by the zinc sulphide and makes the precipitate of arsenic trisulphide appear brown, but lead is not precipitated owing to the excess of acid in the solution.

Puller (Zeits. Anal. Chem. 1871, 41) showed that arsenic trisulphide was only completely and speedily precipitated from a solution of arsenious acid by sulphuretted hydrogen when the solution was very strongly acid. Working with an excess of only 1 cc. of acid in 70 cc. of liquid, we have in some cases found that the arsenic was completely separated at once by zinc sulphide, but in other cases with only this small excess of acid we have found that all the arsenic did not come down immediately, whereas with 5 cc. of acid in excess we find the quantity of arsenic ordinarily met with in iron ores, &c. is always removed at once. If the quantity of arsenic present be very large, requiring an unusual addition of zinc sulphide, it is better to add 10 cc. of acid in excess instead of 5 cc., since it must be borne in mind that the zinc sulphide gradually neutralises the acidity of the solution. If the volume of liquid be more than 100 cc. we also find that the complete separation of the arsenic is uncertain, unless the solution be allowed to stand some hours. It is advisable to cool the solution before adding the zinc sulphide, otherwise the evolution of sulphuretted hydrogen is too violent, and an unnecessary quantity of zinc sulphide has to be used to effect saturation.

The precipitate of arsenic trisulphide, together with the silica in the sample, is now filtered, for which a loose-textured filter-paper should be used. It filters rapidly if the quantity of silica be not very large, and if much sulphur has not been precipitated, which latter contingency will not exist if the precautions we have indicated have been followed. The precipitate, when lead is present in the ore, should be rinsed on to the filter and washed two or three times with warm water acidulated with 5 cc. of hydrochloric acid in 100 cc. This keeps the lead sulphide in solution. The precipitate may then be given three more washings with hot water, which is enough to remove all but a trace of the iron. The filtrate is now boiled to expel the sulphuretted hydrogen, it is then diluted with cold water to about 200—250 cc., and a sufficient quantity of ferric chloride solution added to combine with all the phosphorus and leave a slight excess of ferric iron. If now the usual method of precipitating the ferric phosphate be adopted, viz., by neutralising the excess of acid with ammonia and then adding ammonium acetate and boiling, it will be found that the addition of ammonia to the solution causes at once a considerable precipitate of sulphur, a fact which points to the formation of pentathionic acid in the process. In order to avoid this precipitation of sulphur we were led to use precipitated calcium carbonate to throw down the ferric phosphate. This not only avoids the separation of sulphur, but precipitates the ferric phosphate in a bulky, flocculent form, which filters much more rapidly than the precipitate produced by ammonium acetate, which is very often slimy and clogs the pores of the filter-paper, so that much time is wasted in filtering it.

When using calcium carbonate we find the precipitate of ferric phosphate comes down in the best form for filtering when the temperature of the solution is about 65°—70° C. We throw the calcium carbonate into the liquid from the end of a spatula, taking care to rapidly replace the glass cover on the beaker to avoid loss by effervescence, and after each addition of calcium carbonate we give a circular motion to the liquid in the beaker until the whole of the ferric phosphate and the excess of ferric hydrate are precipitated. Care should be taken to avoid the addition of more than a very small excess of calcium carbonate. With an excess of 5 cc. of hydrochloric acid about 3 grms. of the carbonate are required to neutralise the acid and precipitate the ferric phosphate. The calcium carbonate should be free from phosphorus. The precipitate of ferric phosphate formed in this way filters rapidly, and it has also the advantage of dissolving readily in dilute nitric acid, which is the next operation if it be desired to precipitate the phosphorus as ammonium phospho-molybdate. It should, however, be washed with warm water and not with boiling water, as in the latter case it is rendered less easily soluble. When dissolving the precipitate of ferric phosphate in acid, off the filter-paper, a glass cover should be held over the funnel to avoid any loss caused by the effervescence from the small excess of calcium carbonate mixed with the precipitate.

Instead of precipitating the arsenic with zinc sulphide, sulphuretted hydrogen gas may of course be used, and if the bulk of the liquid be less than 100 cc. and the proper quantity of acid be present, the whole of the arsenic can be entirely separated in a quarter of an hour. Zinc sulphide is, however, much handier. If may be bought as a powder, or it may be made in the laboratory by precipitating with sulphuretted hydrogen from a hot acetic acid solution, washing the precipitate by decantation, drying at 100° C., and finally pounding it in a mortar. It should be free from other metals precipitated by sulphuretted hydrogen in acid solution, and from phosphorus.

If it be desired to determine the amount of arsenic, the precipitate of arsenic trisulphide, after being washed, should be dissolved in ammonium sulphide. When much silica is present in the ore, it is difficult to remove all the arsenic by pouring the ammonium sulphide on the filter, and we find it best to rinse the precipitate off the paper into a beaker with a jet from a wash-bottle containing ammonia, and then to digest in the beaker with ammonium sulphide, allow the silica to settle, filter off the clear liquid, and digest again, and finally to transfer the siliceous residue to the filter-paper once more and wash with ammonia. The ammoniacal solution is then evaporated to dryness on a water-bottle and the residue oxidised with a few drops of concentrated nitric acid and a drop of bromine. This is again evaporated to dryness or to an oily consistency taken up with a little hydrochloric acid, ammonia added, and any silica present filtered off. The arsenic is then precipitated in the filtrate by magnesia mixture, collected on a weighed filter-paper and dried at 100° C. An addition of 0·001 grm. should be made to the weight of the precipitate for every 16 cc. of liquid in which the arsenic was precipitated, to compensate for the solubility of the ammonio-magnesium arsenate.

The following are some of the results we have obtained, which show the satisfactory working of our method. The phosphorus in every case was weighed as ammonium phospho-molybdate:—

Arsenic taken.	Phosphorus taken.	Arsenic found.	Phosphorus found.
Grm.	Grm.	Grm.	Grm.
0·010	0·00216	0·0094	0·00215
0·010	0·00216	0·0095	0·00216
0·010	0·00216	0·0100	0·00218
0·0060	0·0028	0·0059	0·0027

In each of the above experiments a solution of ferric chloride containing about 1·5 grm. of iron was taken, to which the known quantities of arsenic and phosphorus were added in the form of solutions of arsenious acid and sodium phosphate. The arsenious acid was then oxidised with bromine-water, and after boiling off the excess of bromine the arsenic and phosphorus were determined as described.

We have made numerous analyses of iron ores, manganiferous iron ores, and manganese ores, steel, and cast iron by this method, and it is in daily use in our laboratory.

We find that after the sample has been dissolved and evaporated to dryness, we are able by this method to complete an estimation of phosphorus in ores, &c. containing arsenic, in from an hour and a half to an hour and three-quarters.

Yorkshire Section.

Chairman: Sir James Kitson, Bart., M.P.
Vice-Chairman: Dr. F. H. Bowman.
Committee:

A. H. Allen.
J. B. Cohen.
T. Fairley.
A. Hess.
R. Holliday.
J. J. Hummel.
G. Ward.
J. Lewkowitsch.
F. W. Richardson.
Jas. Sharp.
G. W. Slatter.
J. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

SESSION 1892—93.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

March 6.—L. Liechti and Prof. J. J. Hummel. "On the Theory of some Reactions which occur during the Mordanting and Dyeing of Wool." Part I.

March 27.—L. Liechti and Prof. Hummel. "On Mordanting and Dyeing of Wool." Part II.

May 1.—F. W. Richardson, F.C.S., &c. "Silk, with special Reference to its Chemical Constitution, and its Estimation in Fabrics."

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Meeting held November 7th, 1892.

MR. T. FAIRLEY IN THE CHAIR.

THE COMBUSTION OF COAL IN HOUSE FIRES.

BY J. B. COHEN, PH.D., AND G. HEFFORD, A.I.C.

The amount of sulphur in coal is a matter of importance from several points of view.

The sulphur may seriously affect the quality of iron in blast-furnace operations or it may attack, when burnt in a boiler furnace, the plates of the boiler. Both these matters, being of a certain industrial importance, have received attention, and coal for technical purposes is frequently analysed.

The effects of the sulphur dioxide, which gets into the atmosphere, oxidises there to sulphuric acid, and then commences a raid upon stonework, brickwork, vegetation, and the human respiratory organs, is often mentioned as an evil, but the evil not being readily estimated in pounds, shillings, and pence, is not regarded as seriously affecting our well-being.

It is interesting to find that one of the first smoke-abatement meetings was called together in Leeds in 1842, and since then there have been reports of commissions and exhibitions of appliances in Manchester, London, and elsewhere, with the object of lessening the evil. We may ask, after half a century, to what extent has atmospheric pollution been diminished in those 50 years? Anyone who is capable of answering that question would, we should imagine, prefer to maintain a melancholy silence.

It is now generally admitted that the house fire is the chief delinquent in this matter. The quantity of coal which each householder burns is comparatively so small that neither waste in its consumption nor the injurious products turned adrift into the air are a sufficient inducement to him to alter the present system. In these matters we are absolutely in the hands of our architects, builders, and municipal corporations, unless we choose to go to the expense of putting in new and expensive fire-places. The digestive power of an ordinary open fire-place for any kind of fuel is economically as bad as it can be, and this is not a small consideration when we remember that roughly one-fifth of the annual coal production, about 30 million tons, is consumed in house fires. For we must not forget that, according to the Royal Commission appointed to study the question of coal supply, we shall only be able to indulge in this cheap luxury for 200 years more.

It is well known that combustion in an ordinary open grate is much less perfect than in a boiler furnace. Some of the coal distils unburnt or half burnt as hydrocarbons, and unburnt carbon impregnated with tarry matter passes up the chimney as soot.

The efficiency of the boiler fire with its long layer of fuel, air inlet from below the grate, and strong draught, may be realised from this fact, that, the set of boilers of the Corporation sewage works at Holt Town, near Manchester, is nearly exclusively fed by cinders from household fires, collected from the ash-pans in the town.

The following table gives the analyses of coal and the cinder obtained from it, when burnt in an ordinary fire-place. In analysis A. 1 cwt. of the sample was burnt, the cinders being sifted daily and reburnt with the fresh coal. In analysis B. a poorer quality of coal was used, and the cinders collected without sifting. Appended to this is the analysis of the cinder of the same kind of coal burnt in a boiler furnace.

TABLE I.

—	A.		B.		
	Coal.	Cinder.	Coal.	Cinder.	Furnace Cinder.
C.	84·3	34·9	77·5	69·9	24·3
H.	5·01	1·1	6·4	1·9	0·9
S.	1·24	2·1	1·6	2·2	1·6
Ash	4·2	63·6	4·5	26	72·9
Moisture O & N.	Not determined.	..	Not determined.	..	..

It would appear from this that it might be profitable to grind up the cinders and use them for producer- or water-gas.

In estimating the amount of soot which escapes combustion we have numerous experiments by various observers, though not of a very concordant character.

In 1855 Delezenne estimated carbon which escaped combustion as 5 per cent. of the total weight. He further estimated that 6,320 kilos. or $6\frac{1}{3}$ tons of soot fell in 12 hours in the town of Lille. This is doubtless incorrect. If he had stated that that amount went up the chimney it might be nearer the truth. From experiments made in Manchester and Leeds by collecting the snow and determining the daily deposit of soot, the amount which fell in 24 hours per square mile in Leeds was about 250 lb., and in Manchester about double that quantity during fog.

In 1858 John Graham estimated that very black smoke does not contain more than $\frac{1}{10}$ per cent. of the carbon burnt. Scheurer-Kestner found that in boiler furnaces the carbon lost as fuel never exceeds 1 per cent., while on the average it is $\frac{1}{2}$—$\frac{3}{4}$ per cent.

In the matter of house fires we have a large mass of reliable data in the analyses of Roberts-Austen undertaken in connexion with the London Smoke Abatement Exhibition. He had opportunities there not only of collecting the solid particles suspended in the chimney gases, which would ultimately pass into the air, but also in a few cases of collecting all the soot deposited in the chimney.

In the case of three close stoves of careful construction rather less than $\frac{1}{2}$ per cent. was found, while in some cases it fell to $\frac{1}{4}$ per cent., and in one case to $\frac{1}{20}$ per cent. These were in special appliances for preventing smoke. In an open fire-place 0·61 per cent. of the coal was deposited. This was soot deposited in the chimney. We have not made any estimations of the total soot deposited in this way, on account of the inconvenience of doing so effectively, but we have determined the amount of dust passing up the chimney.

In doing this we have followed a method similar to that adopted by Roberts-Austen.

The apparatus consisted of a glass tube about 6 in. long, well plugged with cotton-wool, and provided with glass stoppers at each end, which were inserted during the weighings. The weighed tube was attached to a wider glass tube fixed horizontally into the chimney about 6 ft. above the top of the fire-place or about 10 ft. from the floor. The temperature there was on the average 25°, and seldom exceeded 30°. We aspirated the gases from the lighting of the fire until the coal had nearly burned away, so as to obtain a fair sample. The volume of gas aspirated was 100--150 litres. The tube was then dried at 100° and weighed.

No. I. represents the mean of 10 determinations carried out with coal A. (Table I.), and No. II. the mean of four determinations with coal B.:—

I.	II.
0·027	0·033 grms. per 100 litres of flue gases.

This result, calculated on a basis of 1·2* vols. of CO_2 per cent. in the flue gases, represents about 5 per cent. on the carbon or about 4 per cent. on the coal burnt. This dust is very rich in carbon. The following Table II. gives the analyses of soot of different origin:—

TABLE II.—ANALYSES OF SOOT.

—	Manchester Air Analysis Committee. Out-door Deposit.	Roberts-Austen. Aspirated from Flue.	Authors.	
			Deposit in Flue used.	Deposit in another Flue.
Carbon	39	86--94	68·5	75·3
Hydrocarbons,&c.	14·3	(H)3·3—5·2	(H) 4·4	3·9
Sulphuric acid ..	4·33	..	(S) 4·8	3·2
Mineral matter, &c.	36·67	8—9·7	22·7	16·3

The amount of flue-dust passing up chimneys, determined by different observers, is given in the following Table III.:—

TABLE III.

—	House Fire. Roberts-Austen.	Black Smoke. Angus Smith.	House Fire. Authors.
In flue gases, grms. per 100 litres.	0—0·09	0·043	0·03
Per cent. of carbon burnt (taking 1·2 per cent. of CO_2 in flue gases).	0—13	..	5·00
Deposited in chimney per 100 of coal.	0·61—2·25	..	..

On page 3 of Roberts-Austen's report on the Smoke Abatement Exhibition, he says: "The soot is unimportant when compared with the other products of imperfect combustion, as the amount of fuel lost as soot is known to be small, and it is easy to ascertain by inspection whether much or little smoke is emitted from any particular appliance." But from the data given in the report, the amount of soot aspirated from the flue will be found in one case to be 13 per cent., and a mean of about 5 per cent. on a large number of results taken together. This means that of about 100,000 tons, which we may take as the annual house consumption in Leeds, 5,000 tons annually, or 7 tons in 12 hours, pass up the chimney in the form of soot. Moreover, as only a comparatively few of the heavier particles fall, the greater part will remain suspended, to the amount of many tons, in the atmosphere of the town.

The amount of sulphur in coal has frequently been determined, and from the difference between that and the sulphur contained in the clinker, the amount passing into the air has been ascertained. These determinations have been made in connexion with boiler furnaces.

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* This represents the mean of a number of determinations, both gravimetric and volumetric, and agrees with those of other observers.

In a paper read before the Manchester Section of the Society of Chemical Industry, Bailey showed that 53—55 per cent. of sulphur from the coal escaped into the air, 4·8—5·4 per cent. remained in the clinker, and 39·6—42·3 per cent. went somewhere, but no indication is given of whither.

We have found a calculation of Angus Smith's in which he estimates the weight of sulphur dioxide in 100 litres of chimney gases as 0·23 grm. of SO_2 from coal with 2 per cent. of sulphur—about 10 times our number, but he has taken 300 cub. ft. of air to burn his pound of coal, whereas in a house fire about eight times that volume is used. In a direct estimation of SO_2 in black smoke he obtained 0·07 grm. in 100 litres—about four times our amount.

An indication may be given of the method which we employed. A weighed quantity of coal, of which a sample was analysed, was burnt. The cinders were carefully collected and weighed. The cinders were analysed with the results given in Table I. The difference between the constituents and weight of coal and cinder gives the weight of C, H, and S which passed up the chimney.

In order to check these results by an independent set of experiments the chimney gases were aspirated during the burning through a glass-wool plug to stop solid matter, through a calcium chloride tube to absorb moisture, then through two weighed Winkler washing vessels containing potash solution, and finally through a weighed drying tube. After 10 litres had been aspirated the potash apparatus was weighed, emptied for analysis, refilled with potash, and the aspirator set going again. Thus successive 10 litres were sampled throughout the burning of the coal. The object was partly to get a good sample of gases, and partly to determine if any change occurred in the rate at which the SO_2 and CO_2 were evolved during the combustion. The increase in weight of the potash apparatus gave the total weight of sulphur dioxide and carbon dioxide. The liquid was then diluted, acidified with acetic acid, and titrated with centinormal iodine solution and the SO_2 estimated.

Now it is evident that if all the sulphur lost from the coal had found its way as SO_2 into the flue gases the ratio of carbon to sulphur on the whole combustion should be the same as that determined by analysis of the coal and its cinder. As these two methods are entirely independent of one another, any difference in the sulphur must be looked for in the soot and solid matter passing up the chimney. We found a practical difficulty in carrying out the method, due probably to the fact that the SO_2 is not completely absorbed by the caustic potash, as the following results will show. We think that the use of a solution of sodium peroxide might act as a better absorbent, in which case the sulphur would be estimated as barium sulphate, but we have not yet tried this method.

Distribution of Sulphur, &c. in Coal Sample B.

—	100 Parts of Coal contain		
	C.	H.	S.
Coal	77·5	6·4	1·6
Less cinder	15	0·4	0·45
Burnt and as soot	62·5	6	1·15
Soot from analyses (Tables II. and III.)	2·7	0·17	0·19
Burnt	59·8	5·83	0·96
Ratio of C : S in flue gases per 59·8 parts of C.	..	..	0·75

It will be seen from this that the amount of sulphur obtained by absorption is too low.

The distribution of the sulphur in these samples will be very nearly as follows:—

—	A.	B.
Burnt	71·78	60·0
In cinder	13·71	28·13
In soot	14·51	11·88

The next point to which we directed our attention was to determine the manner in which the sulphur was combined in soot. We have not carried our investigation in this direction further than to show that there are present organic sulphur compounds, which may be extracted with ether and which are volatile. Owing to the strong physiological action shown to be possessed by some of the organic sulphur compounds, it seems desirable to carry this investigation further. It may be pointed out that the ordinary methods for determining sulphur in coal cannot be applied to soot. The sulphur in this case may be estimated by the use of fuming nitric acid.

(*For Discussion, see close of following paper.*)

NOTE ON THE DISCOLORATION OF SILVER ARTICLES.

BY J. B. COHEN, PH.D., AND G. HEFFORD, A.I.C.

The discoloration of silver articles, especially during foggy weather, is usually attributed to the formation of silver sulphide from sulphur compounds in the air. As sulphur dioxide is undoubtedly the one present in largest quantity, experiments were made on the action of dry and moist sulphur dioxide on pure silver and on silver-copper alloys under a variety of conditions, but only in one case was any blackening produced. This was where the silver-copper alloy was enclosed in a tube of sulphur dioxide gas containing a small quantity of soot, separated, however, from the alloy by a plug of glass-wool. It might appear from this that soot either decomposes sulphur dioxide or gives off sulphur in some form, which is capable of combining with the silver. We were able to demonstrate that foggy air rapidly aspirated over bright silver-copper alloys separated by a stout plug of cotton-wool, showed considerable difference in discoloration, the filtered air producing less effect than the unfiltered air. This would confirm the view that solid particles of soot influence in some way the discoloration of silver. The presence of sulphuretted hydrogen in the air is, however, not excluded if one may attribute the darkening of lead acetate paper by the gases aspirated from our experimental flue as due to this gas; but the quantity in ordinary air must be very small. At the meeting when the above was read Mr. Thomson mentioned that silver was rapidly blackened in hydrochloric acid vapours (see discussion). We have since repeated Mr. Thomson's experiment, at first without success, and found that the failure to produce blackening was due to our having employed either pure silver or a silver alloy in *dry* hydrochloric acid gas. The blackening, however, rapidly occurs in the moist gas with the silver-copper alloy, but not with pure silver. The cause of this is readily explained. The acid dissolves out some of the copper of the alloy as cupric chloride, which is decomposed in contact with the silver, depositing a black film of copper. Dry hydrochloric acid, on the other hand, appears not to attack copper, and resembles in this respect other metals like aluminium, which easily react with the moist gas. It is therefore quite evident why neither pure silver nor dry hydrochloric acid effect any change. As electroplated articles are discoloured in the air quite as much as silver-copper alloys, we cannot attribute this effect to hydrochloric acid.

* * *

Discussion.

The **Chairman** suggested that the blackening of silver alluded to might be caused not by hydrogen sulphide, but by the volatile organic sulphur compounds present. With regard to the estimation of very small quantities of sulphur dioxide mixed with large volumes of air or other gases, his experience had been that merely aspirating the gases through solution of caustic soda or other absorbent was not effectual, and that correct results could only be obtained by vigorously shaking up the absorbing solution with the gas. He had had occasion to note that the irritating effects of the gases from destructors and other flues of a similar character were often really due to ashes in the form of exceedingly fine dust in suspension rather than to any offensive matter in the gaseous form.

Mr. W. **Thomson** said that he had at one time made experiments on the blackening of silver by various gases, and found that hydrochloric acid in the presence of light produced a greater discoloration than even sulphuretted hydrogen. Possibly the blackening observed by the authors of the paper was in part due to hydrochloric acid.

With regard to the collection of falling soot on a surface of snow, he thought that the method gave too low results, since much of the soot was blown away. If a glass plate wetted with glycerin were exposed, much more soot collected on it than on an equal surface of white paper or snow.

Mr. **Richardson** inquired if there was any evidence of the presence of sulphuric acid in addition to sulphur dioxide in the flue gases.

Dr. **Lewkowitsch** inquired if the organic sulphur compounds had been further studied. He thought they were certainly to be expected, as coal in an ordinary fire underwent to a large extent a process of destructive distillation. His experience was leading him more and more to regard the substitution of producer-gas for coal as a fuel to be an economy, and the best means of abating the smoke nuisance.

Mr. **Procter** commented on the high percentage of carbon in the cinder, as shown by the analysis quoted. He suggested that the high temperature of furnaces was not necessarily more favourable to complete combustion than the lower one of domestic fire-places, since the fused surface of clinkers protected the carbon within. He queried whether the blackening of silver observed might be due to sulphuretted hydrogen evolved by the action of sulphurous acid from particles of calcium sulphide mechanically caught by the cotton-wool.

Prof. **Smithells** alluded to the doctrine that polluting the air with unburnt carbon and sulphurous acid was really enriching it with antiseptic media of infinite value to congested centres of population. He trusted that scientific men would insist on some proof of this being produced; for himself he disbelieved it entirely.

Dr. **Cohen**, in reply, stated that the possibility of the blackening of silver being due to the organic sulphur compounds had been present to the authors' minds, and indeed they had made an experiment in which a silver coin was placed over a crucible containing some soot, and the whole heated to 100°; the silver was perceptibly discoloured. The nature of these compounds they intended to investigate, as it was interesting in view of the extremely poisonous character of some of the organic sulphur derivatives.

In the case of soot falling upon snow it was probable that most of it stopped there; owing to the roughness of the surface it would not be blown about as on a pavement. As to the disinfectant effects of flue gases, it was probable that the smoke nuisance to some extent carried its own remedy with it, for it seemed that the presence of dust in the atmosphere induced a larger rainfall, and consequent purification of the atmosphere.

Meeting held February 6th, 1893.

DR. J. LEWKOWITSCH IN THE CHAIR.

THE SALTS OF BREWING WATERS.

BY T. A. GLENDINNING, A.I.C.

Brewing waters, which are chiefly derived from wells or borings, are on a somewhat different footing from potable waters, for, in the latter, purity is the desideratum, and if, in addition, poisonous metals are absent and the solid matter not excessive, the water may be considered as satisfactory. In the former, however, besides purity, a knowledge of the dissolved salts is almost, if not absolutely, essential. It is unnecessary for me to remind you of the great influence of geological construction upon the character of the beers brewed in any district, the gypsumous waters of Burton long famous for pale ales, and the soft, stout-producing waters of Dublin and London being typical examples. We shall find it simplify matters to divide waters roughly into three classes—

(A.) Gypseous waters (that is, rich in calcium sulphate), such as are found at Burton.

(B.) Waters containing little or no gypsum; to this class belong those derived from the chalk and those poor in dissolved salts, like the Leeds town supply.

(C.) Waters containing no gypsum, but carbonates and sulphates of the alkalis. Such are derived from below the London clay, and are admirably adapted for producing black beers.

The following tables give two typical examples of each class. The figures represent grains per gallon:—

(1) an artesian boring.	(2) Burton deep well.
(3) deep well in the chalk.	(4) Leeds supply.
(5) very deep boring.	(6) also a boring.

—	A.		B.		C.	
	1.	2.	3.	4.	5.	6.
Silica	0·24	0·49	1·10	0·07	0·28	0·70
Alumina	0·18	0·49	0·04	0·07	0·61	0·43
Lime	16·34	36·33	17·37	2·01	9·92	13·46
Magnesia	2·09	10·15	0·49	0·52	3·24	4·60
Soda	5·89	7·25	1·72	0·77	21·97	10·70
Potash	..	0·86	..	..	..	Trace
Chlorine	7·98	2·37	1·99	0·80	6·08	3·64
Sulphuric acid (SO_3)	19·86	52·29	5·14	1·36	12·42	14·32
Nitric acid (N_2O_5)	..	1·25	3·51	0·13	0·16	0·16
Sodium chloride	11·13	3·90	3·28	1·32	10·02	5·99
Sodium nitrate	..	1·97	..	0·19	0·25	0·25
Sodium sulphate	..	10·21	..	..	22·04	17·01
Sodium carbonate	..	..	..	..	9·59	..
Potassium sulphate	..	1·59	..	..	..	..
Calcium chloride	1·90	..	..	..	..	..
Calcium nitrate	..	..	5·33	..	..	..
Calcium sulphate	33·76	77·87	8·74	2·31	..	8·02
Calcium carbonate	2·64	7·62	21·34	1·69	17·54	18·00
Magnesium carbonate	4·39	21·31	1·03	1·09	6·80	9·66
Silica, iron, and alumina.	0·41	0·98	1·14	0·14	0·89	1·13
	54·23	125·45	40·86	6·74	67·13	60·06

We will assume that a water analysis has been made and yielded a quantitative knowledge of the bases and acids present, which you will admit can be obtained with every pretention to accuracy. A list of these bodies doubtless appears very interesting, and, if imposingly drawn up, might possibly inspire respect, but it has one fatal disadvantage, which is its almost, if not complete, uselessness in the hands of the manufacturer. A chemist might form some idea as to the constitution of the salts present, but the information deduced would be limited, if one had to criticise the water as to its value for brewing purposes. The reason is not far to seek, for though a glance tells us, for example, that the dissolved salts are rich in lime and sulphuric acid (C_2), it does not follow that all the lime or all the acid exists in solution as calcium sulphate, for there may be other salts of lime and also sulphates of other bases present. It has hence become necessary to have as accurate an idea as possible of the salts present, and since these cannot be directly estimated, the acid and basic bodies are combined in the most probable manner, and I may say that the data thus obtained are of great value. In setting about this combination the following facts are taken advantage of :—

(1.) The affinity of potassium for chlorine is greater than sodium, hence chlorine is combined with potassium before sodium.

(2.) Calcium nitrate is decomposed by potassium carbonate, sulphate, and chloride, the sodium salts probably acting in the same way. The alkalis are, therefore, given the preference over lime for nitric acid.

(3.) Magnesium sulphate is decomposed by calcium chloride, and consequently it seems natural to unite sulphuric acid with lime rather than with magnesia. To this point I shall refer directly.

It is, as you know, quite possible for a state of equilibrium to exist among different salts in solution, which is readily upset by heat, concentration, or even by agitation, and as all water used for actual brewing is either previously boiled or heated, a rearrangement may take place among the bases and acids and a new and more stable state of equilibrium be established. We may, for instance, mix together *dilute* solutions of sodium carbonate or bicarbonate and calcium sulphate without obtaining an immediate precipitate, but heating immediately throws calcium carbonate out of solution. I think it advisable, therefore, when stating the salts of a water to consider the changes likely to be brought about on boiling, and to consider any bodies thrown out of solution as representing those originally present. This precipitation occurs when bicarbonates of calcium and magnesium are present, since they are decomposed by heat, the carbon dioxide being expelled and the carbonates deposited. In stating the calcium and magnesium sulphates and carbonates the two chief methods prevailing are these:—

(*a.*) To estimate the combined carbon dioxide directly by titrating the water with standard acid. This is then combined with the lime and expressed as calcium carbonate, any excess of carbon dioxide being combined with magnesia, or any excess of lime is combined with the sulphuric acid to form calcium sulphate.

(*b.*) To calculate the sulphuric acid first as calcium sulphate, any excess of SO_3 being combined with magnesia or any excess of lime calculated as carbonate. The result of this second plan is that magnesium carbonate and calcium sulphate are often given as existing together in the same water (see example 2). Now this might be the case in the cold, but on heating such a solution, carbonates will certainly be precipitated either of calcium, magnesium, or of both, and sulphates of one or of both will remain in solution. To decide this question I have recently done a number of experiments, the results of which may be thus briefly summarised :—

(1.) When calcium sulphate and magnesium carbonate (as bicarbonate) are present in solution in equivalent amounts, double decomposition occurs according to the equation $CaSO_4 + MgCO_3 = CaCO_3 \times MgSO_4$.

The decomposition is about four-fifths complete, the precipitate produced consisting almost entirely of calcium carbonate, whilst about four-fifths of the magnesia remains in solution as magnesium sulphate. A trace of calcium sulphate is carried down with the precipitate, whilst the undecomposed one-fifth of magnesium carbonate is partly precipitated, but the greater part remains in solution.

(2.) When we have either calcium sulphate or magnesium carbonate in large excess, complete or almost complete decomposition occurs. I have not determined the exact ratio requisite for complete decomposition, since this is a point of mainly theoretical interest.*

Evidently, then, in combining lime, magnesia, carbonic, and sulphuric acids, the order to be adopted is—

SO_3 combined first with magnesia and then lime.
CO_2 ,, ,, lime ,, magnesia.

The importance of this is seen in the following examples, where the first column of each series gives the salts calculated on this basis, and the second column on the old basis. Leaving out the soda salts we have—

—	A.			
	1.		2.	
	a.	*b.*	*a.*	*b.*
Magnesium sulphate...........	6·27	..	30·45	..
,, carbonate..........	..	4·39	..	21·31
Calcium sulphate	26·66	33·76	43·35	77·87
,, carbonate.............	7·85	2·64	33·09	7·62

—	B.		C.	
	1.		2.	
	a.	*b.*	*a.*	*b.*
Magnesium sulphate...........	5·16	..	7·06	..
,, carbonate..........	..	1·03	4·72	9·66
Calcium sulphate	2·89	8·74	..	8·02
,, carbonate.............	25·62	21·34	24·03	18·00

So important is the influence of the salts in brewing waters that we find many London firms carrying on their black beer production in London, whilst their bitter beers are brewed in Burton in breweries they have erected there for that purpose. But now that the chemistry of these waters is better understood, it is no uncommon thing to find London firms turning out good bitter beers, or Burton brewers brewing good stouts, and the part which chemistry plays is simply this—to so alter the composition of the dissolved salts that a water is made suitable for brewing the desired beer. Take, for example, a water like B ; with the exception of chalk, which will be lost on heating, there is not sufficient of any salt present to recommend the water for brewing purposes as it stands. If, therefore, desired for pale-ale production the calcium sulphate must be increased 10, 15, or 20 times its present amount, according to circumstances, whilst, if required for mild-ale production, the sodium chloride is increased.

You will therefore see the importance of the method employed for combining the bases and acids as salts, for thereon depends the treatment considered necessary. If, in the first water on Table 2, it were necessary to increase the calcium sulphate up to 40 grains per gallon, the calculation by the first method would require the addition of 13·4 grains, whilst the second requires only 6·2 grains. Again, in the *second* water, the two methods of calculation represent a difference of no less than 34·5 grains of calcium sulphate.

It will be found that, as a rule, all the chlorine in a water exists as sodium chloride with sometimes potassium chloride in addition. Some waters, especially those near the coast, contain more chlorine than the equivalent of the alkalis, and in these cases either calcium or magnesium chloride is present. Now, I have frequently seen cases in which calcium chloride and magnesium carbonate are given as existing in the same water, but just as the latter salt is decomposed on heating with calcium sulphate, so also does decomposition occur when magnesium carbonate is heated in the same solution with calcium chloride, the precipitate thrown out of solution consisting almost entirely of calcium carbonate. Consequently any excess of chlorine not expressed as sodium or potassium chloride should be combined with magnesia in preference to lime. I had fully intended bringing before you some experiments of this point, but unfortunately the time required to complete them has not been forthcoming.

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* For a complete account of the experiments, see Brewing Trade Review, February 1, 1893.

It may happen, however, that a brewer is not blessed either with a perfect water or with one which simply requires bringing up to Burton standard by increasing its salts, but has to produce good beers with a water containing salts altogether undesirable or even injurious to beer production.

Sodium carbonate, if present to any great extent, would prove fatal to the brewing of anything but black beers, and sodium sulphate, though by no means as harmful, is nevertheless an undesirable constituent of brewing waters.

For the decomposition of sodium carbonate the employment of free acid would be, to say the least, dangerous. One method used is to gypsum the water, but this causes the formation of sodium sulphate, which, when present in any amount, is most undesirable, although not so productive of harm as the carbonate. The sodium sulphate is therefore then decomposed by the addition of calcium chloride, yielding salt and calcium sulphate. By far the best method is the direct employment of calcium chloride solution, which at one operation decomposes both these sodium salts, calcium carbonate being precipitated and the much-desired calcium sulphate obtained in solution. The solution of calcium chloride must be pure and of a known strength, and the volume added to a water to be treated should contain an amount of the salt equivalent, or rather more than equivalent, to the sodium sulphate and carbonate.

The methods employed in making an analysis of the solid matter dissolved in water are so well known that they require but little comment from me. There are, however, just a few points to which I should like to direct your attention.

Firstly, temperature at which the total solids should be dried. I believe the most usual temperature is 110° to 120° C., and when such is the case an allowance should be made, in stating the salts present, for the water of crystallisation of certain of them.

The following are given by a recognised authority on water analysis, for this temperature, although he admits that anomalous cases have occurred in which the salts appeared to have become anhydrous:—

$$\begin{array}{ll} CaSO_4 & + \tfrac{1}{2}\ \text{Aq or } \left\{\begin{matrix} CaSO_4 \\ CaSO_4 \end{matrix}\right\} + 1\ \text{Aq} \\ MgSO_4 & + 1\ \text{,,} \\ Mg(NO_3)_2 & + 2\ \text{,,} \\ Ca(NO_3)_2 & + 1\ \text{,,} \end{array}$$

The method of estimating the soda and potash is, as you know, to evaporate firstly with barium hydrate to remove the sulphuric and carbonic acids, and then to treat with ammonium carbonate to remove lime and magnesia. The filtrate obtained is evaporated to dryness with ammonium chloride, and the ammonia salts decomposed by gentle ignition. The sodium and potassium are then dissolved out with water. It is the method of ignition which should be noted, as it is of great importance. At first the heat must be very gentle and gradually increased until, when ammonia fumes ceased to be evolved, dull redness should be reached. If the heat be too rapidly raised, the alkaline chlorides melt and appear to enclose some of the ammonium salts which are not completely removed, and the results are too high. Should the residue not be sufficiently heated, all the ammonium salts are not removed, and then too high a result is obtained. If heated to too high a temperature the alkaline chlorides will partially volatilise and give too low a result. With practice very accurate results can be obtained. The potassium should always be estimated. It is not sufficient to estimate the alkalis as chlorides and call the result sodium chloride, for in some waters an appreciable quantity of potassium is present. This can of course be estimated in the alkaline chlorides. The only other point to be noticed is the determination of nitrates and nitrites. Nitrites are not often present, but a careful determination of the nitrates should be made. The method is to evaporate the water under examination with potash to get rid of ammonium salts, and then to reduce the nitrates by means of zinc-copper couple, ammonia being distilled off, after further addition of potash, and estimated by Nessler's reagent in the ordinary way. Now, the potash employed should be carefully looked into, for when ordinary potash is used the results obtained are generally too high, this being doubtless due to nitrates contained in the potash. It is a good plan therefore to use potash precipitated by alcohol, but even then I have found a correction necessary. Wanklyn advises that the potash should be made by dissolving metallic potassium in water, but whether this is done or not a blank determination with the materials should certainly be made.

In conclusion, I am afraid my remarks have been for the greater part but old news. Still, in spite of that, they serve as an illustration of the direct application of chemistry to the improvement of a manufactured article, and on this ground may not be entirely devoid of interest.

Discussion.

The Chairman remarked that it would be interesting if Mr. Glendinning could tell them the influence of the individual salts upon the quality of the beer. It was easy to understand that sodium carbonate should be injurious, but why should the presence of sodium sulphate be undesirable? The fact that calcium carbonate and sodium sulphate can co-exist in solution was interesting, and had lately been used to explain the formation of deposits of natural soda in certain North American lakes. It was unfortunate that it was not yet possible to determine the way in which the various acids and bases were combined in the water. Why analysts should omit the determination of the potassium in the alkaline chlorides was difficult to understand, as the estimation was so easily carried out. Recent experiments on the Continent had shown that the flavour of a wine was to some extent conditioned by the particular variety of yeast used; was this also the case with beer?

Mr. Richardson also desired to know the influence of the dissolved salts upon the quality of the beer. The text-books gave very conflicting statements; among others, that a water which was clouded by soap solution was not adapted to brewing purposes; if this were so Messrs. Bass's and Messrs. Allsopp's waters would be condemned: and further, that alkaline chlorides diminished the amount of albuminoid matter in beer; were these statements in accordance with the facts? Had Mr. Glendinning tried the effect of sodium nitrate on calcium carbonate when the two salts were boiled together in dilute solution? The nitric radical was certainly present in the solids as calcium nitrate, for nitrous fumes were evolved on ignition, and these could not come from the sodium nitrate, for this yielded oxygen when heated. The magnesium was said to be separated by precipitation as carbonate, but according to his experience magnesium carbonate was decidedly soluble in water, according to one authority, to the extent of 0·1 per cent. in boiling water. He himself had found it necessary, in estimating it, to separate it from the alkaline salts by precipitation with ammonium phosphate. The alkalies in the residue of waters were well estimated by titrating the chloride with standard silver nitrate. As to the nitrates, a very good way of reducing them was to leave the water standing all night with potash and aluminium foil. He had not found that the salts in the residue, when dried at 100°—110°, retained any appreciable amount of water of crystallisation.

Mr. G. W. Slatter thought that the analytical results were of much greater value than those obtained by calculation, since the methods for combining the different acid and basic constituents were to a certain extent arbitrary, different chemists from identical analytical data getting dissimilar calculated results; and this was to be expected, for it was impossible to say in any case how the different acids and bases were *actually* combined, though the surmise formed on this point would no doubt often be correct. Were Mr. Glendinning's analyses made with the water before or after boiling?

Mr. Glendinning: Before.

Mr. Burrell took exception to the analysis that represented the Leeds water supply as containing calcium nitrate. He had constantly analysed this water and had never found nitrates. He suggested that the method of first boiling with potash to get rid of ammonia and then reducing the nitrates in the alkaline residue by a copper-zinc couple was a faulty one, inasmuch as ordinary potash nearly always contained traces of nitrates, which would vitiate the result. The method recommended by Williams (J. Chem. Soc. 1881) and adopted by the Water Committee of the Society of Public Analysts, in which the ammonia was estimated in a separate portion of the water to that in which the nitrates were determined, was to be preferred.

Dr. Cohen had used the zinc-copper couple and found the method very accurate and reliable. By the aluminium method the nitrates and nitrites present in potash might be corrected for by performing a blank experiment simultaneously with the real one, and taking the difference of the two results. But if aluminium were used, and amalgamated by dipping it into mercuric chloride, the reducing action was much accelerated, and no potash was necessary. According to the modern view that salts in dilute solutions undergo dissociation, the first part of Mr. Glendinning's table of analysis more nearly represented the facts than the second part, in which the acids and bases were represented as combined together. Given a certain proportion of acids and bases in solution, it was immaterial how they were originally combined, for they would certainly not be present in their original combination.

Mr. Broadbent asked why such stress should be laid upon the separation of the potassium from the sodium salts, seeing that the potassium salts were present in almost infinitesimal proportions, and also what was the influence of the small quantity of potassium salts upon the quality of the beer as compared with that of sodium salts.

Mr. Ward also commented on the unsatisfactory nature of the present methods of arranging the results of water analyses. The fact that nitrous fumes were evolved on heating the solid residue, scarcely sufficed to prove that calcium nitrate and not potassium nitrate were contained in the original sample of water; for an inter action might have ensued during evaporation. It would be better in determining the suitability of water for the brewer's purpose, that the water should be boiled before analysis; as, in the process of brewing, it was boiled. Had potassium or magnesium salts any influence on the growth of particular kinds of yeast?

Mr. Procter understood Mr. Glendinning to say that the carbonic acid had been estimated by titration with acid, and presumed that this applied to that present as bicarbonates, and that the free carbonic acid had not been determined, but for some purposes the latter was an important constituent. He had employed the method of titration with sodium carbonate with phenolphthalein as indicator, described by Mr. Archbutt at a previous meeting of the Section, and the results seemed accurate, though the end-reaction was not so sharp as might be desired.

He found that in determining permanent hardness by Hehner's method in the presence of magnesia, very different results were obtained when the solution was only boiled to those given by evaporation to dryness, and was therefore inclined to believe in considerable solubility of magnesium carbonate.

It would be interesting to know whether the presence of nitrates and nitrites had any marked effect in brewing waters, since it had been noted by a continental firm of leather manufacturers that bran-drenching, which was a process depending on lactic fermentation, proceeded more satisfactorily with water containing nitrates.

Mr. Knaggs inquired what action took place between lime-water and sodium carbonate. How must one account for the presence of sodium carbonate in the pit waters of the district.

Mr. Glendinning, in reply, said that with regard to the influence of salts upon the quality of beer, a paper would shortly be read on this subject by two Burton chemists before the Institute of Brewing. With any given malt, gypseous and non-gypseous waters extracted practically the same amount of nitrogenous matter, but the manner in which this was precipitated on boiling was influenced by the salts present. A gypseous water caused the albuminoids to separate in flocks, which were readily filtered by the hops in the hop-back, whereas the presence of much sodium carbonate caused the albuminoids to separate in a fine state of division. When gypsum was present in excess it exerted a weakening influence on yeast. Sodium chloride in beer was derived mainly from the water, whilst the potassium chloride present originated in the materials used —malt, hops, and sugar. He was not aware that it was seriously stated anywhere that waters rendered turbid by soap solution were not to be recommended for brewing purposes. In estimating potassium chloride in presence of sodium chloride, titration with silver nitrate gave very good results. The water residue dried at 100°—110° C. contained water of hydration of some of the salts present. The necessary corrections to be made had been given both by Heron and by Matthews. In stating the results of an analysis the actual analytical data should be given in addition to the salts probably present as deduced from the bases and acids. In the estimation of nitrates and nitrites a blank determination should be made with the materials used, since the potash might contain nitrates and thus cause too high a result. Nitrates were often found in waters otherwise perfectly pure, and were rather evidence of contamination at some *previous* period.

Glasgow and Scottish Section.

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J. Stanley Muir, Chemical Laboratory, University of Glasgow.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, January 10th, 1893.

MR. CHAS. A. FAWSITT IN THE CHAIR.

THE EXTRACTION OF NITRATE OF SODIUM AND IODINE IN NORTHERN CHILE.

BY JOSHUA BUCHANAN, JUN.

In dealing with the nitrate industry of Northern Chile, I shall confine the practical part of my paper to the methods as practiced in one of the large nitrate oficinas in the Desert of Atacama, about 50 miles from Taltal. It is the method, with a few unimportant mechanical differences, which is practiced in all oficinas, but this particular establishment is one which I had exceptionally good opportunities of studying.

The deposits of *Caliche*, or crude nitrate of soda, belonging to this oficina, are of very great extent, running in a narrow belt of an average width of about a mile, to nearly 40 miles to the north of the work itself. The entire district, for hundreds of miles north and south, is a desert of the dreariest description. The nitrate pampas are vast plains covered with sand to the depth of about two inches, and studded over with large stones. It is difficult to account for the situation of these stones, which are fragments of Andesite. They are rounded, as if water-worn, and notwithstanding their weight, some of them weighing upwards of a quarter of a ton, they rest on the extreme surface of the sand, a surface through which the horses' hoofs sink to a depth of three or four inches.

A characteristic nitrate pampa, or *Calichero*, as it is called, would consist of the following strata. First, a layer of sand and gravel, about 1 in. to 2 in. deep; then there is a 6-in. layer of a white, friable substance called by the natives *Chusca*, which is simply sulphate of calcium in a very porous condition. Below this is a stratum of from 2 to 10 ft. thick, composed of a compact mixture of earth and stones, the stones, like those on the surface, being *Andesite*. Then there is a layer of from 1 to 3 ft. thick, of a substance known as *Costra*, which is low-grade caliche containing a large quantity of chlorides, felspar, and earthy matter. The caliche, or crude nitrate of soda, lies below this. It forms a layer of from 1½ to 2 ft. thick. In the Tarapaca district, further north, it is very much thicker, ranging from 4 to 12 ft. in thickness. Below the caliche is a stratum of *Coba*, which is a species of fine clay, and is about 3 in. in depth. It forms the bottom of the *Calichero*, and rests on earth and porphyritic rocks. The *Costra*, or layer immediately above the caliche, contains a considerable quantity of a double sulphate of magnesium and sodium, called *Astrachanite* or *Blödit*, and having the formula -

$$(Na_2SO_4 + MgSO_4) + 4H_2O.$$

The value of the caliche is very variable, being from 15 to 65 per cent. nitrate of sodium. It is found that the richness of the caliche varies directly as the thickness of the layer of earth and stones above it. It is also found that the richer it is in nitrate the poorer in iodine, and vice versa. The caliche contains a large number of salts, including sulphates, chromates, nitrates, chlorides, iodates, borates of calcium, magnesium, and sodium, and also double salts of these. Among the latter I may mention *Lautarite*, which is native iodate of calcium, $Ca(10_3)_2$.

There is also present in small quantity, a double iodate and chromate of calcium, having the formula—

$$7Ca(10_3)_2 + 8CaCrO_4$$

It is difficult to advance any one theory for the formation of these deposits. From the presence of guano, remains of birds, eggs, and marine objects frequently found in the caliche, a belief is prevalent among the nitrate workers that there were great guano deposits there at one time, that the plains had then sunk under the sea, and on their elevation again, the nitrate was formed by the action of the slowly concentrating solution of salt upon the guano. There is another theory which holds that the deposits are due to the mutual action of decomposing sea-weed and common salt. Neither theory, however, explains why the bromides which are found in sea-water should have completely disappeared from the caliche, for so far not a trace of bromine in any state of combination has been discovered. It may be, however, that a secondary decomposition has taken place, whereby bromides and bromates were decomposed with the liberation of bromine.

The calicheros are opened out by sinking holes about 9 in. in diameter down through the various strata as far as the *coba*. A heavy charge of gunpowder or dynamite is then put in and the hole filled up with earth and tightly rammed down, the object being to cause as much rending as possible. The work of taking out the caliche is all done by contract-men, who are paid so much per cart, the price being fixed by a surveyor or over-looker, who judges by the depth of excavation necessary and by the hardness of the overlying strata what ought to be a fair price. The price per cart thus varies very much, as in some calicheros the supernatant layers are soft and only 3 ft. or 4 ft. thick, while in others they may be 14 ft. or 15 ft. in thickness, and very hard. A good miner will earn on an average about 3 dols. per day. During the opening of a calichero, as the work done is quite unproductive, the men receive 1·50 dols. to 2 dols. per day. They require to be closely watched, as when they get an opportunity they will load up a cart with earth and stones which would require to be paid for as caliche if it passed the tally-clerk. The product from the various calicheros is mixed so as to produce as nearly as possible an average of 35 per cent. nitrate of sodium.

A fair sample of caliche, after mixing, will contain—

		Per Cent.
Earth, stones, &c.		50
Nitrate of sodium		35
Magnesium Sodium Calcium	Chlorides	10
Water, sulphates, and other salts		5

As the deposit of nitrate is so thin, it is obvious that a large tract of country must be worked to keep up the supply. At present the oficina which I am describing works calicheros extending to upwards of ten miles from the works, a line of rails being laid through all the workings from one calichero to another. The caliche is brought in carts from all sides, and is placed on platforms at various places along the line. In the morning an engine and train of empty trucks leaves the oficina and uncouples two or three trucks at each platform, returning with them when filled.

On entering the works the caliche is at once taken to the stone-breakers, which are the largest size made. By them the raw material is reduced to a fairly uniform size of about 2½ inch cube, and from there it is at once conveyed in small waggons to the boiling-house. It is there thrown into the boiling tanks, about 75 tons into each. The tanks are approximately 9 ft. deep, by 8 broad, and 45 long, and have a false bottom of perforated iron about 8 ins. from the foot. They have each two siphons, one emptying into a drain leading to the crystallising tanks, and the other to the neighbouring tank. They have also a plug at the bottom worked by a long handle from the top. The refuse is discharged through two man-holes at the bottom into cars below. It is hardly necessary to give a full description of this part of the process, as it is simply the Shanks lixiviation system applied to nitrate. The tanks are provided with five coils of 3-in. steam-pipe, steam being used at a working pressure of 35 lb. per square inch.

The water used is got from the Cordilleras, being conveyed in pipes a distance of 80 miles, from two deposits, at Sapos and Sandon. A considerable quantity is also obtained from wells on the company's property. These wells, of which there are eight, are at a considerable distance from each other, and do not give a steady supply of water. The pipes from the Cordilleras are often burst from the intense cold which prevails on the mountains in winter, so that the problem of water supply is a very serious one, and is a source of never-ceasing anxiety. Every precaution is taken to prevent waste, all steam is carefully condensed, and the liquors are used over and over again, the only loss being from the great evaporation in the crystallising tanks.

In the boiling tanks solution is allowed to go on until the liquor registers 110° Tw. at 120° C. It is then run off by means of the siphon to the crystallising tanks. The process of solution is then repeated; the liquor, when it ceases to be of the required strength being siphoned off into the next tank into fresh caliche, and when very weak it is run off by the bottom plug into a tank below, from which it is pumped back again into the boiling-house; the refuse in the tanks being then discharged through the manholes. On the average, a charge takes 2½ days to exhaust. There are 16 of these tanks in this oficina, worked in sets of four.

On looking across the surface of the boiling tanks when working, the air and steam appear quite purple from the presence of iodine vapour. This is due to the fact that as all the mother-liquors from the crystallising tanks cannot be treated in the iodine house, part is returned without further treatment to the boiling-house. In this state it contains a comparatively large quantity of iodate. It is there mixed in the tanks with liquor returned from the iodine house, which contains, as will be seen later, iodine in the form of iodide. Accordingly, although the solution in the boiling tanks shows a distinctly alkaline reaction, yet from the absorption of atmospheric carbonic acid, and probably also from the presence of traces of peroxide of hydrogen, due to the presence of clouds of steam, decomposition takes place with the liberation of iodine, which, for the most part, is lost in the state of vapour.

The crystallising pans are approximately 10 ft. × 12 ft. × 1½ ft. to 2 or even 4 ft. deep, although this is excessive. The liquor remains in the crystallising pans from four to six days, according to the season of the year, crystallisation of course taking place much quicker in winter than in summer. The mother-liquor is then run off into the iodine house, and the nitrate is thrown out of the pans on to platforms sloping so that the mother-liquor may drain back into the pans again. It is then lightly sprinkled once or twice with water to wash out as much of the mother-liquor as possible. It is allowed to remain on the platforms till dried by the sun, after which it is put into bags and sent down to the port to be shipped Its composition as it leaves the works is as follows:—

	Per Cent.
Nitrate of sodium	96·75
Water	2·1
Chloride of sodium	0·75
Sulphates	0·3
Insoluble matter	0·1
	100·00

The general plan of the further treatment of the mother-liquor is as follows:—The liquor, containing the iodine chiefly in the form of iodate of sodium, is run into tanks and decomposed with bisulphite of sodium.

The iodine is allowed to settle out, filtered, dried, and sublimed. In detail, the process is performed thus—

The first stage is the manufacture of carbonate of sodium. This is done simply and quickly by igniting a mixture of six parts nitrate of sodium with one part coal-dust. The mixture is made on an open hearth, and, after thorough incorporation, is piled into the form of a cone, a little water poured over it, and the mass is then ignited. It is always advisable to have an excess of nitrate present, as it gives a more porous and soluble product. The carbonate so obtained is in blocks of a dry cellular character, frequently tinged green from the presence of oxide of chromium. It contains from 70 per cent. to 75 per cent. anhydrous carbonate of sodium, with often as much as 10 per cent. nitrate of sodium. In addition it always contains varying quantities of sodium silicate and calcium sulphate.

When thoroughly cooled, the blocks of carbonate are thrown into a small set of lixiviation tanks, similar in shape to the nitrate ones, and cold water is run in, the temperature speedily rising from the heat evolved by the hydration of the carbonate. The solution is made of 20 per cent. strength, and is then, after cooling, run into iron, lead-lined cylinders about 15 ft. long by 5 ft. diameter, laid horizontally. Four of these cylinders are used, laid two above two. About 200 cub. ft. of solution is run into each. In the lower third of one end two perforated lead pipes are let in and run along near the bottom. At the top of each of the lower cylinders a pipe is connected with the two entrance pipes of the cylinders above. Sulphurous anhydride is generated in a small sulphur kiln connected with the lower cylinders. The gas is first drawn through a cooling coil of pipes immersed in a tank of water before entering the carbonate solution. The gas is sucked through the system by means of a steam ejector connected with the top pair of cylinders. The sulphur used is native, and is almost pure. Absorption is allowed to go on until the solution contains a mixture of monosulphite and bisulphite of sodium, in the proportion of one part mono- to two parts bisulphite. This generally takes about 24 hours to effect. When the reaction has gone far enough the lower cylinders are discharged into a storage tank; the solution in the upper cylinders, which has meanwhile been absorbing the residual gas, is run into the lower pair, and a fresh charge of carbonate is put into the upper. The process is both simple and cheap, the carbonate costing about 4*s.* 6*d.* per cwt. and the sulphur about 8*s.* 6*d.* per cwt. The quantity of sulphur consumed in the production of 100 lb. of iodine is about 140 lb.

The mother-liquor from the crystallising tanks is now in the precipitating tanks awaiting treatment. These tanks are made of wood coated with pitch. They are 18 ft. long by 7 ft. by 3 ft. deep, and are provided with a syphon-pipe which can be lowered into the liquor. They have also got a revolving wooden stirrer laid along the top, worked by hand from each end. The mother-liquor, as run into the iodine-house, contains on an average 3 grms. of iodine per litre, chiefly in the form of iodate. To every 360 cub. ft. of liquor, 16 cub. ft. bisulphite solution is added and thoroughly stirred in. Theoretically the reaction which now takes place is as follows:—

$$2\ NaIO_3 + 3\ Na_2SO_3 + 2\ NaHSO_3 = 5\ Na_2SO_4 + I_2 + H_2O.$$

Like most theoretical equations, however, this requires to be considerably modified in practice. In ordinary cases it is found that the best results are obtained with the reagents in the proportion given above, viz., 2 parts bisulphite to 1 part monosulphite. The reason is, that there is always a little iodide present with the iodate, and the excess of bisulphite renders the solution acid enough to produce the reaction—

$$NaIO_3 + 5\ NaI + 3\ H_2SO_4 = 3I_2 + 3\ Na_2SO_4 + 3\ H_2O.$$

In some cases it is found necessary to add free sulphuric acid on account of the liquors being alkaline from the presence of considerable quantities of borates. This, however, is of more frequent occurrence in the districts about Tarapaca and Iquique than in the one I am describing.

After thorough incoporation of the reagent, the solution in the tanks is allowed to settle for six hours. The clear liquid is then run off by means of an iron pipe standing up through the tank and fastened to the bottom by a socket joint so that it can be lowered to any depth required. The liquor is run into large deposit tanks for removal of the free iodine in solution. It now contains about 0·3 grm. of iodine per litre, partly free and partly in the form of iodide. As water is such an expensive item it is necessary to use it over and over again, and as it requires to be pumped through iron pipes by means of metallic pumps it is necessary to get rid of the free iodine in order to avoid corrosion of the plant. For this purpose a mixture of equal parts of the bisulphide solution and carbonate solution is thrown in, the exact quantity required for each tank being estimated in the laboratory. The free iodine is thus converted into iodide of sodium by the following double reaction:—

$$2\ NaHSO_3 + 2\ I_2 + 2\ H_2O = 4\ HI + Na_2SO_4 + H_2SO_4$$
$$2\ Na_2CO_3 + 2\ HI + H_2SO_4 = 2\ NaI + Na_2SO_4 + 2\ CO_2 + 2\ H_2O$$

The spent mother-liquor is then ready to be pumped back into the boiling-house. Meanwhile the precipitated iodine is ladled out of the tanks into buckets and thrown into barrel filters. These simply consist of ordinary barrels, about 4 ft. high, having a false bottom about 4 in. from the foot, perforated with ¼-in. holes, and having a sack stretched over it. The iodine precipitate is there allowed to drain until it ceases to drip, and is then transferred to a screw-press to be further dried. It is placed between folds of sacking and a pressure of several tons is brought to bear on it. On removal from the press the precipitate is now found to be in fairly hard cakes, containing from 65 per cent. to 70 per cent. of iodine, the remainder being water, silicic acid, and sulphate of calcium. The iodine is now ready for sublimation, and for that purpose it is transferred into cylindrical iron retorts, somewhat like a round gas-retort, fired from below by a small coal fire. Each retort holds about 1,000 lb. of precipitate.

The retort is connected with a series of eight earthenware condensers, consisting simply of eight short, wide pieces of socket earthenware pipe, 3 ft. long by 1½ ft. diameter. The joints are all carefully luted with clay, and the last pipe is closed by a flat piece of wood well luted round the edges. The sublimation is allowed to go on for five days. At the end of that time the fires are drawn, and the retort and condensers allowed to cool. On opening the condensers they are found to contain from 650 to 700 lb. of iodine of a guaranteed purity of 98 per cent. The residue in the retort is removed, cooled, and washed with bisulphide solution to remove any iodine which may still remain in it. It now consists mainly of silica and sulphate of calcium. The iodine is then packed in barrels for transportation. The total cost of manufacture is about 1*s.* 8*d.* per lb.

To those of you who are interested in laboratory processes the following notes on the routine work of the oficina laboratory may be interesting. In a large work like this, involving so many chemical processes, the work of the chemist is incessant, there being a staff on duty both day and night.

The principal thing requiring estimation is the total nitrate in the *Caliche.* This is done by weighing out 0·5 grm. into a porcelain basin; to this is added 50 cc. of a 20 per cent. solution of sulphuric acid, and the solution is heated to boiling. While still boiling, solution of ferrous sulphate is added with constant stirring, producing a brownish-black coloration, which almost immediately disappears. The reaction is complete when the further addition of ferrous sulphate fails to produce this coloration. The standard ferrous solution is made of such strength that 25 cc. are required for 0·5 grm. pure nitrate of sodium This method is used in the ordinary routine work and is accurate enough for ascertaining the average values of the different samples from the *Calicheros*, but even with much practice the probable error of the process is about 2 per cent.

For more accurate determinations, and also for estimating the refined nitrate, the Schlösing-Grandeau process is used. There are also two processes used for the determination of iodine. The first is simply a quick and approximate method, and consists in taking 50 cc. of the mother-liquor and adding iodide of sodium and dilute sulphuric, when the following reaction takes place—

$$NaIO_3 + 5\,NaI + 3\,H_2SO_4 = 3I_2 + 3\,Na_2SO_4 + 3\,H_2O$$

The iodine liberated is then titrated with standard thiosulphate solution, and the quantity obtained is divided by six, the result being taken as the quantity of iodine present. The determination of the iodine in the liquor after precipitation is done much more accurately. The iodine is now in the form of iodide, and the process is as follows:—150 cc. of the water are put into a bottle, 10 cc. of a mixture of equal parts of chloroform and bisulphide of carbon are added, and then three drops of a saturated solution of nitrous acid in concentrated sulphuric acid, causing decomposition of the iodide. The bottle is then closed and well shaken until the iodine is dissolved by the chloroform and bisulphide.

The solution is then allowed to settle and filtered through a wet filter, only the aqueous portion passing through. The iodine solution is then run into a bottle and titrated with thiosulphate. This process is also sometimes used for the mother-liquors, 50 cc., of liquor being taken, and sulphuric acid and bisulphite solution being added to liberate the iodine.

The boiler waters require to be constantly tested. They are generally found to be alkaline, usually from the presence of borates.

In conclusion I may say that the chemical investigation of the nitrate deposits is as yet only in its infancy. It is only very recently that men of high scientific training have been put in charge of the laboratories of the oficinas, and without doubt we shall before long hear more of the very varied constituents of these deposits, which for so long have had almost a purely commercial interest.

Discussion.

The Chairman said that the paper just read was especially acceptable from the fact that Mr. Buchanan had been in Chili for a number of years, and therefore spoke from personal knowledge of this district. The importance of those nitrate of soda deposits was very great, because on them the manufacture of nitric acid, gunpowder, and explosives depended so largely. A paper relating to this subject, read some time ago before the Philosophical Society of Glasgow, gave him the impression that those deposits would soon be exhausted. That being the case their importance to all nations became very apparent. By purchasing, and so creating a monopoly in them a Government would thereby be able to regulate the supply of explosives to other countries.

Mr. E. C. C. Stanford said that the paper impressed him with the necessity for finding some new outlet for the consumption of iodine. Mr. Fawsitt had suggested, some time ago, its possible usefulness in waterproofing. At the present time iodine was used to a small extent in the manufacture of iodine colours, but its principal use was for medicinal purposes. Allowing for a considerable increase in those manufactures, the possible consumption could not amount to very much. Particular interest was attached to this paper, because this was the first time the subject had been brought before a chemical society. A paper on the extraction of iodine from the same source had been read some years ago by an engineer before the Institute of Civil Engineers in London. The author of that paper did not profess to have much knowledge of the chemistry of the subject, yet it was remarkable how very accurate his paper had proved to be. His process was exactly similar to that described by Mr. Buchanan. The presence of iodine in those deposits pointed to sea-water or sea-weed as a probable origin, but the great characteristic of both of those substances was the presence of bromine, and as even traces of bromine were absent, the possibility of those deposits being the product of evaporation of sea-water or the decomposition of sea-weed was removed. By the further chemical investigation of the deposits, he had no doubt a number of other substances would be discovered, and thereby assist in revealing their origin.

Mr. Beilby said that the importation of nitrate of soda had given a severe blow to the sulphate of ammonia trade. He would be pleased to hear particulars regarding the actual cost of production of nitrate of soda on the spot.

Prof. Mills inquired if Mr. Buchanan could give any accurate idea regarding the geological formation of the district in which those deposits were situated.

Mr. Rottenburg understood that at the present price of nitrate no "caliche" would pay containing less than 45 per cent. nitrate of soda, so that with low grade "caliche" containing 30 per cent. considerable loss must be entailed. He would be pleased to have Mr. Buchanan's opinion on that point. In giving the analysis of the nitrate of soda no mention had been made of nitrate of potash; it would be interesting to know the quantities of chromium and nitrate of potash present.

Mr. Chrystal inquired what the amount of iodine in rich "caliche" was, as compared with that in poor deposits of nitrate.

Mr. Fairlie asked if any theory had been formed to account for the presence of the chromium in the deposits.

Mr. Fawsitt, referring to Mr. Stanford's remark on the use of iodine in waterproofing, said that it had at one time appeared as though this might be a possible outlet, but the present cost of iodine precluded its use for the purpose. Unless there were some material alteration in the price of iodine, its consumption for the purpose indicated could not be large.

Mr. Buchanan, in reply, said that the greater part of the iodine was found in the low-grade deposits. The richer in nitrate the poorer was the deposit in iodine. That was the reason for mixing low and high grade caliche. The chief profit was obtained from the iodine. The exportation of nitrate itself entailed a loss of about 4,000*l.* per six months. Referring to Prof. Mills' question, he was unable to give particulars regarding the geology of the district. As far as he was aware, in the northern districts 50 to 100 miles from Taltal, the percentage of nitrate of potash in the deposits was very small. Chromates were present as mere traces. The accurate percentage of iodine in the deposits had not been estimated. The works chemist only estimated the quantity of iodine recoverable from the mother-liquor. Owing to the great variableness of the deposits, it was impossible to obtain representative samples for the purpose of accurately estimating the amount of iodine present in the "caliche." There need be no fears, he thought, entertained regarding the exhaustion of those deposits in the immediate future. He could assure them that they would last, at the present rate of consumption, for generations.

Nottingham Section.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

1893:—

Wednesday, March 8th, at 7.30 p.m.:—Prof. F. Clowes. "Gas Testing by means of the Hydrogen Flame."

Wednesday, March 29th, at 7.30 p.m.:—Mr. S. J. Pentecost. "Notes on Silk Bleaching."

Communication.

THE MANUFACTURE OF PORTLAND CEMENT IN NORTH CHINA.

BY R. FINCH.

The works at Tong Shan were designed and built by the author to manufacture Portland cement for the Imperial Government about three years ago. The Plant consists of—

12 pairs 4′ 6″ millstones.
2 Blake Marsdens stone crushers with the usual system of elevators to the mill hoppers.
Wash mill.
2 wet mills.
2 carter's mills.
3 slurry pumps.
Set of cask working machinery equal to 400 casks per 12 hours.

The whole driven by a horizontal condensing engine and three 30 feet × 7 feet Lancashire Galloway boilers.

21 slurry "backs."
1 brick-making machine.
4 50 ton cement kilns.
6 90 ,, ,, ,,
26 10,, ,, ,,

All of the ordinary dome pattern, fitted with exhausts for draining off the CO_2.

4 drying-ovens.
24 coke-ovens, constructed on the Carvès system, with condensing arrangements for extracting the tar and ammoniacal liquor. Gas works for illuminating and laboratory purposes.
Artificers' workshops, warehouses, &c., &c.

The works are connected by a branch line with the Chinese Imperial railways, and are in direct communication with the port of Tientsin, and thence by steamer and canal to the whole of the Imperial Government works, forts, &c., &c.

In connection with the works is an extensive chemical laboratory and assay office, in which gold, silver, lead, iron, &c. ores, raised at the various mines of the Chinese Engineering and Mining Co., and coal, from their important collieries at Linsi and Kniping, are regularly assayed and analysed. With the assistance of two Europeans, the whole of the above is carried on under the direction of the author, day and night, by native coolie labour.

The materials used in the manufacture of Portland cement here, are ordinary mountain limestone, which is found locally in abundance, and in various states of purity, and marl, rough "potters'" clay, fire-clay, and an aluminous clay, found near the outcroppings of the coal of the district. The clays have to be mixed. The limestone varies from 71 per cent. to 98 per cent. $CaCO_3$, and the clays from 15 per cent. to 42 per cent. Al_2O_3, and from 35 per cent. to 68 per cent. SiO_2, as they are delivered into the works. Both limestones and clay are practically free from MgO, rarely containing more than 0·20 per cent., whilst the oxides of iron never exceed 4 per cent. On account of the great differences in the percentages of the principal ingredients of the limestones and clays, the greatest possible care has to be taken in mixing the raw materials, so as to insure having a slip of uniform quality. Every half hour samples are drawn from the mill spouts and clay mills, and analysed, and the same remark applies to the slurry as it is pumped to the "backs." The raw materials are all weighed into the wash-mills. By taking these necessary precautions no difficulty is experienced in obtaining a slip of perfectly uniform quality. Owing, however, to the different densities of the raw materials used, however finely ground, they will, and do settle down into their several strata at the backs; so that before the slurry can be transferred to the drying ovens, it has to be completely turned over with the shovel, and thoroughly kneaded under the feet of coolies. Fortunately labour is very cheap out here, or this would materially add to the cost of production. This, however, ensures a perfectly mixed slurry, ready to be moulded into bricks for transferring to the drying ovens. It would seem at first sight as if the same end could be obtained by discarding the wash mill altogether and mixing by hand with the subsequent kneading process, but after a lengthened trial the author has discarded it, as he could never succeed in getting a slip sufficiently intimately mixed to prevent an undue amount of dusting in the kiln. He has also tried dry pressing in a brick-making machine, and although it is an improvement on hand mixing, it is by no means so perfect or satisfactory a process as washing through the wash mill, grinding through the wet mill, &c., &c., whilst the cost of preparing the raw materials for the brick-making machine (dry pressing) is higher than that of turning over, kneading, and moulding into bricks the contents of the "backs" ton for ton. Attached to the brick-making machine is the usual arrangement for mixing but it does its work so very unsatisfactorily that premixing is absolutely necessary. Of course the cost of drying the slurry from the backs has to be taken into consideration, but this mixture can be made so uniform that practically no dusting occurs in the kilns; which is not the case with the machine-made dry bricks, although the analyses of both are identical. The fuel used in the kilns is hard furnace coke, made on the premises. Coal from the neighbouring collieries is very cheap; but owing to its very bituminous character, it is unfitted for use in a dome-shaped kiln, as at a very low temperature it forms a perfect cake of coke between each layer of slurry in the kiln, completely shutting off the passage of air. On the other hand, the use of hard furnace coke is by no means so easy a matter as one would have thought; a strong current of air being necessary for its combustion, the greatest care has to be exercised in charging only the exact quantity of coke, and in regulating the draught through the kiln. Any laxity in this, results in clinkering the lower layers of slurry into one mass at a very early stage, and thus impeding the draught before the middle and upper portion of the kiln can be acted upon. With care, and by paying close attention to the sight holes and air inlets fixed at regular intervals from the bars to the charging eye, the passage of air can be so regulated that the perfect and uniform clinkering of the whole contents of the kiln is assured. By this arrangement of air holes, the CO evolved during burning is made use of as a heating material in the upper portion of the kiln, and does not carry away such a considerable amount of warmth in a latent state as is complained of by Mr. Henry Reid in his work on Portland cement, &c., page 244:—Here, as in most other cement works, the heat escaping from the kiln is made use of in the drying ovens, and in the generation of steam.

By attention to the drying-ovens, the author experiences no difficulty in obtaining a sufficient quantity of thoroughly desiccated slurry bricks for the whole of the kilns at work This mode of drying is cheaper, handier, and much more satisfactory than the old drying-floor arrangement. The drying-ovens are simply flues carrying the heated gases from the kilns to the chimney; they are fitted with tramways running from the slurry backs to the charging doors of the kilns. The trollies are of iron, and fitted with a series of shelves placed one above the other, on which the wet slurry is stacked previous to being passed through the ovens (precisely the same method as is employed in drying "double" superphosphate), so that when the trollies are loaded it is unnecessary to touch the slurry until it arrives perfectly dry at the charging door of the kilns. By this method of working there is practically no moisture to be expelled in the kiln, five hours in the drying ovens being sufficient for complete desiccation. The kilns are charged with 9 per cent. of hard furnace coke, divided evenly throughout the entire mass of the kiln, and by attention to the air-holes referred to above this is found sufficient to produce a very dense and perfectly clinkered cement from the bars to the top. Before this system of drying was introduced from 18 per cent. to 20 per cent. of coke was necessary, and the product of the kiln was then by no means so satisfactory. Since the introduction of the drying ovens, and by careful and constant watching of the preliminary mixing, slip, and final mixing of the raw materials, it would be difficult to imagine anything working more uniformly and satisfactorily. At the foot of the kiln the clinker is sorted into two qualities by coolies.

The daily output is about 70 tons No. 1 quality and 30 tons No. 2 quality, the latter containing the ash from the coke and what trifling amount of dust the kiln may contain. The reason for thus separating the clinker into two qualities is that the requirements of the market here necessitate it. The engineers in charge of the construction of the Imperial Government railways insist upon having cement supplied to them, the whole of which less 5 per cent. will pass through a sieve containing 6,400 holes to the square inch, and a briquette of which will, after seven days in water stand a minimum tensile strain of 580 lb. per inch, while the engineers of other departments of the Imperial Service, demand a tensile strain of 400 lb. per inch after seven days in water. The former test will be considered a very severe one; but as the fracture never takes place but at a higher tensile strain than that provided for in the contracts, the author experiences no difficulty whatever in supplying Portland cement to stand that test. The grinding is of course very closely watched, and samples are drawn every hour, day and night, from the mill spouts, the whole of which are mixed together and taken to the testing office to be made into test briquettes. This is gauged with 23 per cent. H_2O; and although it is fresh from the mill, very rarely more than 0·05° F. rise of temperature takes place during gauging. After lying 10 days in warehouse no increase of temperature takes place. Both qualities of this cement are of great density, No. 1 averaging 166 lb. per bushel and No. 2 153 lb. per bushel. After gauging, the initial setting takes place in from 5 to 7 hours, after which it indurates very rapidly, either in or out of water; so much so, that after three days only in water it invariably stands a test of over 1,000 lb. (tensile) and 800 lb. respectively per briquette, the briquette being equal to an area of 2·25 in. After 28 days in water, in the majority of tests, the author fails to obtain a fracture, the testing machine (Bailey's patent testing cement machine) only working up to 2,000 lb. The fineness to which the cement is ground in a measure explains this, but it is mainly due in the first place to the care exercised in mixing the raw materials, and in the second place to the perfect clinkering process of the kilns, brought about by the use of hard coke and the careful regulation of the admission of air at the different points of combustion. The colour of this cement is a trifle lighter than that of the best qualities of English Portland. It grinds from the kiln of two uniform qualities, rarely showing a difference of 100 lb. per briquette. Neither quality will fracture at a compression of 3,500 lb. per briquette, nor at a tensile strain of 1,300 lb. for the No. 1 quality or 1,000 lb. for the No. 2 quality after seven days in water.

At foot are the average analyses of the various stones, clays, and cement:—

Black Clay.

Org. matter and H_2O	27·10
Fe_2O_3	1·63
Al_2O_3	34·01
SiO_2	36·60
$CaCO_3$	0·66
	100·00

Grey Marl.

Org. matter and H_2O	6·90
Fe_2O_3	1·21
Al_2O_3	29·23
SiO_2	59·82
$CaCO_3$	2·81
MgO	0·03
	100·00

Grey Potter's Clay.

Org. matter and H_2O	12·49
Al_2O_3	36·11
SiO_2	50·90
$CaCO_3$	0·29
MgO	0·21
	100·00

Pit Clay. Brinn.

Org. matter and H_2O	9·36
Al_2O_3	30·48
SiO_2	55·38
$CaCO_3$	1·41
Fe_2O_3	3·14
MgO	0·23
	100·00

Mixture of Clays.

Org. matter and H_2O	17·35
Al_2O_3	26·40
$CaCO_3$	1·18
Fe_2O_3	1·27
SiO_2	53·80
	100·00

Limestone.

$CaCO_3$	97·53
SiO_2	1·51
Fe_2O_3	0·71
MgO	0·19
H_2O	0·06
	100·00

Limestone.

$CaCO_3$	84·80
Al_2O_3	1·79
Fe_2O_3	0·81
MgO	0·11
SiO_2	10·92
H_2O	1·57
	100·00

Limestone.

$CaCO_3$	74·64
Fe_2O_3	2·82
Al_2O_3	5·22
MgO	0·21
SiO_2	16·05
H_2O	1·06
	100·00

Coke.

H_2O	0·66
C	90·68
S	0·12
Ash	8·54
	100·00

No. 1 Cement.

SiO_2	24·55
Al_2O_3	12·65
MgO	0·14
Fe_2O_3	0·87
CaO	61·66
CO_2	0·13
	100·00

No. 2 Cement.

SiO_2	26·12
Al_2O_3	12·94
MgO	0·15
Fe_2O_3	0·89
CO_2	0·10
CaO	59·80
	100·00

Journal and Patent* Literature.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Baskets for Containing Carboys and other such like Vessels. W. E. Cottell, Birmingham. Eng. Pat. 22,373, December 22, 1891.

The improvements consist in strengthening the basket by means of a rim of iron, which is solid, tubular, or ∩-shaped, and from which vertical wires are suspended, which wires are either bent under or round the bottom. These wires may be carried up and round so as to form a core for the osier handles. Osier uprights are filled in between the wires, and the whole is plaited with osiers in the usual way.—J. C. C.

Improvements in Apparatus for Drying and Heating Minerals and other Substances. A. Harris, Middlesbro'. Eng. Pat. 734, January 14, 1892.

The patentee employs a horizontal rotary cylinder heated from the outside and fitted with internal screw-threads, which, on rotation of the cylinder, propel the material to be dried from one end towards the other, where it escapes through holes provided in the circumference of the cylinder. —B.

Improvements in Apparatus for Use in Filtering and Purifying Oils, Glucose, or other like Matters. J. Peiat, Paris. Eng. Pat. 801, January 14, 1892.

The invention relates to apparatus for filtering and purifying, by means of heated air, substances such as lubricating oil which has become thick and heavy through previous use. Its construction is as follows:—

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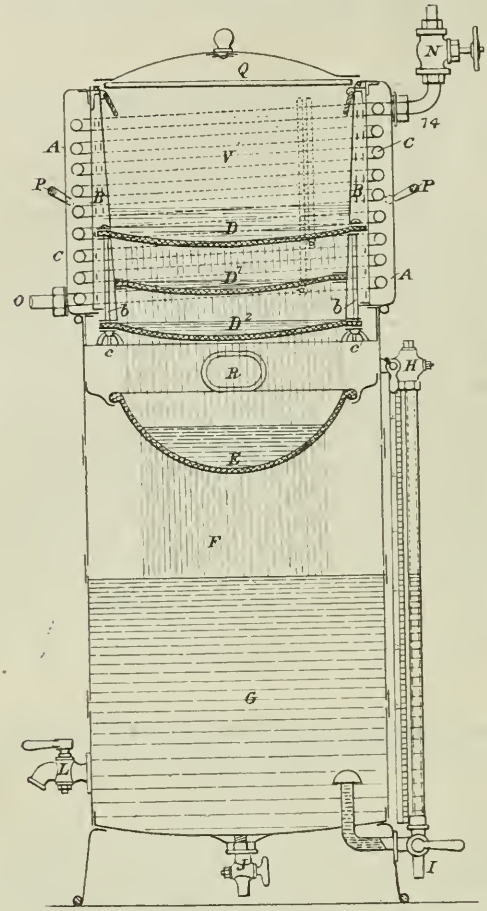
* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.



Improvements in Apparatus for Filtering and Purifying Oils.

The oil to be purified is fed in any convenient manner into the slightly conical vessel V, with cover Q, to the lower end of which are bolted short annular sections carrying the filtering sheets D, D^1, and D^2. The vessel is surrounded by a double casing consisting of an outer shell A and an inner perforated liner B, carrying a steam coil C between them. The vessel and its casings are mounted on the top of a receptacle F for the purified oil, which, preferably, is fitted with an additional filtering sheet E. The receptacle is provided with a gauge-glass for ascertaining the level of the purified oil G, and has a three-way cock I below, communicating with the lower part of the oil reservoir through a short raised tube surmounted by a strainer. Any water or sediment contained in the purified oil sink below the raised tube, and can be drawn off through the taps J and L, whilst the purified oil is drawn off through the tap 1.—B.

Improvements in Apparatus for Wholly or Partially Separating Liquids from Solids. S. K. Welsh, London, and J. H. Godman, St. Albans. Eng. Pat. 1591, January 27, 1892.

A hollow cylindrical drum is suspended on horizontal trunnions within a cistern partly filled with the liquid to be filtered. The circumference of the drum is perforated and its interior divided into compartments by radial partitions. The central part of one side of the drum is kept in close contact with the inside of the cistern, through which several ports are cut for the exit of the filtered water issuing from corresponding apertures in the side of the drum. Each of the holes in the side of the cistern is in connexion with a separate receptacle for the filtered liquid in which a vacuum may be maintained for accelerating the passage of the liquid, each succeeding receptacle being kept under a higher vacuum than the previous one. Over the perforated circumference of the drum is laid an endless moving band of cloth or other permeable material, covering the drum to a height above that of the unfiltered liquid in the cistern, and being thence taken over rollers which carry it past rotary brushes or other cleaning apparatus with a view to removing any deposit left on the cloth.—B.

Improvements in Apparatus for Heating Furnaces or other Appliances for Metals, Glass, or other Materials. J. A. Yeadon and W. Adgie, Leeds. Eng. Pat. 2460, February 9, 1892.

The revolving retort described in a previous specification (Eng. Pat. 19,183, this Journal 1890, 797) is charged with carbonaceous matter and heated, preferably with its own crude gases, and the gas produced in this way is applied either crude or purified, mixed with air, or with water-gas, or other gases for heating any kind of furnace for any of the purposes mentioned above.—J. H. C.

Concentration of Liquors and Utilization of Steam arising therefrom. W. J. Mirrlees and A. J. Liversedge, Glasgow. Eng. Pat. 3257, February 19, 1892.

In the concentration of liquors such as are treated in the manufacture of sugar, caustic soda, and other products, the inventors heat the liquor in one vessel by means of steam from a boiler, and use the vapour arising from the concentrated liquor for heating other liquors in separate vessels in which secondary or supplementary operations are to be effected.—B.

Improvements in and connected with the Method of and in Apparatus for Drying Peat, Manure, and Similar Matters. W. Bowler and J. Bradbury, Manchester. Eng. Pat. 6442, April 4, 1892.

The materials to be dried are spread on a series of horizontal surfaces or shelves arranged within a furnace through which hot air or other gases circulate. The materials are moved along the surfaces by endless chains in a direction opposite to that of the current of air, dropping at alternate ends to the next lower shelf, and are fed into and taken out of the furnace through the action of rotary valves.—B.

Improvements in the Process of Treating Cork and Apparatus therefor. H. J. Haddan, London. From J. T. Smith, New York, U.S.A. Eng. Pat. 18,199, October 11, 1892.

This invention relates to the treatment of cork for industrial or other uses. For this purpose moulds are employed which are made in sections, which, when in use, are held together by clamps. The cork is introduced into these moulds and there subjected to high pressure, and such a degree of heat as will cause the resinous matters contained in cork to melt or evaporate, thus cementing the separate pieces of cork together.—C. O. W.

Improvements in Apparatus for Controlling the Flow of Acid or other Liquid to and from Casks or other Receptacles. A. H. Wendt, Gelnhausen, Germany. Eng. Pat. 19,837, November 3, 1892.

A is the tank from which the acid is to be raised to a higher level through the ascending pipe B. The casing C contains a ball-valve E in connexion with a piston-valve F, which latter opens or shuts off the pipe G through which air under pressure can be let into the tank for raising the acid to the desired level. The pipe D leads to an acid reservoir which is placed at a somewhat higher level than the tank A. The rush of acid lifts the valve E from its seat until the tank is full, when it descends together with the piston F, thereby opening the passage for the air, whose pressure on the back of the piston helps to keep the valve closed. When all acid has been discharged from A, the air escapes through the pipe B, thereby releasing the pressure on the piston F and enabling the weight of the acid from the reservoir to open the ball-valve for a repetition of the process.—B.

Fig. 1.

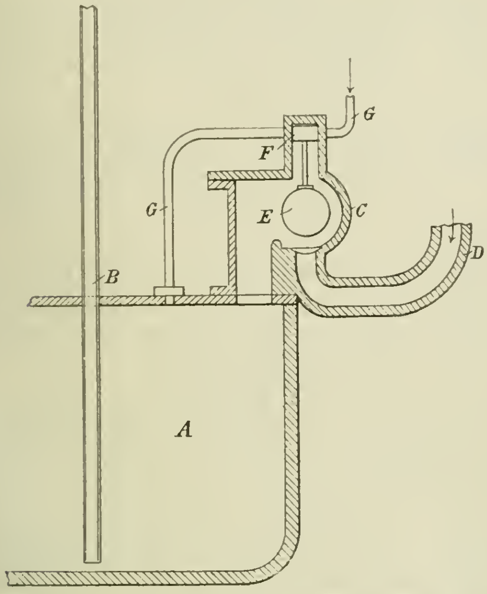
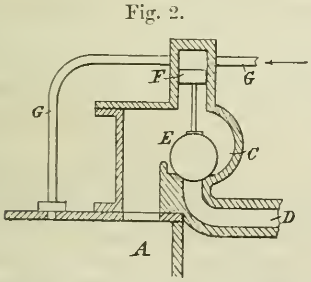


Fig. 2.



II.—FUEL, GAS, AND LIGHT.

The Estimation of the Thermal Effect of Fuels by the Calorimeter. W. Hempel. Zeits. f. ang. Chem. 1892, 389.

See under XXIII., *page* 179.

A Method of Estimating the Sulphur in Coal and Organic Substances. W. Hempel. Zeits. f. ang. Chem. 1892, 393.

See under XXIII., *page* 181.

PATENTS.

Improvements in Washing and Preparing and Coking of Smudge, Slack, or other Coal, and in the Application of the Gases resulting therefrom, and in Apparatus therefor. D. Rylands and H. Naylor, Barnsley, Yorks. Eng. Pat. 471, January 9, 1892.

Smudge, slack, or coal is delivered on to an inclined trough, the inclination of which can be adjusted, and is carried forward by a stream of water. Movable partitions are placed along the trough at intervals. The heavier impurities are arrested by the partitions, and the coal passes onwards through similar troughs and is deposited in perforated hoppers furnished with perforated pockets to assist drainage. When the cavities formed by the partitions are full the supply of coal is discontinued and the partitions are removed one by one, beginning with the highest. The stream of water then carries the stony matter forward and it eventually drops through a valve opened in the end of the trough. The coal-washing operations are then recommenced. The washed coal in the hoppers is either discharged into trucks or on to a conveyor. The first portion of the latter has perforated sides and a bottom sloping from the centre outwards; the second portion is not perforated, but is steam-jacketed to complete the drying of the coal. The conveyor is also provided with drive-chains to which scraper-plates are attached for the turning over of the coal. The coal after washing can be used for coking. In the latter operation the hot gases from the ovens are used to heat steel crucibles placed in the flue, air being admitted if necessary. The gases are then used for heating purposes. —H. K. T.

Improvements in Coke-Ovens. J. Mitchell, Barnsley Yorks. Eng. Pat. 1647, January 27, 1892.

In the side of an ordinary coking-oven three or more flues or passages are made for the purpose of admitting air for the combustion of the gaseous products given off. The passages are placed above the clearing-hole and gradually decrease in depth and increase in width from the outside inwards, so that the air, which is admitted just above the top of the coal, is spread out in a thin sheet. The centre passage is horizontal, the lateral ones incline upwards. The bricks by which they are formed are preferably made in two pieces and are shaped to suit the curvature of the oven.—H. K. T.

Improvements in the Manufacture or Production of Water Gas and Apparatus therefor. S. Fox, Leeds. Eng. Pat. 1804, January 29, 1892.

In order to shorten the time occupied in heating a water-gas generator, the patentee employs a hot instead of a cold air-blast; the air necessary for this purpose is raised to a high temperature in a regenerator which has been heated by hot gases from the water-gas generator. A single regenerator divided into two chambers or two separate regenerators are employed so that the apparatus may be worked continuously.—F. S. K.

Improvements in and Connected with the Manufacture of Illuminating Gas. W. H. Wilson, Liverpool. Eng. Pat. 2073, Feb. 3, 1892.

With the object of increasing the quantity of gas made from any kind of coal or other material, and at the same time of obtaining a higher illuminating power, the mouthpieces and ascension pipes of the ordinary gas retorts are heated in such a way that no pitch is deposited in them: the heating may be conveniently accomplished by surrounding the parts mentioned with brickwork or metallic sheeting provided with flues, through which the waste gases from the retort bench are passed.—F. S. K.

Improvements in Apparatus for Automatically Generating and Burning Inflammable Vapours. C. A. Paquelin, Paris, France. Eng. Pat. 4050, March 1, 1892.

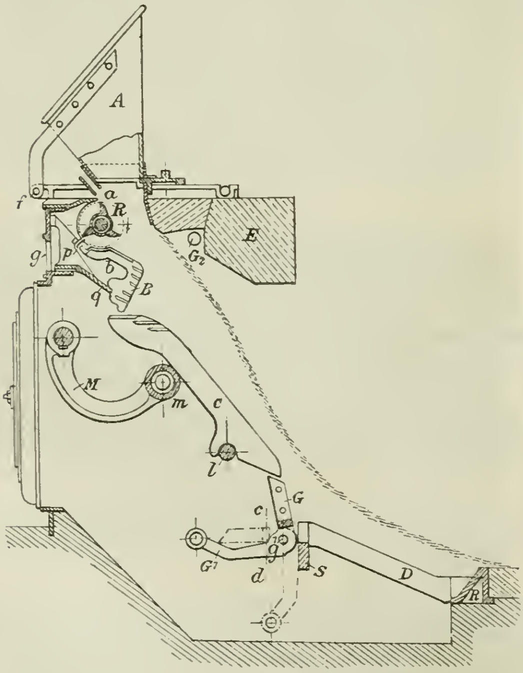
The apparatus to which this patent refers was described some years ago (Eng. Pat. 6859 of 1886); the improvements consist in a reduction of the size of the apparatus, and in the employment of a relatively large independent reservoir, which renders it possible to use the apparatus continuously for several hours.—F. S. K.

Improvements in the Manufacture of Fuel, together with the Means and Combinations in Connection therewith. T. J. Barnard, Tavistock, Devon. Eng. Pat. 8949, May 11, 1892.

This is a compound fuel for making briquettes, and consists essentially of a mixture of small coal, coke, charcoal, or peat with fæcal matter and coal-tar or pitch, to which may be added for special purposes clay, limestone, cinders, putrid fish, sulphur, sulphur-mundic, sulphuric acid, nitre, resin, petroleum, or treacle. The briquettes are heated in a closed retort, the volatile products being condensed. These form a valuable liquid fuel.—H. K. T.

Improvements in Furnaces. E. G. Brewer, London. From La Societé E. Herrmann and Cohen, Paris, France. Eng. Pat. 12,930, July 14, 1892.

The grate of this furnace consists of four parts—B, C, G, and D. The fuel is forced into the furnace from the hopper A by means of the rotary feeder R, and is first supported by the grate B and the upper part of C. It here undergoes partial combustion by means of the air supplied through the lateral orifice G'' and the orifices at g. The latter air supply is separated by means of the plate g from that entering lower down through the butterfly valves of the furnace door.



Improvements in Furnaces.

Whilst resting on the bars B the fuel is subjected to the radiant heat from the arch E. It becomes coked, and gives off inflammable gases, which are burnt in the furnace by air arriving through the bars C. When the fuel arrives at the bars C it is in the form of coke, whilst G and D receive only clinker. In order to remove the latter, the grate G is turned on its pivot g' by means of the lever G' and then forms a platform which facilitates the removal of the clinker. The combustion is regulated by adjusting the air supply arriving through g and through the valves of the furnace door.—H. K. T.

Process of and Apparatus for Preparing Tar, Oil, Paraffin, Pitch, Heating and Illuminating Gases, and Large Coke from Fibrous Organic Materials such as Peat and Lignite. P. Jensen, London. From M. Ziegler, Nachterstedt, Germany. Eng. Pat. 17,484, September 30, 1892.

The most important points which need mention are those referring to the structure of the coke-oven and to the method of coking.

The coke-oven consists of a large, vertical, cylindrical space, closed at the top by means of a plug-valve, and surrounded by heating flues; this space is divided by a horizontal partition into an upper drying chamber, the walls of which are made of cast iron, and a lower coke chamber, the walls of which are of brickwork; both chambers contain an inner cylindrical column, consisting of flat, round plates, which occupy the centre of the cylindrical space from top to bottom.

Prepared blocks of turf, about 6 in. in length, and previously dried in the condensers mentioned below, are introduced into the upper chamber, and, owing to the conical top of the central column, are brought into close proximity with the heated iron walls; the water vapour evolved is drawn off by means of a suction-pump. The turf is then allowed to drop into the lower chamber, where it is converted into coke, the gases being drawn off by means of exhausters; the finished coke passes into a conical chamber, provided at its bottom or apex with a large plug-valve, and finally falls into a tank, cooled by a water-jacket, where it is quenched with steam.

The gases evolved during the coking process are passed through condensers to free them from water and tar, and are then employed for heating the coke-oven.

The working of the oven is continuous and the coke is obtained in large, firm blocks; the tar is worked up in the usual manner.—F. S. K.

Improvements in and Connected with the Manufacture of Illuminating Gas from Water and Fluid Hydrocarbons. T. G. Springer, London. Eng. Pat. 17,978, October 8, 1892.

Various improvements are described in this patent, the principal object being to secure economical working.

In the first place the products of combustion formed during the heating of the fuel are burnt in the usual manner in a chamber containing refractory material; the gases from this chamber, instead of being allowed to escape, are passed through the furnace of the steam-boiler which is employed in the production of the water-gas, so that a saving of fuel is effected.

In the second place the small quantity of illuminating gas which is left in the cupola at the time of the reversal of the apparatus is also utilised for the production of steam.

Thirdly, the manufactured gas from the fixing chamber is passed through a vessel containing the pipes through which the oil is flowing under pressure to the chamber where it meets the water-gas; the oil, thus heated, is immediately vaporised on issuing from the pipes and is readily taken up by the water-gas.

Improved, moveable, hollow furnace bars, through which water circulates, are employed to obviate the frequent opening of the ash-pit door of the furnace.—F. S. K.

A New or Improved Apparatus for Carburetting Gas and Air for Illuminating and Heating Purposes. A. W. Wells, Harlesden, Middlesex. From F. Verrue, Brussels. Eng. Pat. 19,483, October 29, 1892.

The usual method is employed for carburetting the gas or air, namely, that of passing the gas through a vessel supplied with oil; the essential features of the patent are novel devices for ensuring the saturation of the gas and for preventing the freezing of the carburettor.

The carburettor consists of three concentric chambers, which are filled with perforated cylinders resting upon cloth. The cylinders in the outer chamber, into which the gas first enters, are filled with porous wood-fibre which is saturated with oil by capillary absorption; the cylinders in the middle chamber contain asbestos, and serve to partly free the gas from excess of oil; the innermost chamber contains cylinders filled with a bad conductor of heat, such as charcoal, and serves as a condensing chamber in which the excess of oil is completely removed. Above and below the central and middle chambers are spaces containing a bad conductor of heat to protect the chambers from changes of temperature; this object is also secured by completely surrounding the carburettor with a water-jacket.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

On Pyridine Bases in Mineral Oils. R. Zaloziecki. Monatsh. Chem. **13**, 498—503.

Mineral oils contain as a rule but slight quantities of nitrogen, varying between 0·01 and 0·1 per cent., and reaching only occasionally as much as 1·1 per cent. When dealing with such small quantities, it is a difficult task to ascertain the combinations in which the nitrogen is present. So far ammonia, ammonium carbonate, and benzo-isonitrile have been discovered either in the crude oils or in their products of distillation, and lately alkaloid bases have been observed by Bandrowski in the crude oils of Slobodarungurska.

The author made further investigations on this subject. The waste acid from Boryslaw oil, as obtained at the Drohobycz works, has been diluted to 106° Tw., to separate tarry matters, the clear liquor drawn off, made alkaline with lime, whereby the original aromatic odour changes into the characteristic pyridine-like odour. On treating the mass with a current of steam, oily drops are obtained. These are separated from the water, treated with hydrochloric acid, and then with alkali, and redistilled. The oily mass possesses the smell of pyridine. It is slightly soluble in water, easily in ether, alcohol, and acids. The analysis of the platinum double salt shows the presence of several bases free from oxygen—very likely hydrated pyridine derivates—seeing that part of the platinum double salt is decomposed by hot water, according to Anderson's reaction.

This is of great interest for the genetic theories of the mineral oils, as pyridine compounds, normal or hydrated, are products of fermentation and decomposition of the animal body.—H. A.

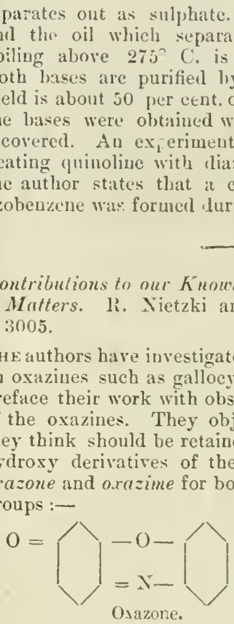
IV.—COLOURING MATTERS AND DYES.

A New Synthesis by means of Diazo Compounds. II. R. Hirsch. Ber. **25**, 1973—1975.

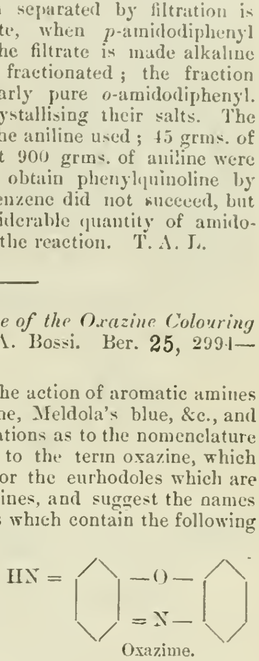
In a previous paper (Ber. **23**, 3705; this Journal, 1892, 354) the author has described the reaction which takes place when diazo compounds are heated with phenols, yielding in the case of diazobenzene and phenol, *o*- and *p*-hydroxy-diphenyl, diazohydroxybenzene being formed as an intermediate product. He has now extended the reaction to analogous nitrogen compounds, and states that diazoamidobenzene when heated with aniline yields amidodiphenyl and diphenylamine. The formation and decomposition of the diazoamidobenzene are carried out in one operation. The diazo solution from 50 grms. of aniline, 150 grms. of 30 per cent. hydrochloric acid, 400 grms. of water and ice, and 39 grms. of sodium nitrite in 100 cc. of water, is mixed with 950 grms. of aniline, made alkaline with caustic soda, and the oil, after separating, dried with calcium chloride. It is then warmed in a flask to about 150° C., and the temperature gradually raised to 190°, when the greater part of the aniline distils off. When the thermometer has risen to 200° the residual bases are boiled with 10 times the weight of water and hydrochloric acid added until neutral. The liquid becomes a deep red, due to the formation of amidoazobenzene hydrochloride. Caustic soda is then slowly added when the greater part of the amidoazobenzene separates and dissolves with other impurities in the layer of diphenylamine floating on the surface. The aqueous portion separated by filtration is treated with sodium sulphate, when *p*-amidodiphenyl separates out as sulphate. The filtrate is made alkaline and the oil which separates fractionated; the fraction boiling above 275° C. is nearly pure *o*-amidodiphenyl. Both bases are purified by crystallising their salts. The yield is about 50 per cent. of the aniline used; 45 grms. of the bases were obtained whilst 900 grms. of aniline were recovered. An experiment to obtain phenylquinoline by heating quinoline with diazobenzene did not succeed, but the author states that a considerable quantity of amidoazobenzene was formed during the reaction. T. A. L.

Contributions to our Knowledge of the Oxazine Colouring Matters. R. Nietzki and A. Bossi. Ber. **25**, 2994—3005.

The authors have investigated the action of aromatic amines on oxazines such as gallocyanine, Meldola's blue, &c., and preface their work with observations as to the nomenclature of the oxazines. They object to the term oxazine, which they think should be retained for the eurhodoles which are hydroxy derivatives of the azines, and suggest the names *oxazone* and *oxazime* for bodies which contain the following groups:—



Oxazone.



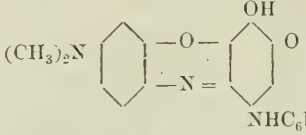
Oxazime.

The corresponding compounds of the methylene-blue series would be known as *thiazones* and *thiazimes*.

1. *Action of Aniline on Gallocyanine.*—Nietzki and Otto (Ber. **21**, 1745; this Journal, 1888, 559) described a body formed by this reaction assuming that two molecules of aniline reacted with one molecule of gallocyanine with elimination of one molecule of water. Later investigations have shown that the following reaction takes place:—

$$C_{15}H_{12}N_2O_5 + C_6H_5NH_2 = CO_2 + H_2 + C_{20}H_{17}N_3O_3.$$

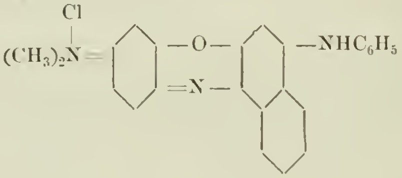
If the operation be conducted in a closed vessel, absorption of oxygen takes place, but this absorption does not appear to affect the yield, which remains the same whether the experiment be conducted in a current of air or of carbon dioxide, and is about 50—60 per cent. calculated on the gallocyanine. This absorption of oxygen does not take place in the case of the formation of the colouring matter known as "Prune" obtained by the action of aniline on gallocyanine methyl ether, the formula for which is $C_{22}H_{21}N_3O_5$, as already determined by Nietzki and Otto, from which it would appear to be an addition product of aniline and gallocyanine methyl ether. In the case of gallocyanine anilide a similar addition product appears to be formed when the components are ground together in the cold. The mass becomes crystalline and no carbon dioxide is given off. That this is not a simple aniline salt of gallocyanine is shown by the fact that the substance may be treated with dilute hydrochloric acid without regenerating gallocyanine. On attempting to purify the body by recrystallisation it forms gallocyanine anilide on even gentle warming and it would appear that the carboxyl group is replaced by the aniline rest with evolution of carbon dioxide, a reaction which cannot take place in the case of the methyl ether. It would thus appear that the formula of the body is—



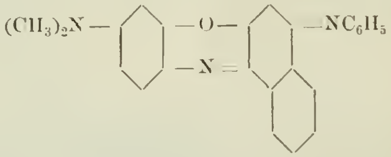
2. *Action of Aniline on Meldola's Naphthol-blue.*—The condensation takes place very easily. It is only necessary to heat a salt of Naphthol blue with an excess of aniline on the water-bath and precipitate the salt of the new colour base by the addition of alcohol. In order to obtain it free from zinc, a solution of the commercial zinc double salt of naphthol blue was precipitated by dilute nitric acid, and the nitrate thus obtained heated with aniline. The nitrate of the new colour base was converted into the base and this into the hydrochloride. This salt is sparingly soluble in water and cold alcohol, and crystallises from the latter in long, shiny, green needles. The base is precipitated from an alcoholic solution of the hydrochloride by ammonia and forms fine brownish needles of the formula, $C_{24}H_{19}ON_3$, insoluble in water and alcohol. The salts dye animal fibres and vegetable fibres mordanted with tannin a greenish-blue, which is turned red by weak alkalis. The formation of the body from the chloride of naphthol blue is expressed by the equation—

$$C_{18}H_{15}N_2OCl + C_6H_5NH_2 = C_{24}H_{20}N_3OCl + H_2$$

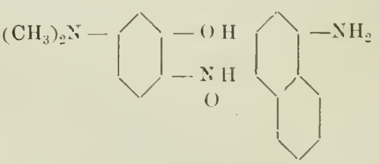
and its constitution as follows:—



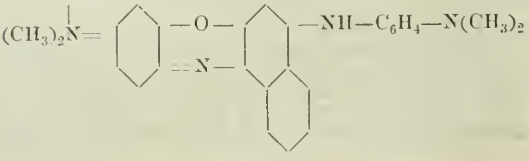
whereas the formula of the base, which does not contain water and has only weak basic properties, would be—



If this view be correct, the body belongs to the Nile-blue series and is a phenyl derivative thereof. Nile-blue is prepared by the action of nitrosodimethyl-*m*-amidophenol on α-naphthylamine—

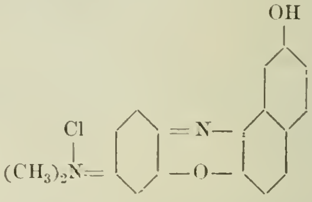


and by substituting phenyl-α-naphthylamine for the α-naphthylamine in the above reaction a base is obtained identical in every respect with that formed by the action of aniline on Meldola's blue. Both bases melt at 275°, and both give the same absorption spectra. Another body belonging to the same class is Witt's cyanamine, produced by the action of alcoholic potash on Meldola's blue, the same substance being obtained by the action of dimethyl-*p*-phenylene diamine on Meldola's blue, and having the formula—



Attempts to prepare Nile-blue by treating Meldola's blue with ammonia only yielded cyanamine, and in general those amines which reacted most easily were aniline and its homologues, whilst of the fatty amines only secondary ones, such as dimethylamine, appeared to react.

The paper concludes with a description of the colouring matter *Muscarine,* a condensation product of nitrosodimethylaniline and 2·7 dihydroxynaphthalene, and hence a hydroxyl derivative of Meldola's blue, which it resembles in several particulars. Its formula is—

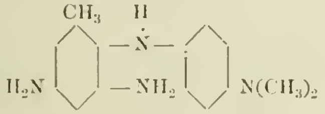


and it reacts with aniline in a similar manner, giving the body $C_{24}H_{20}N_3O_2Cl$. It would thus appear that by the action of aniline on oxazines the nitrogen of the aniline forms the linking atom, and the replacement most generally takes place in the position para to the imido group of the oxazine ring. In the case of gallocyanine, the para position being occupied, the aniline rest enters ortho to the imido group, but a replacement like this only takes place when an easily removeable group occupies this position, for in the case of resorufine and resorufamine, which contain a substituted para but a free ortho position, no condensation with aniline or analogous bases takes place.—T. A. L.

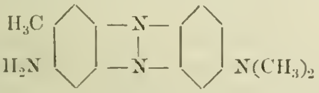
On Dinitro-chlorotoluene and its use in the Synthesis of Azine Colouring Matters. R. Nietzki and E. Rehe. Ber. **25**, 3005—3009.

By the action of nitrosulphuric acid on *o*-chlorotoluene (prepared by Sandmeyer's reaction from *o*-toluidine) a dinitro-chlorotoluene is obtained. A mixture of three parts by weight of nitric acid of sp. gr. 1·48 and 9 parts by weight of concentrated sulphuric acid is cooled and 1 part by weight of chlorotoluene is added, the temperature finally being kept for some hours at 80° C. The product when poured on to ice yields an oil which crystallises on standing, and the crystals, purified by recrystallisation from alcohol, form needles easily soluble in alcohol and ether, melting at 45° C. The constitution of this body was determined in two ways: 1. By heating the substance with alcoholic ammonia a dinitro-toluidine was obtained melting at 208° C. identical with that obtained by the action of ammonia on dinitro-*o*-cresol ethyl ether (Städel, Annalen, **217**, 183). 2. By boiling the body with alcoholic potash it is converted into dinitro-*o*-cresol melting at 85° C. (Nölting and Salis, Ber. **14**, 987). These substances having a known constitution, it follows that the groups have the following positions in dinitro-chlorotoluene: $C_6H_2CH_3Cl(NO_2).CH_3:Cl:NO_2:NO_2 = 1:2:3:5$. On reduction it is converted into chlorotoluylene diamine, which crystallises from water in long needles melting at 73°. The salts crystallise well, but are easily soluble in water. A diacetyl derivative is obtained on heating with acetic anhydride. The dinitro-chlorotoluene, like the corresponding benzene derivative, reacts easily with amines which replace the chlorine atom. By the action of aniline, dinitro-tolylphenylamine is obtained in red plates melting at 169°. In the case of *p*-phenylene diamine two reactions can take place, one molecule of the diamine interacting with one or two molecules of dinitro-chlorotoluene. In the first case, dinitro-tolylamidophenylamine is formed, giving almost black needles sparingly soluble in alcohol and melting at 170°. It forms a yellow sulphate easily soluble in hot dilute sulphuric acid, and an acetyl derivative melting at 210°. With two molecules of dinitro-chlorotoluene, tetranitro-ditolyl-*p*-phenylene diamine is obtained. This crystallises from nitrobenzene in small brownish-red needles melting above 330°, and can be separated from the other product owing to its insolubility in hot dilute acids. The following compounds have also been prepared: *dinitro-tolyl-β-naphthylamine,* red prisms melting at 142°; *dinitro-ditolylamine* from *o*-toluidine, brown needles melting at

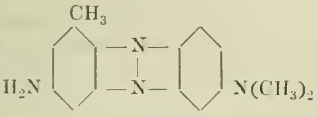
135° ; *dinitro-amido-ditolylamine* from *m*-toluylene diamine, bronzy plates melting at 148°. By the action of dinitrochlorotoluene on dimethyl-*p*-phenylene diamine a compound is formed which on reduction is isomeric with the leuco base of Witt's toluylene-blue. The nitro compound formed by this reaction gives brownish-black needles easily soluble in dilute mineral acids. On reduction with stannous chloride and hydrochloric acid a tin double salt of the new base sparingly soluble in concentrated hydrochloric acid can be obtained. The hydrochloride oxidises very easily, and could not be prepared in a pure state. It turns blue in the air, giving a shade similar to toluylene-blue. The base has the following constitution:—



The corresponding azine was obtained by dissolving 30 grms. of the above tin double salt in 1 litre of water, and, after neutralisation with calcium carbonate, adding 30 grms. of Weldon mud containing 60 per cent. of MnO_2. The mixture is then heated on the water-bath until the blue colour has disappeared and given place to a reddish-brown. After filtering, the azine is obtained by extracting the residue with alcohol and purified by precipitation with water and ammonia, and repeated crystallisation from dilute alcohol, when it separates out in coppery needles. The base is anhydrous at 100°, thus differing from Witt's toluylene-red, which only loses its water of crystallisation at 160°. It dissolves in water with a yellowish-brown colour, and in ether with a greenish-yellow fluorescence. The salts resemble those of toluylene-red, but are somewhat yellower, a difference most marked in comparative dyeings on silk. Concentrated sulphuric acid gives a green solution, which on dilution with water changes through blue to red. In conclusion the formulæ of toluylene-red and of the new azine are compared—



Toluylene-red.



Isomeric body.

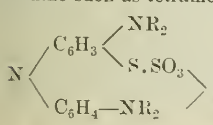
—T. A. L.

On m-Amidodialkyl-o-toluidine—
(1.2.5) $C_6H_3.CH_3.NR_2.NH_2$
and its Convertibility into Methylene-Blue Colouring Matters. A. Bernthsen. Ber. **25**, 3128—3139.

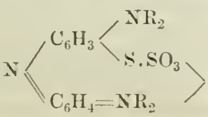
The paper commences with a short summary of the methods for producing colouring matters of the thionine group, as, for instance, methylene-blue, whilst the newer or so-called "thiosulphonic acid" method by the oxidation of equimolecular parts of a monamine, a *p*-diamine, and a hyposulphite is described in detail. According to some of the author's previous work (Annalen, **251**, 1; this Journal, 1889, 452) the first stage of the reaction is the oxidation of the *p*-diamine and one molecule of the hyposulphite to form, for instance, amido-dimethylaniline thiosulphonic acid—

$$(\overset{3}{S}O_3H.S)C_6H_3.\overset{4}{N}H_2[N(\overset{1}{C}H_3)_2]$$

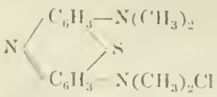
Further oxidation in presence of a monamine yields a green indamine such as tetramethylindamine thiosulphonic acid—



or



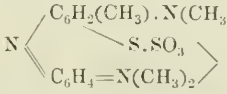
which then, on still further oxidation, is converted into methylene-blue—



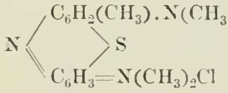
In order, therefore, that diamines may be capable of producing colouring matters of this series they must fulfil certain conditions. Of *p*-diamines only those are of use which contain a non-alkylated amido group and have the general formulæ $NH_2.X.NH_2$; $NHR.X.NH_2$ and $NR_2.X.NH_2$. Thus tetramethyl-*p*-phenylenediamine will not give a thionine colouring matter. As regards the monamine its amido group may be free, partially or fully alkylated, the only condition necessary being that the position para to the amido group shall be unoccupied. According to Weinberg, however (Ber. **25**, 1610), the *p*-amido-diethyl-*o*-toluidine does not, on oxidation with chromate in presence of thiosulphate, yield a thiosulphonic acid. Bernthsen finds that *m*-amido-dimethyl-*o*-toluidine [$CH_3:N(CH_3)_2:NH_2 = 1:2:5$], or the corresponding diethyl derivative, does yield a thiosulphonic acid when oxidised in presence of thiosulphate, and this, on further oxidation together with dimethylaniline, gives a colouring matter very similar to methylene-blue, which he terms homomethylene-blue. He starts with nitro-*o*-toluidine of melting-point 129°·5 [$CH_3:NH_2:NO_2 = 1:2:5$], converts this into the dimethyl derivative and reduces it. The oxidation of this amido-dimethyl-*o*-toluidine with chromate in presence of thiosulphate yields a well characterised thiosulphonic acid—

$$C_6H_2(\overset{1}{C}H_3)(N[\overset{2}{C}H_3]_2)(\overset{5}{N}H_2)(S.\overset{4\text{ or }6}{S}O_3H)$$

This on oxidation together with dimethylaniline gives an insoluble green indamine thiosulphonate—



from which the homomethylene-blue is obtained.



The amido-diethyl-*o*-toluidine behaves similarly, and *o*-amido-dimethyl-*m*-toluidine [$CH_3:N(CH_3)_2:NH_2 = 1:3:6$], which has also been investigated, gives colouring matters of the thionine class. The *m*-nitro-*o*-toluidine, melting at 129°·5, was obtained by nitrating *o*-acetoluide. This on heating with methyl iodide, methyl alcohol, and caustic soda in an autoclave gave a mixture of mono- and dimethyl-nitrotoluidines, which were separated by two methods. 1. The mixture was heated with three times its weight of acetic anhydride, poured into water, and distilled with steam, when the dimethyl-nitro-toluidine volatilises. The acetyl derivative which remains behind crystallises in light yellowish rhombohedra from dilute alcohol, melting at 97°. 2. The mixture was treated with an excess of dilute sulphuric acid of sp. gr. 1·15 in the cold, when the monomethyl derivative remains for the greater part undissolved. The sulphuric acid solution is diluted and made alkaline, and the base which separates is dissolved in hydrochloric acid, and this solution treated with sodium nitrite to convert any monomethyl derivative present into the nitrosamine, which is removed by shaking with ether or chloroform. This substance separates as an almost colourless oil, which crystallises on standing and melts at 65°. On heating with alcoholic hydrochloric acid it yields *m*-nitro-monomethyl-*o*-toluidine, which is sparingly soluble in alcohol and forms yellow plates melting at 137°. After separating the nitrosamine from the solution as above, the *m*-nitro-dimethyl-*o*-toluidine is obtained by neutralising the solution with an alkali. This substance crystallises in small plates or needles melting at 47°·5, and is very easily soluble in alcohol and ether. On reduction with hydrochloric acid and zinc-dust in the cold it yields *m*-amido-dimethyl-*o*-toluidine, which boils at 253°—254° and melts at 47°. The alcoholic solution when treated with the calculated amount of sulphuric acid gives a white precipitate of the sulphate $(C_9H_{14}N_2)_2H_2SO_4$, which is very easily soluble in water. A dilute solution of this salt shows the following reactions:—Ferric chloride gives a bluish-red colour, which turns violet on the addition of hydrochloric acid, and on warming the solution smells of quinone. Bichromate gives a purple-red and iodine a red coloration. An alkaline solution of α-naphthol and potassium ferricyanide gives the deep blue indophenol reaction. Bichromate in presence of dimethylaniline hydrochloride gives a deep green indamine, which, however, is only stable in a neutral solution or in one slightly acid with acetic acid, and is changed to a dirty brown by adding acetic acid. A solution of the perfectly pure base in hydrochloric acid gives no thionine colouring matter with hydric sulphide and ferric chloride. The conversion of the dimethyl-*p*-toluylene diamine into the thiosulphonic acid is nearly quantitative in presence of acetic acid (Ann. **251**, 50). The acid can be purified by crystallisation from water, forming small prisms which melt at about 240°. On warming with caustic soda a yellow precipitate of the bisulphide of amido-dimethyl-*o*-toluidine is obtained, and reduction with zinc-dust and hydrochloric acid gives the corresponding mercaptane—

$$C_6H_2.CH_3.N(CH_3)_2.NH_2.SH$$

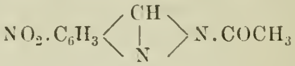
which can be separated as a zinc salt, and, like the bisulphide, gives an easily soluble indamine sulphide with dimethylaniline. This on boiling yields the corresponding thionine colouring matter. The formation of the indamine thiosulphonate by oxidation of the dimethyl-*p*-toluylene diamine thiosulphonic acid with bichromate in presence of dimethylaniline is best carried out by converting the 1.2.5 amidodimethyl-*o*-toluidine into its thiosulphonic acid, and, without separating the latter, adding dimethylaniline hydrochloride and bichromate corresponding to two atoms of oxygen. After a short time the solution forms a thick paste of green-bronzy needles of the tetramethyl-homoindamine thiosulphonate having the formula, $C_{17}H_{21}N_3S_2O_3$. On treating this according to Ger. Pat. 46,805 (boiling with zinc chloride solution) it is converted into homomethylene-blue. Corresponding ethyl derivatives of *m*-nitro-*o*-toluidine are also described. Nitro-ethyl-*o*-toluidine crystallises from alcohol in dark yellow plates of melting-point 98°. Its acetyl derivative crystallises from dilute alcohol in plates or prisms melting at 97°. The *m*-nitro-diethyl-*o*-toluidine is a transparent yellow oil very slightly soluble is water. On reduction it forms *o*-diethyl-*p*-toluylene diamine—

$$(1.2.5)C_6H_3CH_3.N(C_2H_5)_2.NH_2$$

boiling at 266°—267°. A dilute aqueous solution of the sulphate gave a purple-red coloration with ferric chloride on standing and a red coloration in the same way with bichromate. An alkaline solution of α-naphthol and a drop of potassium ferricyanide solution gave a violet-red coloration or precipitate. Bichromate and dimethylaniline hydrochloride gave a dirty reddish-brown coloration, but no green indamine was observed. The conversion into the thiosulphonic acid and the blue thionine colouring matter take place as in the case of the methyl derivative, although the reactions do not proceed so satisfactorily. The author considers his experiments show that there is no essential difference between the behaviour of amidodimethylaniline and its homologues of the tolyl series as regards the formation of thionine colouring matters, and does not accept Weinberg's hypothesis of the quaternary character of the dialkylated *p*-toluylene diamines and the pseudotertiary character of *m*-amido-monoalkyl-*o*-toluidine.—T. A. L.

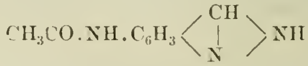
On Derivatives of Indazole. II. O. N. Witt, E. Nölting, and E. Grandmougin. Ber. **25**, 3149—3156.

The authors have previously described (Ber. **23**, 3635) a reaction in which they obtain indazole derivatives by a decomposition of *m*-nitro-*o*-diazotoluene chloride. Some further derivatives of the series are described in the present paper. *Acetylnitroindazole*—



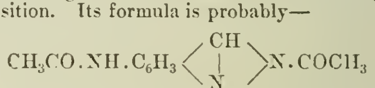
$$\mathrm{NO_2.C_6H_3}\left\langle\begin{matrix}\mathrm{CH}\\|\\\mathrm{N}\end{matrix}\right\rangle\mathrm{N.COCH_3}$$

crystallises from dilute alcohol in long, flat needles, melting at 140°. Attempts to reduce it in order to obtain an indazole derivative acetylated in the indazole ring proved fruitless, as the substance underwent simultaneous saponification, yielding amido-indazole melting at 210°. On heating this with glacial acetic acid it yields acetylamidoindazole—



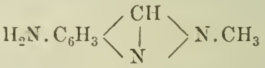
$$\mathrm{CH_3CO.NH.C_6H_3}\left\langle\begin{matrix}\mathrm{CH}\\|\\\mathrm{N}\end{matrix}\right\rangle\mathrm{NH}$$

which is less soluble in water than the base, but dissolves easily in alcohol and crystallises from dilute alcohol in long, white needles melting at 248°. It is easily saponified by heating with concentrated hydrochloric acid or with caustic soda, and then shows all the characteristics of a primary amine. If the acetylation be carried further by continued heating with acetic anhydride a diacetyl compound is formed, melting at 184°—185°, and distilling without decomposition. Its formula is probably—



$$\mathrm{CH_3CO.NH.C_6H_3}\left\langle\begin{matrix}\mathrm{CH}\\|\\\mathrm{N}\end{matrix}\right\rangle\mathrm{N.COCH_3}$$

for although it possesses faintly basic properties it is improbable that both acetyl groups enter the amido group. The amidoindazole on diazotisation and boiling with water gives the corresponding hydroxy-indazole, melting at 215°—216°. This dissolves in dilute acids or alkalis, and the latter solution gives an orange-red coloration with diazotised sulphanilic acid. The authors also mention that nitroindazole on boiling with alcoholic potash yields an azoxy derivative, and that methylnitroindazole, which has already been described, gives the corresponding amine—



$$\mathrm{H_2N.C_6H_3}\left\langle\begin{matrix}\mathrm{CH}\\|\\\mathrm{N}\end{matrix}\right\rangle\mathrm{N.CH_3}$$

on reduction with stannous chloride and hydrochloric acid, but they do not propose to continue the investigation of these compounds. As regards the formation of indazoles from diazo-compounds, the only case apears to be that of the nitrotoluidine melting at 107°. The following amines have been investigated, but only appear to yield the corresponding hydroxy derivative when their diazo-compounds are boiled with water; *o*-toluidine, nitro-*m*-xylidine—

$$[1.3.4.6]C_6H_2(CH_3)_2.NO_2.NH_2$$

melting at 123°, *p*-nitro-*o*-toluidine—

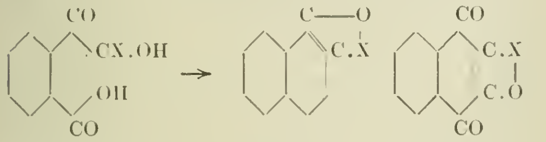
$$1.2.5\ C_6H_3CH_3.NH_2.NO_2$$

melting at 128°. Another method of preparing indazoles has been described by Heusler (Ber. **24**, 4156) by the action of acetic anhydride on diazo-amido compounds yielding an indazole and the acetyl derivative of the original amine. This reaction had been studied before the appearance of Heusler's paper, and the authors suggest boiling the diazo-amido compound of nitrotoluidine with glacial acetic acid as the most convenient way of obtaining nitroindazole, and give the following method for preparing it. A solution of 31 grms. of *m*-nitro-*o*-toluidine melting at 107° in 400 cc. of glacial acetic acid is cooled by adding ice, and a solution of 7 grms. of sodium nitrite is run in. The diazo-amido compound soon begins to separate and is completely precipitated by the addition of water. After filtering off and washing with water it is dried below 100°. It is insoluble in water and petroleum ether, and is best purified by careful crystallisation from glacial acetic acid, when it forms matted yellow needles melting at 201°. It is decomposed by heating with mineral acids into nitrocresol and nitrotoluidine with evolution of nitrogen, but on heating with glacial acetic acid it yields nitrotoluidine and nitroindazole. About 2 grms. of the substance are stirred up with 10 grms. of glacial acetic acid and heated until a yellowish-brown solution is obtained, which, on cooling, deposits yellowish needles. One crystallisation gives white needles of the nitroindazol, melting at 178°, and nitrotoluidine can be precipitated from the acetic acid mother-liquor by the addition of water. This reaction has not been tried with other diazo-amido compounds, but the authors leave this part of the research to Heusler. (See also this Journal, 1891, 632).—T. A. L.

The Conversion of Para- into Ortho-quinone Derivatives.

Samuel C. Hooker. Proc. Chem. Soc. 193 (118), 13--14.

The author announces that he will subsequently adduce experimental evidence showing that, both in the lapachol and other groups, compounds derived from α-naphthaquinone of the type represented by formula I., are far more readily converted by the action of acids into anhydrides derived from β-naphthaquinone (II.) than, as might, perhaps, have been expected, into anhydrides of the α-quinone type (III.).



I. II. III.

Thus, the benzal-dis-hydroxy-α-naphthaquinone of Zincke and Thelen (Ber. **21**, 2203) is quantitatively converted into an anhydride derived from the β-quinone. A variety of similar compounds, derived from aldehydes other than benzaldehydes, have been prepared.

It will also be shown that, as in the case of the β-lapachones, the converse change of β-quinone anhydrides into α-quinone derivatives is easily effected by boiling with dilute solutions of caustic alkali. It is proposed to extend the experiments to hydroxyquinones generally.

The Nitro-Derivatives of Phenolphthalein.

John A. Hall. Proc. Chem. Soc. 1893 (118), 14—15.

The author calls attention to previous incidental references to nitro-derivatives of phenolphthalein by Baeyer (Annalen, **202**, 73), Frande (*ibid.*, p. 154), and O. Fischer (*ibid.*, **206**, 99).

As a pure dinitro-derivative was not obtained by nitrating a sulphuric acid solution, phenolphthalein was dissolved in 10 times its weight of acetic acid; a mixture of nitric acid and acetic acid was slowly added to the solution, keeping the temperature below 10°; 2 mols. of nitric acid were required by each mol. of phenolphthalein. After a time a considerable quantity of yellow needles separated, which, after repeated recrystallisations, melted constantly at 196°. A nitrogen determination gave 6·91 per cent.; that calculated for dinitrophenolphthalein, $C_{10}H_{12}O_8N_2$, is 6·86 per cent.

Dinitrophenolphthalein forms yellow needles, fairly soluble in acetic acid and alcohol; it dissolves in alkalis with a yellow colour, but has practically no affinity for animal fibres. On reduction with sodium sulphide, it yields a fine blue solution, which, however, is very unstable. Frande states that, on reduction, his dinitrocresolphthalein yielded a blue solution, from which he isolated an amido-compound, but apparently did not analyse it. Some attempts were made to condense phthalic anhydride and ortho- or para-nitrophenol, but without success.

Tetranitrophenolphthalein.—Phenolphthalein dissolved in five times its weight of sulphuric acid was nitrated with 2 mol. proportions of nitric acid at about 10°; the mixture was allowed to stand about two hours, and its temperature was then raised to from 20° to 30°, and kept between these limits during the addition of another equal weight of nitric acid; as this second part of the nitration did not seem to proceed so rapidly as the first, the mixture was allowed to stand 12 hours, then poured into a large volume of water: the nitro-compound separated as a white precipitate, which was filtered and washed till free from sulphuric acid. The dried product proved to contain about 75 per cent. of a substance soluble in cold acetic acid to the extent of only about 1 per cent., which, by repeated recrystallisations from acetic acid or a mixture of phenol and alcohol, was obtained of a constant melting-point (244°—245°). A nitrogen determination gave 10·89 per cent.; that calculated for tetranitrophenolphthalein, $C_{20}H_{10}O_{12}N_4$, is 11·2.

Tetranitrophenolphthalein is with difficulty soluble in most ordinary solvents; it forms pale yellow, indistinct crystals, readily soluble in alkalis; salts of the heavy metals, as barium, lead, and silver, precipitate its neutral solution. The sodium salt is a yellow dyestuff, sold under the name of Aurotine.

On alkaline reduction it yields an unstable blue colour. It was also observed that when phenolphthaleinsulphonic acid (Annalen, **202**, 73), was treated with 2 mol. proportions of nitric acid in presence of sulphuric acid, it yielded a soluble nitrosulphonic acid, but when 4 mol. proportions of nitric acid were used and the temperature was allowed to rise to 30° C., the product was for the most part insoluble in water, and consisted simply of impure tetranitrophenolphthalein.

The author thanks Mr. F. Moore, B.Sc., for the analytical figures which are quoted, and Dr. Dreyfus, managing director of the Clayton Aniline Company, where the experiments were made, for permission to publish the results.

The Formation of Benzyldihydroxypyridine from Benzylglutaconic Acid.

S. Ruhemann. Proc. Chem. Soc. 1893, 218.

Ethylic benzylglutaconate (Annalen, **222**, 261) slowly dissolves in a concentrated aqueous solution of ammonia at 100°, forming a coloured liquid, from which acids precipitate benzyldihydroxypyridine—a substance which exhibits both acid and basic properties. It crystallises in glittering plates which melt at 184°; its dibenzoate melts at 164°. On oxidation it readily yields coloured products possessed of tinctorial powers.

The Action of Nitrous Acid on 1-α-amido-2-β-naphthol.

R. Meldola.

The formation of β-naphthaquinone by the action of nitrous acid on α-amido-β-naphthol is a most unexpected discovery, and the method described by Grandmougin and Michel (Ber. **25**, 972) is certainly the simplest and by far the most effective yet made known for preparing pure β-naphthaquinone in large quantities (this Journal, 1893, 35).

PATENTS.

Improvements in the Manufacture of Dyes of the Rosaniline Series and of Leuco Compounds thereof.

J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 802, January 14, 1892. (Second Edition.)

In Eng. Pat. 11,275 of 1891 (this Journal, 1892, 515) a process is described for obtaining dyestuffs by condensing tetra-alkyldiamidobenzophenone with the alkyl ethers of *m*-hydroxy-amido compounds such as *m*-methoxy-phenyl-*p*-tolylamine. According to the present invention, similar compounds are obtained by substituting the tetra-alkyldiamidobenzhydrols for the benzophenone derivatives, described in the afore-mentioned specification. In the first stage of the reaction leuco-compounds are formed which on oxidation yield basic rosaniline dyestuffs, and these when sulphonated give acid violet colouring matters. These bodies are identical with those already known, but dye duller shades than when obtained by the process hitherto employed. The benzhydrols to be used are the tetra-methyl- and the tetra-ethyl-benzhydrols, which give good results when condensed with the following compounds: *m*-methy-oxy- and ethoxy-phenyl-*p*-tolylamine, *m*-methoxy- and ethoxy-phenyl-*o*-tolylamine, and *m*-methoxy- and ethoxy-phenyl-*m*-xylylamine. The condensation to the leuco base takes place very readily in presence of an acid, and the oxidation is performed by means of lead peroxide in an acid solution. The following example gives the quantities to be employed. About 27 kilos. of tetra-methyl-diamido-benzhydrol and 21 kilos. of *m*-methoxy-phenyl-*p*-tolylamine are dissolved in 250 kilos. of alcohol and mixed with 5 kilos. of 33 per cent. hydrochloric acid. After standing for about five hours the mixture is heated for about three hours on the water-bath. The reaction is complete when a test no longer gives a blue colour when boiled with sodium acetate and acetic acid. After distilling off the alcohol, water and soda solution are added till alkaline and the white precipitate of leuco base is filtered off. It can be purified by dissolving in hydrochloric acid and precipitating with an alkali. To obtain the colouring matter, 10 kilos. of the leuco base are dissolved in 250 litres of water and 6 kilos. of hydrochloric acid, cooled with 200 kilos. of ice, and oxidised by quickly adding 10·2 kilos. of a 50 per cent. lead peroxide paste. After stirring for a quarter of an hour 4 kilos. of sodium sulphate are added, the solution filtered, and the colouring matter precipitated from the filtrate by adding salt. The dyestuff so obtained can be sulphonated according to Eng. Pat. 11,275 of 1891. Acid dyestuffs can also be prepared by sulphonating the leuco base with fuming sulphuric acid and subsequently oxidising the sulphonic acid in the manner already described. —T. A. L.

Improvements in the Manufacture of Colouring Matters derived from Anthraquinone. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 1657, January 27, 1892.

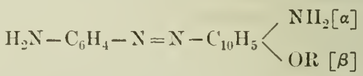
This is an extension of the following Eng. Pats. 12,715 of 1890 (this Journal, 1891, 759), 17,712 of 1890 (this Journal, 1891, 917), 18,729 of 1890 (this Journal, 1891, 917), and 4871 of 1891 (this Journal, 1892, 513), which refer to the oxidation of certain tetrahydroxyanthraquinones in sulphuric acid solution with the formation of so-called "alizarin cyanines." To this class belong alizarin bordeaux, purpurin bordeaux, anthrachrysone, anthrapurpurin bordeaux, and flavopurpurin bordeaux. It has now been discovered that hydroxyflavopurpurin and hydroxyanthrapurpurin, described in Eng. Pat. 18,729 of 1890, when dissolved in sulphuric acid and oxidised with manganese dioxide or arsenic acid, yield dyestuffs of the alizarin cyanine series. About 10 kilos. of dry hydroxyflavopurpurin are dissolved in 200 kilos. of sulphuric acid (66° B.) and 15 kilos. of powdered manganese dioxide added at 60°—70° C. The melt is then heated to 100° C. until a test in concentrated sulphuric acid shows a strong cyanine spectrum. The melt is then poured into water and boiled with an excess of acid sodium sulphite, when the dyestuff which separates is filtered off and washed to remove adherent acid. It is found to be identical with the hexahydroxyanthraquinone described in Eng. Pat. 17,712 of 1890. In a similar manner hydroxyanthrapurpurin gives alizarin hexacyanine identical with that described in Eng. Pat. 4871 of 1891. By employing larger quantities of sulphuric acid and manganese dioxide the conversion takes place at a lower temperature. These cyanines can also be obtained directly from flavopurpurin and anthrapurpurin in one operation, using a somewhat larger quantity of manganese dioxide and conducting the operation at about 120° C. It would appear, however, that this high temperature is not a necessity providing that sufficiently large quantities of sulphuric acid and of the oxidising agent be taken. Colouring matters of this cyanine series may also be obtained not only from tetrahydroxy- and trihydroxy-anthraquinones, but also from dihydroxyanthraquinones providing that these compounds contain at least one hydroxyl group in each benzene nucleus. A further series of colouring matters produced by the oxidation process is obtained from the products formed by the action of ammonia on alizarin bordeaux or alizarin pentacyanine described in Eng. Pat. 8702 of 1891 (this Journal, 1892, 514). The dyestuffs obtained produce greener shades with mordants than the original substances. The following quantities are given: 10 kilos. of the product of the action of ammonia on alizarin bordeaux are dissolved in 200 kilos. of sulphuric acid (66° B.), and 12 kilos of 90 per cent. manganese dioxide stirred in at 20°—25° C. After stirring for three hours the product is poured into water and the whole boiled up with 10 kilos. of a 34° B. acid sodium sulphite solution. The precipitate is then filtered off and washed. It dissolves in sodium carbonate and ammonia with a violet colour, in caustic soda with an indigo-blue colour, and in concentrated sulphuric acid with a violet-red colour. The alcoholic solution is bluish-red and exhibits a characteristic absorption spectrum, thus differing from the original substance. With chromium mordants pure blue shades are produced.—T. A. L.

The Treatment of Amido-Guanidine for the Manufacture of a New Compound, and of Products derived therefrom. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 2194, February 4, 1892. (Second Edition.)

The preparation of diamidogen from amido-guanidine has already been described in Eng. Pat. 6786 of 1891 (this Journal, 1892, 370). Some further reactions and decompositions of the compound are now published. By treatment with nitrous acid, amido-guanidine yields diazo-guanidine, which on treating with sodium acetate forms a new compound called amido-tetrazotic acid. This can be diazotised and employed in the manufacture of colouring matters. Diazo-guanidine also, on treatment with caustic soda, yields azohydric acid (N_3H). The following method is given for producing diazo-guanidine nitrate. One molecular proportion of amido-guanidine nitrate is dissolved in water together with one molecular proportion of nitric acid, and a solution of one molecular proportion of sodium nitrite is run in below 40°—45° C. On evaporation at a low temperature the nitrate is obtained as a crystalline residue. It crystallises from alcohol, forming white crystals melting at 129° C. To obtain amido-tetrazotic acid, the solution of diazo-guanidine nitrate as above obtained is treated with sufficient sodic acetate to form the acetate. The solution is then evaporated, when the diazo-guanidine acetate decomposes into acetic acid and amido-tetrazotic acid, which crystallises from the concentrated solution and can be purified by crystallisation from water. It has the composition $CN_4NH_2.H_2O$, and on heating loses its water of crystallisation and melts at 199° C. In order to produce azohydric acid, a solution of one molecular proportion of a salt of diazo-guanidine is mixed with rather more than two molecular proportions of caustic soda. This forms sodium azotate, which on distillation with a mineral acid gives off azohydric acid. The same acid is also produced by distilling a salt of diazoguanidine with dilute mineral acids. Attention is drawn to the explosive character of azohydric acid and its compounds.—T. A. L.

New Manufacture of Bases and of Colouring Matters therefrom. C. D. Abel, London. From the "Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 2408, February 8, 1892.

New bases which contain two amido groups capable of diazotisation are obtained by combining *p*-nitro-diazobenzene with the α-amido-β-naphthol ethers and subsequently reducing the nitro-amido-azo compounds with alkaline sulphides. The constitution of these bases is represented by the general formula—



$$H_2N-C_6H_4-N=N-C_{10}H_5\begin{cases}NH_2[\alpha]\\ OR\ [\beta]\end{cases}$$

The preparation is performed by combining equal molecular proportions of diazotised *p*-nitraniline and α-amido-β-naphthol ether, filtering off the reddish-brown precipitate of the nitro-azo-amido compound, suspending it in alcohol, adding sodium sulphide, and heating for some time to 70°—80° C. The base is precipitated from the orange-red solution by the addition of water. These bases are readily soluble in alcohol, ether, or benzene, and dissolve with a deep bluish-red colour in dilute acids. They are converted into tetrazo compounds by the action of nitrous acid and yield valuable colouring matters with the sulphonic acids of the following compounds: α- and β-naphthol, α- and β-naphthylamine, the amido-naphthols and the dihydroxy-naphthalenes. All these colouring matters dye unmordanted cotton from an alkaline or neutral bath containing salt or sodium sulphate, and they will also dye wool from a bath containing salt. The shades vary from violet-blue to blue-black.—T. A. L.

Improvements in the Production of Azo-Dyes. S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 2789, February 12, 1892.

This specification describes the preparation of colouring matters containing the 1·6 or 1·7 α-naphthylamine sulphonic acids, designated respectively β and δ by Clève. The process consists in combining the tetrazo compound of a *p*-diamine, such as benzidine, tolidine, *p*-phenylenediamine, diamidoethoxydiphenyl, diamidostilbene disulphonic acid, diamidonaphthalene disulphonic acid, &c., with 2 mols. of the α-naphthylamine sulphonic acids 1·6 or 1·7. The product thus obtained is diazotised with 2 mols. of sodium nitrite and combined with 2 mols. of a phenol or amine or their sulphonic acids. The process can be varied by combining the diazotised *p*-diamine with 1 mol. of the acids 1·6 or 1·7, diazotising the intermediate compound with 1 mol. of nitrite, and combining the product thus obtained with 2 mols. of a phenol or amine. Another modification is to combine the diazotised *p*-diamine with 1 mol. of the 1·6 or 1·7 acid and with 1 mol. of a phenol or amine, then diazotise with 1 or 2 mols. of nitrite, according to the number of amido groups present, and combine with 1 or 2 mols. of a phenol or amine (see also Eng. Pat. 22,641 of 1891; this Journal, 1892, 1001).—T. A. L.

Manufacture of New Bases and Colouring Matters therefrom. C. D. Abel, London. From the "Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 2953, February 15, 1892.

By the action of diazo-compounds on *p*-xylidine ($CH_3 : NH_2 : CH_3 = 1 : 2 : 4$) true amido-azo compounds are produced directly without the formation of an intermediate diazo-amido body, which is the case when *o*-xylidine ($CH_3 : NH_2 : CH_3 = 1 : 4 : 2$) or *m*-xylidine ($CH_3 : NH_2 : CH_3 = 1 : 4 : 3$) are employed. The compound obtained by the action of diazo-benzene on *p*-xylidine would have the formula—

$$C_6H_5 - N = N - C_6H_2(CH_3)_2NH_2$$

The products obtained resemble amido-azobenzene and its homologues, and by employing sulphonic or carboxylic acids of the diazo-derivatives, compounds are obtained which may be used as dyestuffs for wool giving orange-yellow to reddish-orange shades. Since these bodies contain an amido-group they may be diazotised and combined with the sulphonic acids of the naphthols, dihydroxy-naphthalenes and amidonaphthols giving yellowish-red to bordeaux and violet-brown shades. Their constitution is represented by the general formula—

$$R - N = N - C_6H_2(CH_3)_2 - N = NX$$

A further modification of the process yielding colouring matters for unmordanted cotton consists in combining *p*-nitrodiazobenzene with *p*-xylidine and reducing this compound with alkaline sulphides when a base is obtained having the constitution—

$$H_2N - C_6H_4 - N = N - C_6H_2(CH_3)_2NH_2$$

This on treatment with 2 mols. of sodium nitrite in presence of acid yields a tetrazo-compound, which can be combined with the sulphonic acids of the naphthols, dihydroxynaphthalenes, naphthylamines, and amidonaphthols, or with phenol carboxylic acids. Mixed azo-dyestuffs may also be obtained by combining the tetrazo-compound first with 1 mol. of one of the above-mentioned substances, and afterwards with a second molecule of a different one in the well-known manner. The various shades to be obtained range from orange to blue-black.

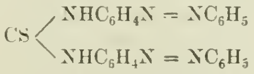
—T. A. L.

A New Black Azo-Dyestuff and the Production of the Same. A. Bang, Leeds. From G. A. Dahl, Barmen, Germany. Eng. Pat. 4109, March 2, 1892.

When *p*-acetnaphthylene diamine (1·4) is treated with fuming sulphuric acid containing 25 per cent. SO_3 it is readily converted into a monosulphonic acid. This body can be diazotised and combined with α-naphthylamine. By diazotising this compound and combining it with naphthol mono- and di-sulphonic acids, black azo-colouring matters for wool and silk are obtained. The following example gives the quantities employed:—Thirty kilos. of *p*-acetnaphthylenediamine sulphonic acid are dissolved in 500 litres of water, diazotised with 35 kilos. of hydrochloric acid and 7 kilos. of sodium nitrite and poured into a solution of 14·4 kilos. of α-naphthylamine in 12 kilos. of hydrochloric acid and 200 litres of water. The amido-azo compound which precipitates is diazotised with a solution of 7 kilos. of sodium nitrite, and this diazo solution is combined with 35 kilos. of β-naphtholdisulphonic acid R dissolved in water and kept alkaline by the addition of 30 kilos. of soda, when the dyestuff at once separates out.—T. A. L.

The Manufacture of New Colouring Matters of the Series of the Indulines by the Action of the Diamido-dialkyl Thioureas on the Aromatic Amines. J. Rohner, Bale, Switzerland. Eng. Pat. 20,423, November 11, 1892. (Under International Convention.)

The hydrochlorides of the diamido-dialkyl thioureas when heated with aromatic monamines yield red and greyish-blue colouring matters soluble in alcohol, and on sulphonation products soluble in water. Colouring matters of the latter class are obtained directly by using diamines such as benzidine, tolidine, or *p*-phenylene diamine. The preparation of diamido-diphenyl thiourea is performed by heating together under a reflux condenser, 20 kilos. of amidoazobenzene, 200 kilos. of alcohol, 5·6 kilos. of caustic potash, and 3—4 kilos. of carbon bisulphide for one to two hours. This yields azobenzenethiourea—



$$CS\begin{cases} NHC_6H_4N = NC_6H_5 \\ NHC_6H_4N = NC_6H_5 \end{cases}$$

which, on reduction with iron and hydrochloric acid at a low temperature (below 30° C.), splits up into aniline and diamido-diphenyl thiourea. The latter is precipitated from the filtered solution by an excess of hydrochloric acid. The base is very sparingly soluble in water, but its salts with mineral acids are easily soluble. In order to convert it into colouring matters, 20 kilos. of the hydrochloride are heated with 60 kilos. of benzidine for four hours to 180° C., the melt allowed to cool, and extracted several times with hydrochloric acid, and after dilution the colouring matter is precipitated from the filtered liquors thus obtained by adding salt. The dyestuff, after filtering and drying, forms a powder, sparingly soluble in water to a deep blue solution. If *p*-phenylene diamine be employed in place of benzidine it is only necessary to heat to 160° C., and the colouring matter produced is redder in shade. The formation of a colouring matter from diamido-dinaphthyl thiourea, obtained as described above, by substituting benzene-azo-α-naphthylamine for the amido-azo-benzene, is effected by heating together 20 kilos. of diamidodinaphthyl thiourea, 30 kilos. of aniline hydrochloride, and 40 kilos. of aniline to 150°—160° C. for five hours, until the melt turns red. After cooling, the melt is treated with hydrochloric acid and extracted several times with water. The residue is dissolved in 40 kilos. of hot alcohol, basified and dried down. It forms a brownish-red powder easily soluble in dilute hydrochloric acid to a violet-red solution. In order to sulphonate it, 20 kilos. of the base are dissolved cold in 100 kilos. of fuming sulphuric acid containing 22 per cent. of SO_3. The melt is gradually raised to 70° C., and kept at this temperature for an hour. It is then poured into iced water, filtered, and the residue treated with ammonia. On cooling, the ammonia salt of the sulphonic acid crystallises out. The colouring matter forms a deep red powder and dyes wool violet-red from an acid bath.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

PATENTS.

Improvements in Apparatus and Processes for Treating Fibrous Plants for the Purpose of Obtaining Fibres therefrom, applicable also for Treating or Finishing Yarns and Fabrics. W. Bottomley, Glasgow. From G. E. Armstrong, New York, U.S.A. Eng. Pat. 20,625, November 27, 1891.

This improvement is applicable to all fibrous substances, such as hemp, jute, and ramie, and deals with a new process for "retting" the fibre. The apparatus used consists of three sets of fluted rollers, the flutes interlocking like the teeth of geared wheels. The fibre is fed along the feed-table, through these rollers, the woody or central portion of the stalk being broken up and dropped down below the rollers, allowing the clean fibre to pass on under brushes revolving at a high rate of speed, which deliver the fibre at the other end. The crushing rollers do not revolve continually in one direction, but alternately backward and forward, by means of suitable gearing. These rollers may be immersed in a tank, containing a complicated mixture of soaps, resin, and sodium carbonate, dissolved in water, the effect of which is to remove the gummy portions of the material acted upon. After the surplus solution has been pressed out, the material is passed through acidulated water, washed, and dried. Ammonia may be added to the final wash-water to thoroughly neutralise any acid left in the fibre.—W. P. D.

Improvements in the Manufacture of Fabric especially suitable for Use as a Substitute for or as an Imitation of Brocade. F. P. Werner, Munich, Germany. Eng. Pat. 22,262, December 19, 1891.

The metallic covering of materials hitherto produced as substitutes for brocades, has been liable to get broken off to the detriment of the fabric. The inventor proposes to obviate this difficulty by proceeding as follows:—The fabric is stretched smooth on a frame and moistened with gelatine, dried, and coated with a mixture of flour-paste and Venice turpentine. When dry this is brushed over with "leather collodion" or shellac, and again coated after drying with "French mixtion," or gold ground oil, to which may be added 10 per cent. of varnish. The leaf-metal is then laid on the surface and afterwards varnished over with an alcoholic solution of shellac, to which may be added 10 per cent. of mastic.—W. P. D.

Improvements in and in the Manufacture of Oil Baizes, American Leather Cloth, and other Waterproof Fabrics. F. Reddaway, Pendleton. Eng. Pat. 22,303, December 21, 1891.

A more flexible fabric having its coating or coatings more firmly united with the foundation fabric and less liable to become detached, and greater durability in the case of printed goods, is claimed under the patent. The design is printed on the fabric before the proofing compounds are put on. It is then necessary to use preparations which will allow the pattern to show through; also by their being more or less translucent or tinted the first design may be modified. The printed fabric is first treated with a substance that will promote the union between the fabric and the proofing preparations such as rock oils, "foots," &c. The subsequent treatment may be of the ordinary character, but special treatment is recommended. The inventor has discovered that some essential oils have the property of dissolving rubber. A thin coat of copal varnish finishes the goods with a brilliant surface.—W. P. D.

Improvements in Ornamented India-rubber, Waterproofed Fabrics, and in the Mode of Producing the same. G. C. Mandleberg, Manchester. Eng. Pat. 22,386, December 22, 1891.

In this invention the improved fabrics are formed by causing ornamental fabrics to adhere to the waterproofed surface of any suitable fabric, the ornamental fabrics being rolled on to the rubber surface, which may have been previously saturated with rubber solvent. Fabrics so treated may be subsequently vulcanised.—W. P. D.

Improvements in Ornamented India-rubber, Waterproofed Fabrics, and in the Mode of Producing the same. G. C. Mandleberg, Manchester. Eng. Pat. 22,382, December 22, 1891.

Any suitable fabric is spread or coated with india-rubber proofing, and is then covered wholly or partly with the spun or twisted thread of any fibre, pressure being used to make it adhere to the india-rubber, no solvent being used. The fabric so treated may be subsequently vulcanised if required. —W. P. D.

Improvements in the Manufacture or Production of Cellular Substance suitable for Paper-making and Fibre suitable for Spinning. G. Hagemann, Ludwigshafen, Germany. Eng. Pat. 477, January 9, 1892.

In a previous patent (18,470, October 27, 1891; this Journal, 1892, 1026) it was shown that the reed Arundo Donax, when treated with caustic soda at 4°—6° B. for four days or more, at ordinary temperatures, yields a pure cellular substance suitable for paper-making; if the reed is split into strips and then treated with caustic alkali a textile fibre is produced. It is set forth in the present patent that similar results are achieved in a much less time, viz., in about $1-1\frac{1}{2}$ hours, when the alkaline solution is heated or even applied boiling. It is alleged that when thus treated the fibre itself will not be injured, whilst the incrustations upon it will be affected sufficiently to allow of the ready cleansing of the fibre. The further treatment required was fully described in the earlier patent.—R. B. B.

An Improvement in Machines for Scutching and Cleaning Fibrous Stems and Leaves. G. M. Lane, London. Eng. Pat. 2032, February 2, 1892.

Many machines for scutching the fibrous stems have tables moving to and fro to carry the fibres under the revolving beaters and then withdraw them. It is necessary to firmly hold the fibres by means of a clip near one end of the table, and the present improvement consists of automatically opening the clip when the table has receded, so that the material can be easily withdrawn and fresh inserted.—W. P. D.

Improvements in Machinery for Decorticating Jute, Ramie, and other Fibrous Plants. F. B. Fremerey, Galveston, Texas, U.S.A. Eng. Pat. 5646, March 22, 1892.

The defects in machines previously in use for this purpose purpose are that they require to be fed by hand, that the separation of the valuable fibre from refuse is often incomplete, and that the fibre itself is often broken or cut by woody fragments being crushed through the bark of the fibrous portion. The principal feature of the present machine is that the feeding is done automatically. The feeding mechanism includes a pair of stripping jaws, which cause the leaves and limbs of the stalks to be scraped off. From the feeder the stalks pass between slitting rollers, which slit them open longitudinally, then between flattening rollers, which open out the slit stalks. The pith of the stalks is broken into fragments by passing them between fluted rollers, and finally the crushed and broken stalks pass on to beaters, which beat off the woody fragments, leaving the fibre.—R. B. B.

A Process for Freeing Sheeps' Wool from Pitch and other Impurities. A. Bayer and K. Herold, Brünn, Germany. Eng. Pat. 10,834, June 8, 1892.

The woolly material is soaked in a mixture of "extract" oil and coal-tar oil. It is then dried by means of a centrifugal machine, and passed through rollers to disintegrate the solid impurity. Finally it is washed with ammoniacal water to remove the oils, or the pitch is extracted with petroleum spirit. The wool may be afterwards bleached by any suitable process.—W. P. D.

Improvements relating to the Cleansing of or Extraction of Fatty Substances from Wool and the like, and to a Method of Clarifying the Solvent used therefor. W. R. Lake, London. From W. T. Cutter, Connecticut, U.S.A. Eng. Pat. 16,827, September 20, 1892.

The solvent used may be naphtha or any liquid having similar properties. The particular features of the process are the repeated percolation of the same portion of solvent through the wool, and the removal of all impurities, except dissolved fatty matter, from the naphtha by causing the wool itself to act as a kind of filter.

The process consists in allowing naphtha to percolate through wool which has been previously dried by a current of hot air. The naphtha charged with fatty matters, and also containing various impurities in suspension, is returned into the vessel containing the wool. This is repeated several times; the wool retains the suspended matter, while the clear naphtha containing fats in solution is distilled to recover the solvent. The wool is again subjected to a current of hot air to remove traces of naphtha, and finally washed with water whereby suspended matter and potash salts are removed. These latter are recovered in the usual way by evaporating the wash-water.
—R. B. B.

Improvements in Apparatus for Washing or Cleansing Wool or other Materials. G. L. P. Eyre, London, and T. J. Hopkins, Trowbridge. Eng. Pat. 17,405, September 29, 1892.

In many machines the washing or scouring of the wool is incompletely effected, because the under portion of the wool lying on the apron does no come into contact with the liquid. This invention provides means whereby either (1) the wool may be placed on a perforated apron, and jets of liquid directed from below with considerable force, as well as from above; or (2) the liquid may be directed from above only or below only, and the wool automatically turned over so as to expose different portions to the action of the liquid. The invention may be applied to various wool-washing and wool-scouring machines, but is specially adapted for use in a washing or cleansing apparatus devised by the same patentees (Eng. Pat. 10,134, 1891).
—R. B. B.

Improvements in Wool-washing Machines. H. Ackroyd and T. Ambler, Halifax. Eng. Pat. 18,405, October 14, 1892.

The inventors propose to introduce a "flush at the ducking-spout near the pressing end of wool-washing machines." The water flows down through a perforated plate on to the wool, and then escapes to the bottom washing-tank, cleansing the wool and carrying the sand and dirt down with it.—W. P. D.

Improvements in Wool-scouring and Fat-saving Apparatus. J. Rhodes, Sydney, Australia. Eng. Pat. 19,071, October 24, 1892.

The scouring agent employed is benzene or some other volatile solvent. The wool is alternately saturated with the solvent and squeezed between rollers. A series of tanks and travelling bands or aprons is arranged. If four tanks are used the fresh benzene acts first upon the wool on the fourth apron, below which is a catch-tank of special construction. The benzene is then raised from the catch-tank into an elevated tank above the third apron and sprinkled down on to another lot of wool, and so on until it reaches the catch-tank below the first apron. The fresh benzene thus acts on the cleanest wool, and as the liquid is conveyed along the series of tanks the dirty liquid will be continually acting on dirtier wool. The fat and benzene are separated by distillation. The whole apparatus is enclosed within a cover to collect volatilised solvent.
—R. B. B.

Improved Means applicable for Use in the Treatment of China-Grass and other Plants adapted for Employment in the Textile Industry. L. E. Vial, Paris, France. Eng. Pat. 19,135, November 5, 1891.

This invention relates to an improved method of treating China-grass and other textile plants whereby their fibres may be separated from each other and prepared for subsequent use.

The raw material is first steeped in water, then in a bath of some liquid of a fatty or oily nature, *e.g.*, petroleum or colza oil, and lastly in an alkaline bath, the strength of which varies according to the fineness of the fibre desired. These three operations form the first part of the process or maceration. The maceration vats are so arranged that the excess of oily liquid carried over into the alkaline bath flows back again into the oil-vat. The second operation is lixiviation. The apparatus employed consists of an endless band or apron circulating between several pairs of rollers and carrying the material, which is subjected successively to the action of (1) water; (2) some liquid to neutralise the alkali, *e.g.*, a hypochlorite or bisulphite; (3) water again.

The material thus obtained only requires to be dried, made flexible, and combed, to be ready for use. All this is accomplished by means of a rotating horizontal drum, to which the material is attached, with a heated space underneath to assist in drying the material, and a comb arranged to swing above the drum.—R. B. B.

Improvements in Machines for Breaking and Scutching Flax and the like. H. Wolff, Naumberg-on-Lober, and H. Dede, Hamburg, Germany. Eng. Pat. 20,224, November 9, 1892.

This invention relates to improvements in a combined beating and dressing machine. The material is held between interlocking endless chains and bands, and mechanically presented to all the working parts of the machine, the cleaned fibre being delivered at the other end. The inventors also claim that a higher percentage of spinning fibre is obtained by special adaptation of the parts of the machine which affect the "swingling" of the stalks. The fibre is fed into the breaking machine, which crushes the stalks and loosens the outer skin. It is then carried on through two "swingling" or scraping machines. The stripping of the stalks takes place between the serrated working edges of scrapers fixed on a rotating drum, and moveable scrapers fixed to an endless band.—W. P. D.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

An Improved Machine for Dyeing, Scouring, Bleaching, Sizing, Carbonising, and Drying. E. Woodcock, sen., N. O. Woodcock, and E. Woodcock, jun. Eng. Pat. 282, January 6, 1892.

A long, wooden tank is divided into compartments and provided with rollers at the top and bottom of each compartment, the bottom rollers being adjustable in height.

Above the division walls between the several compartments are nipping or squeezing rollers. Such a box for dyeing indigo would consist of five compartments containing respectively soap liquor, hot water, indigo dye-liquor, boiling water acidified, and hot water, and above it would be a set of rollers running in air for the purpose of oxidising the indigo. At the rear end of the tank there is a set of steam drums for drying or carbonising, and a box, provided with rollers and a blower or fan, for cooling the goods.—W. E. K.

Improvements in the Method of and Apparatus for Utilising the Heat of Spent Liquors or Liquids for Dyeing, Manufacturing, and other like Purposes. J. Dawson, Huddersfield. Eng. Pat. 1506, January 26, 1892.

The object of this invention is to utilise the heat of spent or waste dye and other liquors by transferring their heat to fresh water, subsequently to be used for dyeing or other purposes.

In carrying out the invention, suitable tube-boxes and tubes are arranged in tiers or stacks within a water-tank, and through these tubes the spent liquors are pumped. The heat is radiated from the tubes to the water surrounding them, which thus becomes heated, and can be drawn off as required for use.

A float-valve admits cold water into the tank, thus keeping the water at a constant level.—W. E. K.

Errata.

This Journal, 1893, page 41, col. 1, second abstract, lines 4—5 of text thereof, for "The cloth is first impregnated with tannic acid or tartar emetic," &c., *read* "The cloth is first impregnated with tannic acid (or other astringent mordant) and tartar emetic," &c.

Page 37, col. 2, line 20 from bottom, for "in chromic acid," *read* "or chromic acid."

Page 38, col. 2, line 9, for "are scarlets," *read* "and scarlets."

Page 67, col. 2, line 2 below table, insert after "solution of," the words "sodium hydrate and 10 cc. of."

VII.—ACIDS, ALKALIS, AND SALTS.

On Mond's Chlorine Process. F. Quincke. Chem. Ind. 1893, **16**, 10—12.

The author criticises an article which appeared in the *Chemische Industrie* of last December describing a magnesium chloride process by which Brunner, Mond, and Co., Lim., of Northwich, are stated to be manufacturing bleaching powder. The article in question deals only with two German patents, one by Mond, the other by Solvay. A number of other patents have been taken out by the same gentlemen, indicating the development of the process. The chlorine process as now believed to be carried out on a manufacturing scale in Northwich is practically covered by Mond's English patent, No. 2575 of 1889 (this Journal, 1890, 291 and 292), and that of the Deutsche Solvay Werke, No. 54,540. The author sketches this process, adopting the following divisions:—

1. *The production of ammonium chloride* by freezing the mother-liquor of the ammonia-soda process.
2. *The vaporisation of ammonium chloride* in vessels lined with antimony and containing molten zinc chloride.
3. *The separation of the chlorine* from the ammonium chloride vapours at 400°—500° C. by means of magnesia pellets containing kaolin, heated in brick-lined vessels. Thus the ammonia is set free.
4. *The decomposition of the chlorine compounds* in the same vessels, by introducing air of 800°—1000° C., whereby chlorine of 7 to 10 per cent. strength is obtained.
5. *The cooling of the magnesia pellets* with cold air to 400° C. preparatory to passing fresh ammonium chloride vapours over them.

(1.) In order to crystallise out all the chloride, the temperature must be lowered to considerably below 0° C. and the resulting precipitate must then be contaminated with sodium bicarbonate, ammonium bicarbonate, and sodium chloride. These impurities are, however, not likely to interfere with the success of the process.

(2.) In order to prevent the superheating of the vessel, and to effect a rapid and regular vaporisation of the ammonium chloride, many trials were made, such as mixing the ammonium chloride with oxides such as those of nickel and magnesium, introducing an inert gas, adopting vaporisation *in vacuô*, &c., until the present method was devised, by which the ammonium chloride is charged into molten zinc chloride. Iron vessels were found to be attacked, so that vessels of more refractory material, such as carbon, gypsum, clay, nickel, &c., were tried, and finally antimony or an alloy of antimony adopted. The entire retort, as well as all connexions, must be kept at 350° C., and protected with antimony or fireclay.

(3, 4, and 5.) The vessel in which the chloride of ammonium vapours are decomposed is filled with balls or pellets consisting of 100 parts of magnesia, 75 parts of China-clay, and 6 parts of unslaked lime, with potassium chloride solution of 1·1 sp. gr. as binding material. This composition of the pellets was adopted after many trials with the oxides of nickel, cobalt, iron, and manganese, or salts with non-volatile acids, such as silicic, boric, and tungstic acids, had failed. The vessel is filled with the pellets to the height of 2 metres, and consists of an iron cylinder, the brick lining of which contains annular spaces filled with magnesia. The gases pass downwards through the vessel. The retorts may be heated from the outside by producer-gas, but probably are actually brought to the requisite temperature by air heated in Cowper's regenerators. When sufficient chlorine has been absorbed from the ammonium chloride vapours, introduced at 350°—550° C., the last traces of ammonia are removed by means of hot inert gas. Towards the end of the reaction some hydrochloric acid is evolved; when this gas has ceased to be given off, the chlorine is liberated by means of dried air of 800°—1000° C.; the gas thus obtained containing 7—10 per cent. of chlorine. After the pellets have been sufficiently exhausted, the apparatus is cooled to 400° C. and charged again with ammonium chloride vapours.—K. E. M.

The Action of Sulphuric and Nitric Acids on Lead of Different Degrees of Purity. G. Lunge. Eng. and Mining Jour. 1893, 8—10; 32; 56—57.

When the enormous quantity of lead consumed in the construction of apparatus for the manufacture of chemicals, especially of sulphuric acids, is considered, it is remarkable that hitherto there has been no certainty concerning the necessary chemical composition of a lead which offers the greatest possible resistance to sulphuric acids, whether pure or containing the ordinary impurities, of which we need not regard here any except nitrous and nitric acid. A considerable number of researches have been made in that direction, but with extremely discordant results. While a number of authorities maintain that pure lead resists the acids less than that which contains certain impurities, especially antimony, other authorities maintain the reverse of this; and this holds good of other foreign metals as well. The matter is confused by the fact that the impurities of the lead have evidently sometimes an opposite effect at different temperatures, and by the fact that the contaminations of the acid play a part of their own.

This question is really of great importance. Hochstetter quotes cases from his own practice in which concentrating pans for sulphuric acid were strongly acted upon in the course of a single week; and Hasenclever mentions similar cases. But even if we do not regard such extreme instances it is far from being an indifferent question whether an acid chamber, a Glover tower, or a boiling-down pan lasts twice as long or half as long in one case as in another where a different quality of lead had been employed, and such differences occur very frequently. Hitherto the parts played by only a very few of the metals occurring in commercial lead, have been known with any degree of certainty. It has been generally assumed that even very slight quantities of zinc and of bismuth are injurious; copper has been regarded as useful by the majority of those who have paid attention to it, but the greatest diversities of opinion exist concerning antimony. Silver, cadmium, arsenic, and tin occur only in minute quantities in commercial lead, and their presence is generally agreed to be undesirable. Some have thought, but have never proved, that the lead is the more acted upon the more oxygen it contains in the shape of oxides.

In order to settle these questions, which are of equal interest to the lead smelter and the chemical manufacturer, the author secured the co-operation of a very trustworthy pupil and assistant, Dr. Ernst Schmid.

It was necessary, evidently, to lay down certain limits for these researches, and the author resolved, therefore, to confine them to three admixtures of lead which appeared to be most important in this respect, viz., antimony, copper, and oxygen, leaving the others to themselves as certainly not calculated to increase the resistance of the leads. The concentration of the acid was varied, with its percentage of nitrous acid and of nitric acid (going ultimately up to pure nitric acid). Various temperatures were also tried.

The lead which served for the investigation was partly obtained through the kindness of the Royal Saxon Smelting Works at Freiberg, and of Professor Ledebur, of the Freiberg Mining Academy; a portion was rolled expressly for us, in somewhat large quantities, by one of the principal Cologne firms, Wilhelm Leyendecker and Co. The Freiberg lead contained the following impurities:—

—	Soft Lead I.	Hard Lead.	Regulus Metal.
Copper..........	0·001	0·05	0·1 to 0·3
Bismuth........	0·044	0·01	..
Antimony.......	0·0004	1·81	18·1 to 18·3
Arsenic.........	None.	..	1·0 to 3·1
Iron............	0·0005	0·01	..
Tin.............	0·0004	0·04	0·1
Silver..........	0·0005	0·10	..

The name "Regulus Metal" is given, as is usual in the North of England, to an alloy of about one part of antimony with five parts of lead.

The regulus metal is not quite homogeneous; the piece employed for our experiments was specially tested for copper, of which it contained 0·14 per cent. The antimony may be taken at 18·2 per cent.

The soft lead which is obtained from Cologne as the purest obtainable was most carefully analysed in our own laboratory by the method of Fresenius and by cupellation; it contained:—

	Per Cent.
Copper..............................	0·0034
Bismuth.............................	0·0019
Antimony............................	0·0029
Iron................................	Trace
Arsenic.............................	0·0047
Cadmium.............................	0·00025
Nickel and cobalt...................	Traces
Silver..............................	0·0010
Zinc................................	0·0002
Oxygen..............................	0·0024

Several hundredweights of this soft lead were melted with varying quantities of antimony and of copper, in order to eliminate the disturbing influence of the other impurities. Alloys were thus obtained containing exactly 0·2 per cent. of antimony, and 0·02, 0·1, 0·2, 1·0 per cent. of copper.

The mode of investigation which was chosen was the determination of the loss of the weight of the metal after a certain time of immersion in the acid, taking every care to obtain accurate results by working in a perfectly uniform manner. The plan of measuring the attack on the lead by the quantity of gas (chiefly hydrogen) given off in contact with the acid was rejected, and for the following reason. A special apparatus was constructed for this test, avoiding any organic joints, such as india-rubber or cork; the gas was measured in a "gas volumeter," as constructed by the author for general purposes. A number of tests were made by means of this apparatus, which permitted the measurement of the gas with perfect accuracy, and the following results were obtained after exposing the various descriptions of metal to the action of concentrated sulphuric acid at the ordinary temperature for the space of eight days. Soft lead gave off a quantity of gas almost accurately agreeing with the theoretical equation $Pb + H_2SO_4 = H_2 + PbSO_4$. Hard lead (with 1·8 per cent. Sb) and regulus metal (with 18 per cent. Sb), which were far more strongly acted upon than soft lead (as will be seen directly), yielded very little gas, amounting to $\frac{1}{200}$th part of that which should have been given off according to the above equation. Hence it is absolutely inadmissible to judge of the resistance of lead to sulphuric acid from the quantity of gas evolved in contact with the acid. Lead containing antimony yields only a minute fraction of the gas which lead without antimony gives off, undoubtedly owing to the fact that after a short time the antimonious sulphate formed is reduced by lead, which is thus prevented from evolving hydrogen from free sulphuric acid.

This observation possibly explains the prejudice of many manufacturers, who believe that lead containing antimony resists sulphuric acid better than pure lead, because they *see* the attack in the latter case from the bubbles of gas, which are missing in the former, though in reality it is much more attacked. The same experiment shows that lead containing a few per cent. of antimony is preferable to pure lead for vessels or lining of boxes intended for sea carriage of sulphuric acid, which are soldered up, and thus made air-tight. The gas given off cannot escape in this case, and the lead vessels are seriously strained and may ultimately burst, while the quantity of gas given off in the case of hard lead vessels is too slight to be injurious. About 0·5 per cent. of antimony seems to suffice for this purpose. Sulphuric acid makers ought to pay attention to this fact, which is, however, of minor importance now that iron vessels are so generally adopted for storing and carrying sulphuric acid.

The author now gives a synopsis of the results of experiments made under varying conditions.

I. *Action of Sulphuric Acid on Pure Lead and on Lead Alloyed with Antimony.*—In the first series of experiments the already-described Freiberg lead (soft, hard, and regulus metal) was tested; in the second series the Cologne lead and an alloy of this with 0·2 per cent. of antimony.

The acids employed in the first series were:—1. Chemically pure concentrated sulphuric acid of sp. gr. 1·84 at 15° C. (say, 95 per cent. H_2SO_4), in contact with previously dried air. 2. The same in contact with previously dried air, with addition of enough chamber crystals to make exactly 1 per cent. N_2O_3, which resultant acid is termed "nitrous vitriol." 3. The same nitrous vitriol protected from the air. 4. Pure acid, diluted to 1·725—1·765 sp. gr. 5. The same acid with 1 per cent. N_2O_3 as above.

The conditions of temperature and length of contact were varied as follows:—Digesting eight days at the ordinary temperature; digesting six hours at 100° C.; digesting three to six hours at 200° C. The second series (with the Cologne lead) was made in a similar way, but in all cases without contact of air. Each single case was tested by exposing six to eight samples in the same way, taking every precaution to secure an almost absolute uniformity as to the treatment of the tests before and after the experiment, by carrying on the experiments under exactly the same conditions. The author believes he has thus attained perfectly comparable results, but must refer the reader for proof of this to the German publications already referred to, and he here gives merely a synopsis of the average results of the 341 single experiments comprised in this series, arranged in such a manner as to make clear the conclusions to be drawn from them. The synopsis is to be understood in this way:—Column *a* shows the concentration of the acids, the temperature and the length of contacts; column *b* the kind of lead used as described above; columns *c*, *d*, and *e* the comparative attack of pure acids of nitrous vitriol without air and of nitrous vitriol in contact with dry air, the lowest attack being always put = 100; column *f* gives the *absolute* value of the unity 100 for each of the 13 special series of tests, viz., the loss of weight of one superficial metre of lead expressed in grms. Thus on the first line the real values of the figures appearing under *c*, *d*, and *e* (100, 124, 147) are: 128·1, 158·8, 183·3 grms. of lead per superficial metre of soft lead No. 1. lost by eight days' contact with cold concentrated acid. (It was impossible to choose a common unity since the duration of the experiments necessarily differed in the different series.)

It is thus plain that at ordinary temperatures concentrated sulphuric acid acts least on soft lead, more on hard lead, and most on regulus metal. This holds good of all three descriptions of acid; pure acid acts least, nitrous vitriol without air is more destructive, and nitrous vitriol in contact with air is most active. The injurious influence of notable quantities of antimony, is most apparent in the case of nitrous vitriol; the loss of weight increases very rapidly with higher percentages of antimony; a very slight addition of antimony (0·2 per cent.) is rather beneficial than otherwise so far as the ordinary temperature is concerned (series No. 2), but even then only to a very limited extent.

At 100° C. the soft lead in all cases resists the attack better than that alloyed with antimony. The different acids attack in the same order as before; the injurious effect of antimony is even more apparent with nitrous vitriol than with pure acid (series 3 and 4).

At 200° C. the action is of course much stronger, but of the same character as at 100° C.; that is to say, that antimony is decidedly injurious, and, in the case of large quantities (1·8 per cent. and upward), to an enormous extent. The different descriptions of acid follow on the whole in the same order; the apparent anomaly that nitrous vitriol without air sometimes acts slightly less than pure acid is easily explained by the fact that the current of dry air employed in the case of pure acid carried away much water and gradually concentrated the acid.

a Description of Experiment.	*b* Description of Lead.	*c* Pure Sulphuric Acid.	*d* Nitrous Vitriol (1 per Cent. N_2O_3) without Air.	*e* Nitrous Vitriol in contact with Dry Air.	*f* Absolute Value of the unit 100 in Grms. per Sup. Metre.
1. Acid of 1·8 sp. gr. 8 days at ordinary temperature	Soft lead No. I.	100	124	147	128·1
	Hard lead (1·8 per cent. antimony) ..	102	126	148	128·1
	Regulus metal (18 per cent. antimony)	116	156	178	128·1
2. The same acid 30 days at ordinary temperature......................	Soft lead No. II......................	100	305	..	348·1
	The same with 0·2 per cent. antimony	87	245	..	348·1
3. Acid of 1·84 sp. gr. at 100° C. for 6 hours............................	Soft lead No. I.	100	105	122	86·8
	Hard lead	351	471	535	86·8
	Regulus metal......................	224	398	437	86·8
4. The same acid at 100° C. 10 hours..	Soft lead No. I.	100	101	..	79·1
	The same with 0·2 per cent. antimony	145	182	..	79·1
5. Acid of 1·84 sp. gr. at 200° C. 3 hours	Soft lead No. I.	100	95	154	277·6
	Hard lead............................	1,381	1,252	1,397	277·6
	Regulus metal	865	1,270	1,437	277·6
6. The same acid at 200° C. 4 hours...	Soft lead No. I.	100	..	..	565·4
	Hard lead	1,308	..	..	565·4
	Regulus metal	925	..	..	565·4
7. The same acid at 200° C. 6 hours	Hard lead............................	100	95	106	4,728·9
8. The same acid at 200° C. 10 hours ..	Soft lead No. II......................	100	102	..	601·4
	The same with 0·2 per cent. antimony	108	139	..	601·4
9. The same acid at 200° C. 3 hours...	Soft lead No. II......................	100	..	..	190·0
	The same with 0·2 per cent. antimony	102	..	..	190·0
10. Acid of 1·725 sp. gr. at 100° C. 6 hours	Soft lead No. I.	100	66	80	47·0
	Hard lead	104	100	90	47·0
	Regulus metal.......................	112	168	168	47·0
11. Acid of 1·725 sp. gr. at 200° C. 6 hours	Soft lead No. I.	100	..	..	191·9
	Hard lead	783	..	..	191·9
	Regulus metal.......................	1,146	..	..	191·9
12. Acid of 1·765 sp. gr. at 100° C. 10 hours............................	Soft lead No. I.	100	..	..	51·4
	Hard lead............................	108	..	..	51·4
	Regulus metal	133	..	..	51·4
13. Acid of 1·720 sp. gr. at 100° C. 10 hours............................	Soft lead No. II.	100	71	..	55·7
	The same with 0·2 per cent. antimony	114	74	..	55·7

In the case of less concentrated acids (sp. gr. 1·725 to 1·765) at 200° C., the injurious effect of antimony is apparent in every case at a very much higher rate than at 100°. Nitrous acid sometimes acts less than pure acid in this case, evidently because a coating of lead sulphate protects the lead here. This, however, is not the case with concentrated acids, where the lead sulphate is dissolved, nor with more dilute nitrous acids, where nitric acid is formed and dissolves more lead.

It may be expedient to state that the results agree in all essential features with the fragmentary, and hence inconclusive, results formerly found by John Glover (the inventor of the Glover tower) and Cookson and Sanderson (Chem. News, vol. xlv., p. 105). They decidedly disagree with the well-known statements of Calvert and Johnson, according to whom pure lead resists sulphuric acid less than impure lead. But that statement is entirely worthless, as their "virgin lead" contained 0·3246 per cent. of iron and 0·4374 per cent. copper, and they did not estimate the antimony at all. Quite recently Hochstetter, whose memoir will be mentioned later, has also maintained that a slight addition of antimony (0·2 per cent.) protects lead against the action of hot acid; but his mode of investigation was exceedingly rough, and he has not dared to draw practical conclusions from it, as he has done in the case of copper, so that the author believes that his assertion (for it does not amount to any proof whatever) concerning the protecting influence of antimony cannot be held to outweigh the hundreds of experiments carefully conducted by Lunge and Schmid.

II. *Action of Sulphuric Acid on Lead containing Copper.*—The protecting influence of copper upon lead intended for contact with hot acids has not heretofore entirely escaped notice, but it was only quite recently that Hochstetter found that virgin lead in some cases was rapidly attacked or even entirely destroyed when left in contact with very hot concentrated sulphuric acid, while lead containing a little copper sustained very little injury. According to him as little as 0·02 per cent. of copper is sufficient for this purpose, as proved by trials on a practical scale with concentrating pans made of virgin lead to which 0·023 per cent. of copper had been purposely added.

——	Concentrated Acid 1·84 sp. gr. 30 days at ordinary Temperature.		Concentrated Acid of 1·84 sp. gr. 10 hours at 100° C.		Concentrated Acid of 1·84 sp. gr. 10 hours at 200° C.		The same, 3 hours at 200° C.	Acid of sp. gr. 1·720 10 hours at 1000° C.	
	Pure.	Nitro's.	Pure.	Nitro's.	Pure.	Nitro's.	Pure.	Pure.	Nitro's.
Absolute value of the unity 100, in grms. of lead per superficial metre.	348·1	..	79·1		601·4		190·0	55·7	
Soft lead No. II	100	305	100	101	000	102	100	100	71
" + 0·02 per cent. Cu	121	288	101	102	101	108	102	100	70
" + 0·1 per cent. Cu	222	280	102	103	81	110	98	102	72
" + 0·2 per cent. Cu	102	295	101	105	82	108	100	99	73
" + 1·0 per cent. Cu	275	346	121	114	82	107	97	85	63

In order to exclude the accidental influence of other impurities, the author caused several hundredweights of the purest soft lead (the soft lead No. 1 mentioned before) to be alloyed with varying proportions of copper, viz. 0·02, 0·1, 0·2, and 0·1 per cent. The 1 per cent. alloy could not be made homogeneous, and he does not place any special reliance on the results obtained with it. Even at 0·2 per cent. copper there were irregularities found here and there, and in practice this seems to be the highest percentage of copper regularly obtainable.

As far as the acids are concerned it seemed unnecessary in this case to try nitrous vitriol, both with and without access of air, as the tests with lead containing antimony had sufficiently proved that this kind of acid acts much more strongly in the presence than in the absence of air. Otherwise the experiments were carried out as before, and the average results of the 262 tests made are represented in the following synopsis, arranged on the same plan as that referring to alloys of lead and antimony.

We may now draw the following conclusions. The results are here not always quite so decisive as in the case of antimony. Especially with the 1 per cent. alloy the six or eight parallel tests made for each special case disagree too much to base a certain conclusion thereon, undoubtedly on account of the want of homogeneity of that alloy, and we shall, therefore, leave it entirely out of consideration. Otherwise we find that in the cold, concentrated pure sulphuric acid acts decidedly more on lead containing copper than on pure lead, and, except in the case of the 0·2 per cent. alloy, nitrous vitriol always acts much more strongly. At 100° C., both pure and nitrous acid act practically alike upon all descriptions of lead up to 0·2 per cent. copper, the copper having no protecting action whatever at that temperature. A 200° C. concentrated pure acid acts perceptibly less on lead containing 0·1 or 0·2 per cent. of copper than on pure lead, or lead containing but 0·02 per cent. Cu; nitrous vitriol, however, acts in the reverse manner.

This would lead us to conclude that for any use of lead below the temperature of 200°C., that is, for acid chambers and in nearly every other case, copper has *no* protecting action on lead. Only at 200° C. do we find such an action, and that to only a slight degree, and only in the case of pure acid, but not in that of nitrous vitriol. Hence acid-pans in a general way ought never to reach, and still less to exceed, that temperature. It would follow that even they ought not to be made of lead containing copper; but we shall see presently that this conclusion must be modified.

III. *Experiments on a Sudden, Violent Action of Sulphuric Acid upon Lead at Higher Temperatures.*—It has been noticed before, especially by Hasenderer (1872) and by Bauer (1875), that pure lead, when heated with sulphuric acid to 230° or 240° C., is suddenly acted upon with violent effervescence, and is almost at once converted into sulphate. Alloys containing 1 per cent. antimony or copper suffer this violent reaction only at higher temperatures, from 250° to 280° C.; on the other hand, even 0·73 per cent. bismuth lowers the point of sudden action on lead to 160° C. It seemed not unlikely that some of the phenomena observed by Hochstetter might be explained by a similar cause, and this question appeared to possess sufficient importance to merit special investigation, which, however, in this case was confined to the action of pure sulphuric acid. The results are as follows:—

Concentrated sulphuric acid (sp. gr. 1·842) acts at first but very slowly on pure soft lead (No. II.). Up to 175° C. there are only isolated gas-bubbles, which increase very slowly up to 220°. From that point they become larger, and at 260° the lead dissolves all at once completely with violent effervescence and with formation of free sulphur and sulphur dioxide. If the source of heat is removed at the commencement of this reaction it continues nevertheless, and the temperature rises to 275°.

The same lead, when alloyed with 0·2 per cent. copper, exhibits only at 260°, a distinct evolution of gas, which increases slowly up to the boiling-point (310°), at which point the lead is very slowly dissolved; the sudden reaction mentioned above is not at all observed here.

The same soft lead, when alloyed with 1 per cent. antimony, begins to evolve gas at 175°; rather more strongly from

225°; at 275° or 280° the same sudden and complete reaction occurs as with pure soft lead.

If dilute acid is made to boil in contact with lead it is, of course, gradually concentrated and the boiling-point rises constantly. In this case the sudden conversion into sulphate occurs with soft lead at 280°, and with lead containing 1 per cent. antimony at 300°.

We have now proved that the sudden solution of lead in hot sulphuric acid is slightly retarded by 1 per cent. of antimony, and entirely prevented by 0·2 per cent. copper, but it remained to be seen whether these additions would or would not produce a corresponding improvement in the behaviour of lead below the temperature of the sudden reactions but above the maximum of 200° C., formerly adhered to by us as the highest normal temperature to which lead is exposed in acid-pans and similar apparatus. For this purpose 30 tests were made with the descriptions of lead just mentioned, heating them for 9 or 10 hours in open flasks with sulphuric acid of sp. gr. 1·66, ultimately to temperatures of 220° to 270° C., during which operation the specific gravity ultimately rose to 1·774. The results were as follows:—

Description of Acid.	Final Specific Gravity and Temperature of Acid.	Loss of Lead per Superficial Metal Grammes.	Proportion.
1. Soft lead No. II...	1·77 at 220°—225° C.	224·3	100
Do. + 1 °/o antimony	„	5975·1	2,664
2. Soft lead No. II...	1·81 at 240°—255°	5752·2	2,661
Do. + 0·2 °/o copper	„	216·2	100
3. Soft lead No. II...	1·79 at 235°	2724·7	1,703
Do. + 0·2 °/o copper	„	160·0	100

This demonstrates the following facts. Up to 225° C., a temperature certainly never reached in concentrating pans, pure lead stands pretty well, but above that temperature the loss of weight becomes very heavy. At 225° lead with 1 per cent. antimony loses 26½ times more weight than pure lead. On the other hand, at 235° lead containing 0·2 per cent. copper loses 17 times *less* than pure lead, and at 255° it loses 26½ times less. We thus see that while the addition of antimony is very injurious at temperatures both under and over 200°, a slight addition (0·1 to 0·2) of copper greatly improves the lead in its behaviour toward very hot sulphuric acid. We can also now understand that under certain circumstances such an improvement may take place even at temperatures at or slightly below 200° C., viz., in case the lead continues bismuth, which lowers the temperature of the sudden attacks. In this case an addition of a little copper will compensate the injurious action of the bismuth and make the lead resist better in hot acid. This probably explains Hochstetter's observations; for the "virgin lead," of which his easily destructible pans consisted, contained 0·05 per cent. bismuth; in the pans afterwards employed, the effect of the bismuth would be compensated by the addition of 0·02 per cent. copper to the lead, and this caused them to resist the hot acid better than did the first pans.

IV.—Influence of the Presence of Oxides on the Behaviour of Lead toward Sulphuric Acid.—The author had been informed by Freiberg men that they considered the action of sulphuric acid on lead to be greatly increased by the presence of oxygen in the lead. Inquiries showed that this was merely a vague impression or hypothesis, without experimental basis, but as it did not appear at all unlikely to be true, he resolved to put it to the test. He was confronted at the outset by the difficulty of estimating reliably the very slight proportion of oxygen present in lead; in fact, a very complicated process, the description of which would be too lengthy here, had to be worked out for this purpose, and was executed with great perseverance by Dr. Schmid. Ordinary soft lead contains an exceedingly slight proportion of oxygen (0·0024 per cent. on the average), and but very little more if alloyed with a little antimony or copper (up to 0·0036 per cent. with 0·02 per cent. antimony or 0·1 per cent. copper, and 0·0057 per cent. with 0·2 per cent. copper). Numerous attempts were made to artificially increase the quantity of oxygen in pure lead, but the author and Schmid never got beyond a maximum of 0·0050 per cent., and experiments made in the same way as before proved that this slight difference in the percentage of oxygen is not connected with a perceptible difference in the action of sulphuric acid. The oxygen hypothesis must, therefore, be entirely abandoned.

V.—Behaviour of Lead toward Sulphuric Acid of the Highest Degree of Concentration, and toward Nordhausen Acid.—These experiments were made in a specially constructed apparatus, in which no organic substances whatever were employed, at a temperature of 50° C., which was chosen to minimise the escape of SO_3. Comparative tests were made with acid concentrated in platinum up to the usual points with "monohydrate" prepared by my freezing process, but slightly weaker than fresh monohydrate, in consequence of standing for some time, and with Nordhausen acids containing up to 45 per cent. SO_3, all of them carefully analysed. The result of 10 hours' exposure at 50° C. were as follows (42 experiments):—

Description of Acid.	Percentage of Total SO_3	Percentage of Real H_2SO_4	Percentage of Free SO_3	Loss of Weight of 1 Superficial Metre of Lead (Grms.).	Proportionate Loss.
Concentrated sulphuric acid	79·30	96·57	..	64·0	100
Technical monohydrate......................	80·69	98·85	..	867·5	1,356
Real monohydrate (interpolated)	81·63	100·00	..	1,300·0	2,031
Nordhausen acid	83·49	..	10·11	1,899·6	2,968
„	85·31	..	20·02	..	3,207
„	87·10	..	29·77	2,008·8	3,139
„	88·92	..	39·68	1,801·5	2,815
„	89·90	..	45·01	1,649·7	2,578

It will thus be seen that the attack of the acid increases enormously with its concentration above the highest strength usually attained in platinum stills or analogous apparatus. The somewhat deteriorated "monohydrate" of 98·85 per cent. dissolves 13½ times as much lead as acid of 95½ per cent.; with real monohydrate the attack is 20 times, and as the maximum point, with Nordhausen acid of from 20 to 30 per cent. SO_3, 31 or 32 times greater than with acid of 96½ per cent. H_2SO_4. Above that strength, Nordhausen acid acts slightly less, because then a thick coating of lead sulphate protects the lead; but, at all events, it is evident that lead must not be brought into contact, even at very moderate temperatures, with sulphuric acid above 66° B.

VI. *Action of Nitric Acid on Lead.*—While dilute nitric acid is the principal solvent for lead, concentrated acid has very little action upon it, owing to the insolubility of lead nitrate in such acid. Hence lead tanks, pipes, &c., can be used for handling *strong* nitric acid, and this is well known to practical men. Nothing, however, has hitherto been published as to the limits of concentration, and the real wear and tear of lead in contact with strong nitric acid, and the author therefore instituted an inquiry thereon.

The lead used was the Cologne soft lead No. II., the purest at my command. The acids tested were pure nitric acid free from nitrous acid, red fuming nitric acid, and, for the sake of comparison, concentrated sulphuric acid (sp. gr. 1·84), technical "monohydrate," and mixtures of the latter with equal volumes of pure and of fuming nitric acid. The large table on page 148 gives an abstract of the 64 tests made by leaving the lead in contact with those acids during 30 days, at the ordinary temperature.

Description of Acid.	Pure Nitric Acid.											A.	B.	C.	D.	E.
Specific gravity	1·210	1·262	1·305	1·330	1·348	1·371	1·404	1·425	1·458	1·480	1·498	1·520	1·841	..	..	..
Percentage of HNO_3.....	33·82	41·64	48·26	52·37	55·45	59·57	55·03	79·98	79·33	86·05	93·10	..	..	..	..	..
Loss of lead per superficial metre in grms.	3,710	1,803	900	552	398	261	195	195	516	733	378	699	343	4,042	38	35
Proportional number: value of 100=194·4 grms.	1,904	926	462	283	204	134	100	100·5	265	376	194	354	176	2,074	20	18

A.—Red fuming nitric acid. B.—Sulphuric acid sp. gr. 1·841=95·57 per cent. H_2SO_4. C.—Monohydrate = 98·85 per cent. H_2SO_4. D.—Monohydrate + equal vol. nitric acid of sp. gr. 1·498. E.—Monohydrate + vol, red fuming nitric acid 1·520.

It is seen that the action of nitric acid at first decreases pretty regularly as its concentration increases; the minimum action is reached at sp. gr. 1·404 = 55·1 per cent. HNO_3, and this remains steady up to sp. gr. 1·425. From thence the action increases again, so that at sp. gr. 1·480 the loss of weight of the lead is $3\frac{1}{2}$ times greater than that which it suffered at the minimum. Probably in the case of more highly concentrated acids this stronger chemical action outweighs the protection afforded to the lead by the diminution of solubility of the lead nitrates. Those concentrated acids, moreover, cannot easily be kept entirely free from lower nitrogen acids, which seem to increase the action.

It is remarkable that in the cold nitric acid of sp. gr. 1·40 acts less upon lead than ordinary concentrated sulphuric acid, and only $\frac{1}{20}$ as much as "monohydrate" of 98·45 per cent. H_2SO_4; while the same monohydrate, mixed with the strongest acid (whether pure or fuming) has an extremely slight action, viz., $\frac{1}{200}$ of the corresponding sulphuric acid, and $\frac{1}{10}$ to $\frac{1}{15}$ of the nitric acid by themselves. But this is after all easily explained. The action of the strong sulphuric acid, which is caused by its solvent power for lead sulphate, is paralysed by its dilution with the water of the nitric acid, while the latter is prevented from acting upon the lead by a dense coating of lead sulphate. The investigation has therefore proved that nitric acid from sp. gr. 1·37 upwards can be safely handled in lead vessels at ordinary temperatures. The action is least at sp. gr. 1·40 to 1·425; but even stronger nitric acid acts, in the cold, hardly more than ordinary concentrated sulphuric acid, and much less than extra concentrated sulphuric acid. Mixtures of strongest sulphuric and strongest nitric acid, such as are used in the manufacture of dynamite, gun-cotton, &c., have extremely little action on lead.

VII. Action of Nitrous Vitriol of Various Degrees of Concentration and Various Percentage of Nitric Acid upon Lead.—It is well known that the acid in the last chamber of a set of vitriol chambers is always "nitrous," that is, that it contains "nitrous nitrogen" in the shape of "chamber crystals" or nitroso-sulphuric acid in solution; and this is in fact absolutely indispensable for the proper working of the chambers. It is also well known that the acid contained in the last chamber ought not to be diluted beyond a certain limit, in order to protect the chamber from rapid corrosion. This has been always ascribed to the formation of free nitrous and nitric acid, but there are no positive experiments on this matter on record, and the author has tried to fill this gap.

The lead employed in the author's experiments was soft lead No. I. and II., the former tests having proved this quality of lead to be most suitable for constructing vitriol chambers. Many experiments were made, first with a mixture of the purest concentrated sulphuric acid and chamber crystals, representing exactly 1 per cent. N_2O_3, diluted by means of ice to various degrees of concentration down to sp. gr. 1·3, and for a special series of tests adding free nitric acid, after which treatment the composition was determined by analysis. The acids thus prepared were left in contact with lead for a certain time at a temperature of 50° C. The author does not quote any details of the results obtained in this series of experiments, as he does not consider them quite conclusive, owing to the great variations in the percentage of nitrogen acids produced in the diluting process and during the experiment. He will, therefore, merely mention that he and Schmid found that the dilution of nitrous vitriol with water up to a certain point diminishes the action on lead, the minimum being reached at sp. gr. 1·5. From this point dilution increases the action, of course, owing to the formation of free HNO_3 and HNO_2; this is very perceptible at sp. gr. 1·4, and at 1·3 the action is stronger than with nitrous vitriol of sp. gr. 1·71. The addition of very little free nitric acid to dilute acids at once immensely increases the action on lead.

A fresh series of experiments was made with acids of more definite composition. Eight different mixtures were prepared of pure sulphuric acid and pure nitric acid, representing various specific gravities, but all of them containing exactly 0·1 per cent. N in the state of HNO_3. These are marked from A to H in the following synopsis. Another batch of eight acids of the same concentration was prepared in a similar way, containing also exactly 0·1 per cent. N, but this time in the state of nitroso-sulphuric acid (chamber crystals); these are marked from R to Z. Lastly eight acids were prepared by mixing equal volumes of the two former kinds, and therefore containing as nearly as possible 0·05 per cent. N as HNO_3 and 0·05 per cent. N as SO_5NH; these are marked from I to Q. Altogether there were 24 acids, containing in the cold 0·1 per cent. N, three of which there were always of the same specific gravity. They were all left after preparation standing in the cold for 24 hours, and were afterwards kept at 65° or 70° C. for 10 hours, in order to complete the unavoidable decompositions before their action on lead was tested. The percentage of nitrous and nitric acid now present were determined by careful analyses of all 24 acids, and the experiments were then made in such manner that lead was brought into contact with the acids for the space of 70 hours at a temperature of 55°—70° C., this being near the temperature of the first chamber, and another 150 hours at the ordinary temperature (in the intervals between the higher temperatures kept up during the daytime). Each experiment was set up three times over, and in all 72 flasks were treated at the same time on the same large steam bath. In the following synopsis the composition of the acids and the average losses of weight are given, placing the acids of equal specific gravity on consecutive lines. The last column facilitates a comparison of the results by reducing the losses of weight to a common unit of 100, chosen for the minimum attack observed in the case of acid U, which amounted to a loss of 11·4 grms. on a square metre of lead surface.

The conclusions are as follows :—If a little nitric acid be added to dilute sulphuric acid, and the mixture be gently heated, some of the nitric acid is volatilised, but no nitroso-sulphuric acid is formed until the concentration exceeds sp. gr. 1·5—that is, of "chamber acid." From this point oxygen escapes, and more and more nitrous vitriol is formed, so that at sp. gr. 1·768 the nitric acid has almost vanished. On the other hand, in dilute acids free nitric acid is formed from nitroso-sulphuric acid; on heating, almost every trace of N_2O_3 vanishes below sp. gr. 1·51. It is very remarkable that in the dilute acids (below 1·51) the nitrous acid, which in this case must be considered to exist no more as SO_5NH, but as free HNO_2, on prolonged heating, is gradually changed into nitric acid with absorption of atmospheric oxygen. Just about this point of concentration, where the nitroso-sulphuric acid is just capable of existence in very small quantities, the action on lead is at its minimum.

Kind of Acid.	Specific Gravity at 15° C.	Total N.	N present as Trioxide.	N present as Nitric Acid.	Loss of Lead per Superficial Metres in Grms.	Proportionate Loss.
		Per Cent.	Per Cent.	Per Cent.		
A.	1·295	0·0990	0·0001	0·0989	47·6	418
I.	1·301	0·0955	0·0003	0·0952	42·3	371
R.	1·298	0·0971	0·0002	0·0969	43·6	382
B.	1·369	0·0852	0·0004	0·0848	31·5	276
K.	1·370	0·0910	0·0009	0·0901	32·7	287
S.	1·365	0·0199 ?	0·0007	0·0191 ?	32·9	89
C.	1·450	0·0711	0·0008	0·0714	18·1	159
L.	1·441	0·0755	0·0010	0·0745	14·9	13
T.	1·443	0·0733	0·0012	0·0721	16·7	146
D.	1·511	0·0593	0·0018	0·0575	15·5	136
M.	1·512	0·0755	0·0026	0·0729	13·4	118
U.	1·512	0·0887	0·0026	0·0861	11·4	100
E.	1·583	0·0496	0·0130	0·0336	14·5	127
N.	1·583	0·0741	0·0338	0·0403	13·9	122
V.	1·579	0·1006	0·0489	0·0517	11·6	102
F.	1·649	0·0471	0·0142	0·0329	25·6	225
O.	1·647	0·0723	0·0380	0·0343	43·6	382
W.	1·648	0·0992	0·0583	0·0419	28·9	254
G.	1·712	0·0422	0·0245	0·0176	48·0	421
P.	1·713	0·0715	0·0399	0·0316	52·2	458
X.	1·710	0·6991	0·0581	0·0409	43·2	379
H.	1·768	0·0375	0·0309	0·0066	92·0	807
Q.	1·765	0·0684	0·0421	0·0263	65·0	570
Z.	1·768	0·0996	0·0595	0·0401	59·4	521

This action increases with dilution, and decidedly proportionally to it, evidently owing to the formation of free HNO_3 and HNO_2; it is constant between sp. gr. 1·5 and 1·6, and it increases again rapidly above 1·6, where the action of strong sulphuric acid is added to that of nitroso-sulphuric and nitric acids. This leads to the distinct inference that the acid in the vitriol chambers, which necessarily contains nitrogen acids, ought, in order to act as little as possible on the lead, to be at least of sp. gr. 1·5 and at most of 1·6, an inference in accordance with practical experience on the large scale.

The author now sums up the principal results of the investigations as follows :—

1. In the great majority of cases the purest soft lead is the most suitable material for apparatus used in the manufacture of sulphuric acid, such as vitriol chambers, tanks, Gay-Lussac and Glover towers; also for concentrating pans, at least, if they are set in such manner that the fire does not touch the strongest pan first, so that there is no danger of the temperature even temporarily rising to 200° C. The purest soft lead is less acted upon than any other kind of lead, whether by pure or by nitrous sulphuric acid, at least, at temperatures above the ordinary up to 200° C.

2. An addition of very little antimony (0·2 per cent.) does little or no harm; in the cold, such lead seems to resist the acid in some cases even slightly better than pure lead. Such a slight percentage of antimony is therefore admissible where there is need for greater hardness and tensile strength, but merely for contact with acid in the cold. Lead containing more antimony is acted upon much more strongly than soft lead, and this difference increases enormously with a rise of the temperature. Lead containing antimony should therefore never be used for apparatus intended for temperatures higher than the ordinary. It is true that 1 per cent. of antimony raises the temperature at which lead is suddenly changed into sulphate by about 20°, but this sudden reaction does not seem to occur at temperatures such as are reached even in the hottest concentrating pans, except in the presence of exceptional quantities of bismuth; and against this reaction copper is a better protection than antimony, while in addition the latter causes a much more rapid deterioration of the pans at their normal working heat. Hence the use of lead containing antimony must be strongly deprecated for concentrating pans. Only in one case an addition of antimony to lead is to be directly recommended, viz., for air-tight vessels in which cold sulphuric acid is to be stored or carried, because in this case the repression of an evolution of gas is an important consideration.

3. Copper cannot be alloyed with lead in large quantities; 0·2 per cent. Cu seems to be the practical limit. The presence of less than 0·1 per cent. copper has very little useful or injurious influence on the resistance of lead to cold

sulphuric acid; the same holds good of 0·2 per cent. at 100°. At 200° C. lead containing 0·1 or 0·2 per cent. copper is acted upon a little less by pure sulphuric acid than pure lead; but the difference is only trifling, and runs the opposite way in the case of nitrous sulphuric acid. Hence under ordinary circumstances no copper need be added to lead, even for concentrating pans. There are, however, exceptional cases in which lead possesses the property of being suddenly changed into sulphate far below the normal temperature (200° C.), probably owing to the presence of bismuth; in these cases the addition of 0·1 or 0·2 per cent. copper to the lead prevents that injurious reaction, and whoever wants to be protected against all chances, had better make such an addition for the hottest pans. Above 200° C. such a percentage of copper has a strong protective action on lead in contact with sulphuric acid, and this must be regarded for the rare cases where lead is exposed to acid at such high temperatures.

4. The percentage of oxygen (oxides) in lead is always very slight, and has no relation to its resistance against sulphuric acid.

5. The evolution of gas observed on prolonged contact of lead with sulphuric acid has no relation whatever to the real wear and tear of different descriptions of lead. It is greatest with soft lead, and least with hard lead.

6. The action of sulphuric acid on lead rises with the concentration slowly up to 66° B. and a little above (up to 96 per cent. H_2SO_4), but very rapidly beyond this point. Even acid of 99 per cent. H_2SO_4 (technical monohydrate) cannot be handled in lead vessels, and Nordhausen acid still less.

7. *Nitric acid* of sp. gr. 1·37 to 1·42, acts very little upon lead in the cold; stronger acid a little more, but hardly more than 99 per cent. sulphuric acid. Mixtures of strong sulphuric acid and strong nitric acid have extremely lide action upon lead.

8. Nitrous sulphuric acid in the concentrated state acts more strongly than pure sulphuric acid at all temperatures and upon all descriptions of lead. In the case of dilute acids, say sp. gr. 1·72—1·76, the action of nitrous vitriol is rather less than with pure sulphuric acid, owing to the formation of a crust of lead sulphate. With still more dilute acids, where the nitroso-sulphuric acid is partly changed into free nitrous and nitric acid, the action is again stronger. If these acids are compared among each other, it is found that those acids act least upon lead at 65°—70° C., whose concentration is between specific gravity 1·6 and 1·5, that is between the limits which are mostly observed for "chamber acids;" both more highly concentrated, and more dilute acids act more upon the lead in the latter case in proportion to the nitric acid present (or formed).

Note on the Insoluble Modification of Sulphur. W. Schmitz-Dumont. Ber. 1892, 25, 2659—2661.

According to Bellamy (Compt. rend. **91**, 330), when sodium thiosulphate is being prepared from neutral sulphite and sulphur insoluble in carbon bisulphide the following points may be observed, which are not noticeable when soluble sulphur is used:—

1. During the boiling sulphuretted hydrogen is evolved.
2. The hot filtered solution, on standing, becomes turbid from separation of sulphur.
3. The form of sulphur insoluble in carbon bisulphide is taken into solution during the operation in greater quantity than the other modification.

A repetition of this work, however, seems to show that in regard to the first two observations there is practically no difference between the two modifications, and as regards the third observation there is a difference in the rate of solution, but not in the quantity taken into solution.

—T. L. B.

Action of Nitric Acid on Bichromate of Potassium. G. C. Schmidt. Ber. 1892, 25, 2917—2918.

Attempts were made to obtain the salts nitrobichromate and nitrotrichromate of potassium described by Darmstädter (Ber., 1871, **4**, 117). The products obtained were found to consist merely of chromates of potassium intermixed with crystals of potassium nitrate, and it is concluded that such were in reality the products which Darmstädter had taken to be homogeneous, and to represent a single substance.—T. L. B.

Recent Theories of the Sulphuric Acid Process. W. R. Potter. Amer. Chem. J., 14, 21—31.

Reference is made to the theories of Hurter (this Journal, 1882, 8, 49, and 83), Raschig and Lunge (this Journal, 1889, 164—168), Sorel (this Journal, 1890, 175—181), and Schertel (this Journal, 1889, 283). The author concludes that Lunge's theory is not likely to be soon displaced.

—H. A.

Working Results in the Concentration of Sulphuric Acid in Glass Retorts. F. Lüty. Zeits. f. ang. Chem., 1892, 385—389.

The evaporating plant of the Mülheim works, erected in 1885 and designed for a daily output of 3½ tons of vitriol of 169° Tw. (starting with acid of 142° Tw.), yielded, during three years working, results which are communicated in the following report:—

The plant consists of 22 retorts arranged in a row, each retort being set in a sand-bath and provided with a separate fireplace. The waste heat passes into a flue running parallel with the retorts and leading into a chimney. The retorts, as supplied by a Manchester firm, consist of an egg-shaped portion or body measuring 37 in. × 23 in., capacity 44 gallons, and of a loose neck which is prevented from settling down and adhering to the retort by means of interposed strips of lead. The taper part of each neck rests in a lead pipe 2 in. in diameter, set in brickwork, and leading into a lead main about 16 in. in diameter which runs outside the furnaces and above the fireplaces. The escaping gases are condensed in four cylindrical lead towers measuring about 2 ft. 8 in. × 16 ft. 5 in., cooled from outside; any uncondensed vapour passes into the chimney.

The retorts are fed by means of pipe *d*, Figs. 1 and 2, with hot acid of 142° Tw. The acid feed-pipe, 3 in.

Fig. 1.

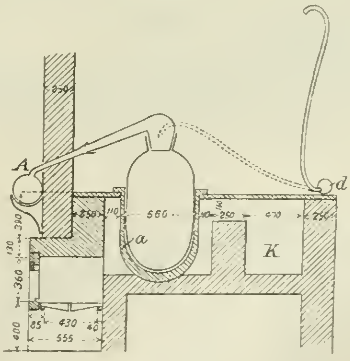


Fig. 2.

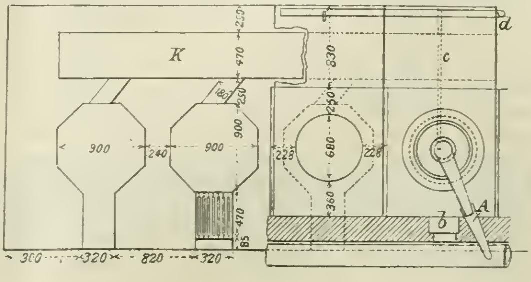
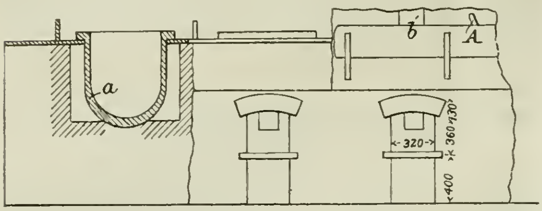


Fig. 3.



diameter, is placed on the main flue at the back of the retorts and is placed in connexion with the last of the evaporating pans for weak acid, on the one hand, and with each of the retorts by means of a ½-in. pipe, on the other. The latter can be raised when not required for feeding purposes. The whole plant is erected in a building provided with double doors to prevent draughts.

Cost of Plant.

A. Buildings.

	£	*s.*	*d.*
Buildings for concentrating in glass	328	0	5
„ „ „ „ up to 142° Tw.	139	16	7
	467	17	0

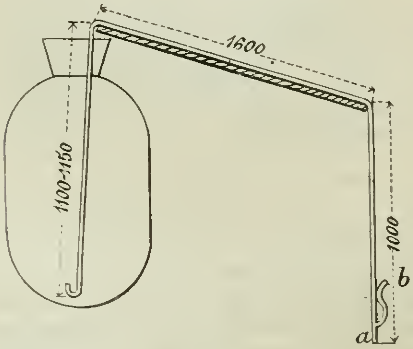
B. Materials.

	£	*s.*	*d.*
Concentrating up to 142° Tw., surface of lead pans 223 sq. ft., containing 4.93 tons of lead	61	13	0
Do. do. 9·9 tons of cast-iron	62	3	0
Do. do. masonry	58	0	0
16·2 tons of cast-iron: constructive parts for concentrating in glass	111	4	6
Masonry for concentrating in glass	130	13	7
1·584 tons of lead for pipes	19	17	9
0·24 tons of lead for siphons, air-pumps, &c.	13	12	0
2 tons of lead for condensers	37	10	0
4·5 tons of lead for coolers	101	5	0
22 retorts	30	0	7
	625	19	5

Whilst the first cost of the plant is considerably below that of a platinum concentrating plant, the depreciation is very much higher.

The vitriol of 142° Tw., which is to be concentrated, leaves the last evaporating pan at a temperature of 120—130° C., at which it is charged into the retorts. These latter are emptied by means of siphons (Fig. 4), made of a fairly resistible alloy consisting of lead with 2—3 per cent. of antimony. Two men are required for siphoning off the strong acid,—the one closing the end *a* of the tube by means of a rubber ring, and the other setting the siphon with a hand air-pump connected to *b*. The retort is not emptied entirely. The siphon is now withdrawn, the charging tube lowered, and the whole operation finished in two hours.

Fig. 4.



Meanwhile the fires are lit under the retorts and in another three hours the fresh batch is heated up to boiling point. At this stage the operation is conducted very carefully owing to the bumping of the liquor and subsequent destruction of the retorts. Another 6—8 hours boiling finishes the operation.

The 169° acid is run into lead cisterns cooled with water.

The condensation of the gases is not very efficient and a lot of acid is lost especially towards the end of an operation. These condensers yield about 0·38 ton of 53° Tw. acid per day, equal to 0·169 ton 142° Tw. acid. The uncondensed acid escaping through the chimney may amount to, say 1—1·25 per cent., but its quantity has not been determined experimentally.

The wear and tear on the retorts is considerable, 35 being broken during the first 14 months. The wear is greatest at that part of the retort where the acid changes its level.

The working results of the first 14 months are as follows.

A. Concentrating up to 142° *Tw.*

Produced 1377·2 tons, 142° Tw. acid, from chamber acid of 106° Tw., for which were required:—

	£	*s.*	*d.*
177·6 tons of coal	79	9	9
Proportion of wages	18	17	4
Repairs	19	11	9
5 per cent. interest on 325*l.*	18	19	1
10 per cent. depreciation on 181·16*l.* (materials)	21	4	3
3 per cent. depreciation on 140*l.* (buildings)	4	17	10
General expenses	17	10	0
	180	10	0

Cost of producing one ton of acid of 142° Tw.:—

	Shilling.
Fuel	1·16
Wages	0·27
Repairs, interest, depreciation	1·19
	2·62

B. Concentrating up to 169° *Tw.*

Produced 1096·5 tons of acid of 169° Tw., including about 650 tons containing 94—96 per cent. of monohydrate, for which were required:—

	£	*s.*	*d.*
659·9 tons of coal	295	5	8
Wages	137	4	0
35 retorts at 27*s.* 4*d.*	47	15	6
Repairs, materials	39	2	9
Interest, 5 per cent. on 775*l.*	45	4	1
10 per cent. depreciation on materials	51	16	5
5 per cent. depreciation on buildings	19	2	7
General expenses	42	·	0
	677	11	0

One ton of acid of 169° Tw. requires therefore:—

	Shillings.
Glass	0·871
Fuel	5·390
Wages	2·509
Repairs, interest, depreciation	3·600
	12·37

These figures show a very high consumption of fuel, due to the intermittent nature of the process, to the number of the fireplaces and to waste of heat from the retorts. With very careful working, and filling the retorts to their utmost capacity, these figures were brought down to:—

	Shillings.
Glass	0·750
Fuel	4·924
Wages	2·350
Repairs, interest, depreciation	3·384
	11·408

The continuous process as used in England yields considerably better results. At Messrs. Chance Brothers, (Oldbury), four retorts are connected to a series, and two series work into a common flue. The retorts are heated with Bunsen burners. For further particulars, *see* Lunge, Sulphuric Acid and Alkali Manufacture, 1st volume, 1891 edition.—H. A.

The Occurrence and the Formation of Glauber's Salt in the Potash Deposits of Kalusz. R. Zaloziecki. Monatsh. Chem. **13**, 504—509.

The salt mountains of Kalusz (Galicia) consist chiefly of a saline clay, containing in the lower strata upwards of 50 per cent. of saline matter. In this mountain there is a vein of *Kainite* about 10—12 metres in thickness, and promising a yield of about 200,000 tons. In a hollow situated on the top of this layer, and exposed to the action of surface-water, the author observed a considerable quantity of crystalline matter separating from the drainage. The crystals contained $93\frac{1}{2}$ per cent. of $Na_2SO_4.10\,Aq$. They could not have originated from the upper layer, since this consisted of clay contaminated with gypsum. A laboratory experiment, in which a 10 per cent. solution of salt at a temperature of 5°—8° C. was run through a tube charged to a height of 30 cm. with ground kainite, decided the question. The resulting solution was caught in four portions, of which the second deposited, on standing overnight, crystals consisting of $Na_2SO_4.7\,Aq$, whilst the other portions yielded, on evaporating and cooling, crystals of sodium sulphate.

The sodium sulphate owed its formation from the kainite in presence of water to the following change:—

$$2\,NaCl + MgSO_4 = Na_2SO_4 + MgCl_2$$

It is an interesting fact that in all the portions tested, the easily-soluble sodium sulphate separated out before the more insoluble gypsum. Evidently the presence of sulphates modifies somewhat the solubility of gypsum.—H. A.

PATENTS.

Improvements in the Production of Chlorine conjointly with the Purification of Lead and the Recovery of Silver. F. M. Lyte and C. H. Lyte, London. Eng. Pat. 17,745, October 16, 1891.

The object of this invention is the production of chlorine from calcium or magnesium chloride The chlorides are decomposed with lead nitrate, and the lead chloride so formed is utilised for the electrolytic production of chlorine; the nitrate of calcium (magnesium) which is simultaneously formed is heated for the recovery of the nitric acid, to be used for dissolving fresh quantities of previously oxidised lead. Silver and other metals may be precipitated from this solution by the addition of spongy lead.

As an alternative way of working, hydrochloric acid is used instead of the chlorides for decomposing lead nitrate (or acetate), the products being lead chloride and free nitric acid, which is used for dissolving fresh quantities of previously oxidised lead, and the silver thereby recovered.

The fused lead chloride may be electrolysed in a glazed earthenware or enamelled iron vessel kept at a suitable temperature. The cell is closed on the top, and is provided with a feed pipe for the lead chloride, a chlorine outlet pipe, and a syphon for drawing off the molten lead. The carbon electrodes—alternately anodes and cathodes—are securely fastened to the lid. In another arrangement the carbon plates are all anodes, the molten lead forming the cathode.—H. A.

Improvements in Apparatus for Concentrating Sulphuric and other Acids. C. J. Schofield, Manchester. Eng. Pat. 19,780, November 14, 1891.

In the usual way of concentrating sulphuric acid in glass retorts considerable wear and tear is caused by the unequal temperature to which the different parts of the retort are subjected. The improvement consists in making the retorts in halves, the lower part to contain the vitriol, and the upper part, made of suitable material, serving as a hood. Each hood is provided with a sight-hole fitted with a glass cover, and with a syphon for the circulation of the vitriol in a series of retorts. The body of the retort is set in brickwork in such a way that in case of breakage the vitriol is caught in a gutter.—H. A.

Improvements in the Production of Chlorine, in the Purification of Lead, in the Recovery of Precious or other Metals with which the Lead may be associated, and in Means or Apparatus employed therein. F. M. Lyte, London. Eng. Pat. 21,464, December 8, 1891.

The main object of this invention is the production of chlorine from hydrochloric acid. The first stage of the process consists in the conversion of hydrochloric acid into lead chloride. This may be effected (1) by boiling lead oxide with hydrochloric acid, adding spongy lead to the solution to precipitate silver, and crystallising out the lead chloride; (2) by precipitating lead nitrate or acetate with hydrochloric acid, using the free acid formed for dissolving more lead, and thus leaving the silver behind; (3) by treating granulated lead alternately with hot hydrochloric acid and air, thereby producing lead chloride, and finally precipitating the silver by means of spongy lead.

The conductibility of the carbon electrodes may be improved by making them with a core of iron or other metal in the form of a plain or corrugated or perforated plate.—H. A.

Improvements in Furnaces for Burning Ores containing Sulphur or Sulphur Compounds. J. S. McDougall, Manchester. Eng, Pat. 22,504, December 24, 1891.

The apparatus consists of a series of cylindrical cast-iron rings one above the other, and separated by means of suitable partitions. A vertical rotating shaft passes through the vessel, carrying arms to strike over each partition. The pyrites are charged in on the top, and are raked down, passing through alternately-placed openings from shelve to shelve, the burnt cinders leaving on the bottom. The shaft is made in several lengths, coupled together by widening one end of a shaft to form a square socket, and fitting into this the square end of the other shaft, the two secured by means of a square key wedged between socket and square end; a tight-fitting spring clip protects the coupling from the action of the sulphurous acid gas. The furnace rings are jointed together by half check-joints secured by set pins and rust jointing; the ends of the pins are not exposed to the corrosive fumes.—H. A.

Improvements in or Connected with the Supply of Liquor to Ammonia Stills. J. J. Meldrum and T. F. Meldrum, Manchester. Eng. Pat. 22,828, December 31, 1891.

A constant rate of feed may be obtained by interposing an elevating feed-tank between the pump (or injector) and the still, and by keeping the head of liquor in this vessel at a uniform height. Any variation in the liquor level is transmitted by means of a float on to a reflux valve, which causes the excess liquor to flow back into the well of the pump. In another device the float is connected to the steam-valve of the injector, and thus regulates the quantity of liquor delivered.—H. A.

Process and Apparatus for the Manufacture of Concentrated Nitric Acid. F. Valentiner, Plagwitz, Germany. Eng. Pat. 610, January 12, 1892.

Colourless nitric acid of about 118° Tw. may be produced by distilling in vacuo a mixture of dry saltpetre and sulphuric acid of 169° Tw. The apparatus consists of a retort, cooler, receiver, vacuum chamber, and air pump.
—H. A.

Improvements in the Manufacture of White Lead by the Acetate of Ammonia Process, more especially in respect of the Regeneration and Recovery of Acetate of Ammonia from the Weak Liquors and Washings Furnished in the Process. W. Smith, London. Eng. Pat. 790, January 14, 1892.

This invention refers to the weak liquors and washings obtained at various stages of the MacIvor process for the manufacture of white lead. These liquors represent weak solutions of acetate of ammonia, and the latter cannot be satisfactorily recovered by concentrating the weak liquors by evaporation. The inventor proposes to distil them with slaked lime, in just sufficient excess, and to condense the ammonia thereby evolved in sulphuric acid. Acetate of lime remains in the still, and this salt may then easily be recovered by evaporating the solution after filtration. The sulphate of ammonium obtained as above is suitably concentrated and mixed with its equivalent of the acetate of lime, also suitably concentrated. The liquid is heated to 25°—30° C., and kept thus for 12 hours, when a practically complete separation of sulphate of lime will have taken place. On filtering cold through the filter press, the clear liquid obtained is a sufficiently pure solution of ammonium acetate for re-use in the MacIvor white lead process.

—C. O. W.

Improvements in the Treatment of Solutions of Arsenic or of Salts of Arsenic for Diminishing the Danger incidental to their Transport, Storage, and Use. J. S. and J. T. McDougall, London. Eng. Pat. 1438, January 25, 1892.

The solutions of arsenic or salts of arsenic are mixed with an infusorial earth for the purpose of solidifying and making them more suitable for transport.—K. E. M.

Improvements in the Treatment of certain Corrosive or Poisonous Liquids, to Render them capable of being Transported, Stored, or Used with less Danger than hitherto. J. S. and J. T. McDougall, London. Eng. Pat. 1439, January 25, 1892.

Sulphuric acid, hydrochloric acid, solutions of metallic salts, tobacco extract, &c., are made more suitable for transport by mixing them with an infusorial earth (such as Kieselguhr) in such quantities that the resulting product forms a solid or semi-solid mass.—K. E. M.

Improved Manufacture of Sodium and Potassium Bichromates. O. Imray, London. From M. M. Rotter, Berlin, Germany. Eng. Pat. 1642, January 27, 1892.

Sodium and potassium bichromates are produced from their neutral salts by treatment with carbonic acid according to the following formula—

$$2\ Na_2CrO_4 + 2\ CO_2 + H_2O = 2\ NaHCO_3 + Na_2Cr_2O_7$$

When a cold concentrated solution of sodium chromate is treated with carbonic acid sodium bicarbonate is precipitated. This is separated and the bichromate solution concentrated by evaporation and again carbonated in the cold until the conversion is complete. When a concentrated cold solution of potassium chromate is carbonated potassium bichromate is precipitated, whilst potassium bicarbonate remains in solution. The precipitate is purified by recrystallisation, whilst the mother liquor is concentrated by evaporation and used in place of potash for smelting chromium ore.—K. E. M.

Improvements in the Electrolytical Decomposition of Alkaline Chlorides for the Production of Chlorine and Alkalies, and in Apparatus therefor. C. A. Faure, Paris. Eng. Pat. 16,262, September 10, 1892.

The apparatus consists of any number of electrolytic vessels formed by porous brick walls, each surmounted by a cap piece of non-porous material; diaphragms composed of slabs of porous material arranged parallel to and at a convenient distance from the walls; and partitions formed of a mixture of suitable substances, such as clay, carbon, and bitumen, kneaded, agglomerated, and baked in an oven so as to form non-porous conducting electrodes. These electrolytic vessels are placed on some non-conducting impervious material foundation such as bricks of sandstone and slates connected by a bituminous cement. The several walls, diaphragms, and partitions are firmly stayed by distance pieces arranged to allow of a free circulation in each compartment, and the compartments formed between the electrodes are rendered fluid tight and cemented to the sandstone side walls with bitumen. Each of the compartments formed between the electrodes and the diaphragms and between the electrodes and the walls is charged with very dense coke which serves as an electrode and to protect the electrodes proper from the action of the products of electrolysis. An arrangement of pipes is provided for supplying the electrolyte and for removing the gaseous products of electrolysis. To start with a solution of equal weights of acid sulphate of soda and sodium chloride is employed, and subsequently the proportion of sulphate is reduced to two per cent. The solution is heated to 20° or 30° C. before it is admitted into the compartments, and the gaseous products of electrolysis, consisting principally of chlorine, oxygen, and carbonic acid, are caused to pass into a purifier, and then over hydrate of lime, preferably after passage through a column of incandescent coke.—G. H. R.

Improvements in the Method of and Apparatus for Concentrating Sulphuric Acid and other Liquids. I. Levinstein, Manchester. Eng. Pat. 19,213, October 26, 1892.

Sulphuric acid or other liquids are concentrated in a series of glass vessels, arranged in steps and placed in a common heating chamber. The vessels have rounded bottoms, and are embedded in a sandbath contained in a metallic dish. The weak liquor after being heated by waste gases of combustion is fed into the uppermost vessel. Every vessel contains a lip which conveys the displaced and overflowing liquor through a loose tapered glass tube to the bottom of the next lower vessel. The fumes which leave the last vessel are condensed in cool concentrated acid. By this arrangement the high cost of concentrating such liquids as sulphuric acid is greatly reduced. The claims include the preliminary heating of the acid, by the heat of the waste products of combustion and in the type of glass apparatus employed, as illustrated in the specification, viz., "a bottle-shaped concentrating vessel blown from the top, and having on one side a spout and on the other side a hole for the insertion and withdrawal of the circulating tube, as shown," &c.—K. E. M.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Behaviour of Portland Cement in Sea-Water. W. Michaëlis. Inst. Civil Eng. **107**, 1891—92.

It is pointed out that concrete work, durable in sea-water, is only to be secured by providing a completely impervious mortar, prepared in a proper manner from suitable cement. Sea-water, owing to the salts, and especially the sulphates in it, exerts a solvent and destructive action on mortars, removing lime, partly as chloride and sulphate, but also as bicarbonate, and leaving soft non-cementitious hydroxides of magnesia, ferric oxide, and alumina. The latter two form simultaneously ferro- or alumino calcium sulphates, which by crystallising and expanding accomplish the further disintegration of the already weakened mass; the hydrated magnesia is innocuous and may be rather useful in stopping the pores. Moreover, it is the calcium aluminates and ferrates which are most readily attacked by sea-water, therefore it is not surprising to find that the action of sea-water on mortars is in proportion as the cements employed are poorer in silica and richer in alumina and ferric oxide. The author has analysed some well-known brands of cements with the following results:—

—	Chaux du Theil.	Cement Grapier.	Santorin Earth.	Stern Cement.	Zullchow Cement.	Lebbin Cement.	Wickede Cement.
Silicon	22·59	25·85	65·43	23·65	23·94	25·61	5·36
Titanic acid	..	..	0·69	..	..	..	..
Alumina	2·63	3·03	15·01	5·74	5·73	3·78	4·67
Ferric oxide	0·84	1·10	1·88	2·40	2·45	2·05	3·16
Ferrous oxide	..	..	2·06	..	..	..	..
Manganous oxide	..	..	0·50	..	..	..	..
Lime	65·62	61·27	2·84	64·62	64·87	65·24	65·04
Magnesia	1·54	1·70	1·06	1·29	..	0·93	0·41
Potash	0·12	0·15	2·94	0·81	..	1·12	1·05
Soda	0·07	0·07	·67	0·17	..		
Sulphuric acid	0·52	0·64	..	1·23	1·42	1·27	0·02
Loss on ignition	6·42	5·89	4·29	..	..	..	..
Phosphoric acid	..	..	..	..	..	–.	0·30

The Chaux du Theil is the one which exhibits the greatest resistance in sea-water, and consists almost entirely of silica and lime. Highly siliceous cements poor in alumina set slowly, but when set, harden rapidly, ultimately attaining the highest strength; adding gypsum to cements rich in alumina to diminish the inconvenient rapidity of their setting is regarded as advantageous from all points of view, as long as too large a quantity is avoided: about 1 per cent. of gypsum, having regard to the sulphates already present, is a rational proportion. For permanent cement work in sea-water it is advisable to use a completely impermeable mixture either throughout or as a shell of considerable thickness, consisting of 1 part of cement with 2, or at the most 2½ times its weight of sand of mixed grain, of which at least ⅓ must be very fine sand, adding subsequently the requisite quantity of gravel and ballast; the cement or hydraulic limes, for reasons already stated, should be rich in silica and poor in alumina and iron. The work may be further protected by washing or spraying with ammonium carbonate or magnesium or other fluorsilicate, or better still by a 4 to 8 inch coating of a concrete composed of 1 of cement, 1 to 2 of sand, and 3 to 4 of coarse gravel, flint, broken stones, &c., and mixed with water containing 2 or 3 per cent. of the weight of the cement of barium chloride.—D. A. L.

Effect of Turpentine Gathering on the Timber of Long-leaf Pine. Eng. and Min. Jour. 1893, 99.

In Circular 8 of the Forestry Division, published about a year ago, it was stated that tests made on timbers of long-leaf pine, bled or unbled, lent countenance to the belief that bled or tapped timber did not suffer in strength by virtue of the tapping. Further tests and examinations permit now the announcement without reserve that the timber of long-leaf pine is in no way affected by the tapping for turpentine. This refers to its mechanical as well as chemical properties, and hence even the reservation that it might suffer in durability is now eliminated, and any prejudice against the use of bled timber in construction, wherever the unbled timber has been considered desirable, must fall as having no foundation in fact, being based only on vague belief, proved to be erroneous. The basis for the statement regarding the mechanical properties is furnished by a series of tests comprising not less than 300 tests, on 32 trees of this pine, bled and unbled, from various localities. To determine whether any changes in the chemical composition take place, a series of chemical analyses of bled and unbled timber has been made, which indicates that the resinous contents of the heartwood are in no wise affected by the bleeding; the oleoresins of the heartwood being nonfluid, the whole turpentine flow is confined to the sapwood.

PATENTS.

Improvements in Kilns. C. Pryce, Ruabon. Eng. Pat. 3215, February 18, 1892.

This invention relates to kilns constructed so that the hot products of combustion are made to heat the incoming air by conduction of heat through the walls of tubes conveying the air. The air is first forced into tubes by steam jets, and receives a preliminary heating in consequence of the tubes being steam-jacketed. It then enters a central channel under the floor of the kiln, and passes out on either side through horizontal iron tubes into two channels built in the sides of the kiln. From these it rises vertically through channels built in the flash wall of the kiln, and on escaping into the kiln meets with combustible gas which has been led by means of similar channels in the flash wall to the air exits. The flame and products of combustion pass over the top of the flash wall into the kiln, and through the materials placed therein, then through the perforated floor of the kiln and round the above-mentioned horizontal tubes, which become heated. Finally, the products of combustion pass to the chimney or through underground flues to other kilns, which may require heating. The gaseous fuel passes into two channels on either side of the kiln placed outside the air channels above-mentioned; it then passes into vertical channels in the flash wall of the kiln as above described. At starting only steam-heated air or the products of combustion from another kiln are passed in. When the materials are dry the gas is turned on and a higher temperature attained.—H. K. T.

Process for Preserving Timber. W. G. de Gelse, Nagy, Kaniza, Hungary. Eng. Pat. 19,947, November 5, 1892.

In this process the wood is impregnated, by any of the usual methods, with tannin solution, particularly oak-bark tannin.—A. G. B.

Improvements in Paints. R. Kieffert, Paris, and H. Thorion, Gargan Livry, France. Eng. Pat. 14,888, August 17, 1892.

See under XIII., *page* 166.

X.—METALLURGY.

Ferro-Tungsten. W. H. Wahl. J. Franklin Inst. 134, 1892, 470—472.

In course of the examination of various ferro-tungsten alloys, ranging in specific gravity from 9·3 to 10·14, it was observed that although they, in general, exhibited similar physical properties,—considerable hardness and toughness, an extremely fine crystalline texture and a fracture resembling that of tool-steel,—yet some of the fractures disclosed the presence of what appeared to be smooth cleavages of imperfect crystals scattered through the fine crystalline matrix. Further investigation of the alloy, having the sp. gr. 10·14, showed that a portion of it resisted the action of *aqua regia* and did not yield to fusion with sodium carbonate and potassium nitrate, this was heavy, black, and pulverulent, and proved to consist of uncombined tungsten. The analysis of this alloy gave the following numbers per cent.:—C, 0·85; P, 0·04; Si, 0·14; Mn, traces; Fe, 42·28; W (alloy), 34·35; W (uncombined), 22·54; total = 100·20. These numbers appear to indicate that the saturation point of iron for tungsten is reached, with the proportions Fe_4W, and that any excess of tungsten above this ratio remains in an uncombined state.—D. A. L.

The Treatment of Copper Ore at Bogoslowsk, Russia. Eng. and Mining Jour. 1893. 6—8.

Ores.—The ore treated is a cupriferous pyrites, which occurs in veins of diorite, containing 4 to 5 per cent. of copper. The composition, from analysis made in 1889, is as follows:—

——	Bachmakoff.	Rachette.	Troitzky.	Pestchank.
S	10·04	1·58	0·33	4·52
SiO_2	14·93	37·65	45·70	32·70
Fe_2O_3..........	55·42	19·61	18·85	26·42
Al_2O_3	1·84	2·39	3·44	4·53
MnO...........	0·50	0·55	0·46	0·85
CaO	5·68	11·75	10·75	26·17
MgO...........	Traces	Traces	..	..
CuO	5·62	3·88	3·44	1·59

The average cost of the roasted ore on the ground at the mines is 10·424 roubles per ton.

The Reduction Works.—These works, which were at a standstill in 1875, have undergone great improvements since 1881. The former treatment consisted in roasting the ores in heaps and in several furnaces, and in smelting copper-iron matte to copper. This iron-copper matte was roasted in furnaces, then smelted to black copper in a refining furnace. The black copper, containing 90 per cent. copper, was refined in a reverberatory furnace. M. Auerbach began to change the old system, and among other departures he introduced the smelting for white-metal of 60 per cent. copper. Later, in 1886, he began to consider the employment of the Bessemer converter, which up to that time had given poor results. The attempt was entirely successful.

The Bessemer Process.—The application of the Bessemer process to copper mattes presents great difficulties. When the production, at one operation, of black-copper from iron-copper mattes is attempted, the temperature of the metallic bath falls very low towards the end. At the beginning, owing to the combustion of the iron and sulphur, the temperature is high; at the end, however, the black copper is scattered through the very fluid matte and sponges are formed which thicken the bath, and are violently cast out by the blast. It is owing to this that large losses of copper occur. At the end the copper obtained is spongy, poor and refined with difficulty. M. Auerbach divided the operation into two parts, a first oxidation giving a white metal containing 60 per cent. copper, and a second, black copper of 96 per cent., with the great advantage of separating the poor slags of the first operation from the rich ones of the second. This division has caused considerable improvement, less copper is lost and there is but a slight increased expense owing to the fusion of the matte in a reverberatory furnace. In a converter of the Manhès type the tuyeres are in a horizontal position almost at the surface of the bath. Shortly after the beginning of the operation slags are abundantly formed on the surface. The blast then acts on these slags and not on the matte, and the oxidation is much less energetic. If the tuyeres are placed vertically at the bottom, as in the Bessemer converter for steel, the black copper remains at the bottom, the blast then blows through the copper, giving rise to projection of the matte and losses. M. Auerbach places the tuyeres at an angle of 45°, and so calculates the quantity of the charge that when the white metal or black copper is formed, the surface of the separation of the matte or of the copper, and the slag is almost at the outlet of the tuyeres. In this manner he does not blow through the slags, nor does he oxidise the product, rich in copper, which remains at the bottom.

M. Auerbach finds that the ordinary clay found close to the works answers sufficiently well for the linings of both reverberatory furnaces and converters. This common clay is hardly attacked any more than silicious bricks, and is replaced with slight expenses. Under these conditions the Manhès process has become a success.

First Operation.—The mattes are obtained by a fusion of the copper ores in the furnaces of the old plant. They contain on an average 20 per cent. of copper. They are raised by means of an hydraulic lift to a higher level than the reverberatory furnaces, and are then shovelled into them. Each charge is of 1·6 ton, and the fusion lasts about three hours. When the matte is melted the converter is turned horizontally, and the matte is run from the furnace to the mouth of the converter through a trough lined with a mixture of charcoal and quartz. When the furnace is empty the converter is turned back and the blast commenced. The first operation is to eliminate the iron and to obtain a rich white metal; it does not last over 25 to 30 minutes. The combustion of the iron and sulphur rapidly raises the temperature of the "float." The flame, which laps the mouth of the converter, is yellow, violet-edged, and is crossed by brilliant sparks. When the flame diminishes and becomes green it is a sign that the iron is burnt, and when it becomes entirely green the operation is ended, and the matte is run into moulds. After cooling the slag is separated from the matte by a blow of a hammer. The white metal averages 64 per cent. of copper.

Second Operation.—The white metal is melted in a reverberatory furnace, and is then treated as in the first. This second blow is more difficult than the first. The temperature is very low, owing to the scarcity of sulphur, and this, which is the chief impurity to be eliminated, is not disengaged at a low temperature. At the moment the metal threatens to congeal, when the projections appear, charcoal is thrown into the converter to raise the temperature. The blow lasts from one hour and thirty minutes to two hours. It is considered finished when on introduction of a shovel in the converter the projections, which solidify upon it as they descend, are no longer of white metal. The flame which was green at the beginning is now yellowish-red. The slag flows out first when the converter is turned, and then the black copper, which latter is refined in a reverberatory furnace. The slag contains about 5 per cent. of copper. In the same converter there are three or four operations for white metal, then two for black copper, and then two or three again for white metal in order to dissolve the masses of copper which remain in the converter.—J. C. C.

The Estimation of Aluminium in Steel. W. Schöneis. Stahleisen, 1892.

See under XXIII., *page* 182.

Estimating Small Quantities of Silver and Gold in Base Metals, Mattes, &c. C. Whitehead. J. Anal. and Appl. Chem. 6, 1892, 262.

See under XXIII., *page* 183.

Further Researches in Connection with the Metallurgy of Bismuth. Edward Matthey. Chem. News 67, 63. Proc. Royal Society, January 26, 1893.

In 1886—87 and in 1890 papers were submitted to the Royal Society bringing under notice facts which had come to the author's knowledge whilst engaged upon the practical extraction of this metal from its ores, and in its separation from impurities which are always associated with it when in a crude or unrefined state.

IV.—*Bismuth: Its Separation from Arsenic.*—In a paper dated 10 February 1887 (Proc. Roy. Soc., vol. xlix.), allusion is made to the fact that arsenic is often one of these impurities, and at the same time a method is given by which the separation of this metal from bismuth was then successfully effected.

The process adopted when that paper was read, and for a considerable period subsequently, when working upon bismuth containing arsenic, consisted in removing the arsenic by fusing the arsenical bismuth in contact with metallic iron at a dull red heat and under flux. A compound of iron and arsenic was thus formed and could be removed as a scum,—the disadvantages of this process being, first, loss of bismuth by volatilisation, and, secondly, much loss of time in the manipulation of any large quantity to be treated.

Having occasion, a few months ago, to melt together a large quantity of arsenical bismuth, some 700 or 800 kilos., that is, more than three-quarters of a ton, in order to obtain a homogeneous alloy upon which to work subsequently by the process above alluded to, it became evident that when the temperature was raised above the melting-point of bismuth, the surface of the metal being exposed to the atmosphere, arsenical fumes appeared, and that these increased as the temperature of the metal became more elevated, the result being that the arsenic came off in dense white fumes (As_2O_3).

The observation of this fact led to further experiments, and it was found that if the surface of the bath of fused arsenical bismuth was freely exposed to the air at a temperature rather higher than its own melting point, and if the molten metal was constantly stirred, it was possible to eliminate the whole of the arsenic alloyed with the bismuth by this simple process of fusion with stirring.

As it is a matter of considerable interest for metallurgists to know, not only that this elimination does take place, but also at what temperature it occurs, a series of experiments have been conducted with a view of determining this accurately.

The work of Roberts-Austen (Proc. Inst. Civil Eng. 110, Part iv.) has shown that a thermo-junction is practically the only form of pyrometer that can be used for delicate thermal investigations of this kind, but the question arose which particular thermo-junction should be adopted. Was it well to use the platinum-iridium one as advocated by Barus, or the platinum-rhodium one suggested by H. le Chatelier? (see also this Journal, 1892, 840, 774; and 1890, 326—327). The author's previous work on the alloys of platinum and rhodium, lately published in the Phil. Trans., settled the question in favour of the rhodium-platinum thermo-junction, for he was satisfied that the alloy of platinum with 10 per cent. of rhodium is as homogeneous as any known alloy could well be, and is therefore admirably adapted for use as a thermo-junction, pure platinum being the opposing metal. Analysis proved that the alloy operated upon in these experiments contained 0·65 per cent. of metallic arsenic.

It will be seen that the melting-point of this alloy of bismuth is 278° C. By raising the temperature of the alloy to 395° C. the arsenic freely sublimates from the bismuth alloy, and at a temperature of 513° C. the whole of the arsenic is eliminated.

A point of much interest in relation to molecular physics became evident in the course of the investigation. Arsenic, as is well known, volatilises at the comparatively low temperature of 180° C., without passing through the molten state. Arsenic is not, however, given off freely from the arsenical bismuth until a temperature of 395° is reached. So that the temperature of dissociation of this alloy, containing 0·65 per cent. of arsenic, is 114° C. higher than the melting-point of the mass. It was interesting to determine at what temperature the arsenic would be evolved if the alloy were heated *in vacuo*.

A portion of the bismuth alloy, containing 0·65 per cent. of arsenic was introduced into a hard glass tube, slightly depressed to its centre, and connected at one end with a Sprengel pump, by which it could be rendered vacuous.

The pyrometric wires were in contact with the metallic alloy and passed to the galvanometer through the opposite sealed end of the glass tube.

Heat being applied, the first indication of the volatilisation of the arsenic, shown by the condensation of a film on the cool part of the tube, occurred at 275° C. When the alloy was quite melted the temperature indicated was 316° C.; arsenic came off freely when the temperature rose to 569° C., condensing in a black mirror.

The metal was then allowed to cool, and its setting-point was found to be 268° C., which corresponds with that of the melting-point of bismuth.

The bulk of the arsenic does not appear to be evolved *in vacuo* at a lower temperature than in air.

As regards the industrial application of the process, some 10 to 12 tons of arsenical bismuth have already been treated in this very simple way, and it has been satisfactorily ascertained that there is no loss of bismuth by volatilisation with the arsenic.

V.—*The Separation of Bismuth from Antimony.*—The process hitherto adopted in practice for the separation of antimony from bismuth has usually consisted in a simple fusion at a dull red heat with bismuth oxide or bismuth "litharge"—an operation successful enough as to its results, but one requiring no small amount of skill in manipulation; it is also one by which only small quantities can be treated readily at one time—and moreover, the temperature which is necessary to effect the separation of the antimony involves appreciable loss on account of the volatilisation of the bismuth at a red heat; notwithstanding many tens of tons of bismuth have, however, been treated under my direction by this process.

In an operation lately conducted, involving the melting of a quantity of bismuth containing about 1 per cent. of antimony, it was found that a peculiar oily film was noticeable rising to the surface of the melted alloy; this film did not form all over the surface of the metal, but appeared to rise as from a boiling centre, and this although the metal was at a temperature very little above its melting-point. A portion of the film or layer was removed and tested in order to ascertain its nature, and it was found to contain a very appreciable proportion of *antimony.* The author therefore caused the operation to be continued, stirring the metal from time to time with a dried wood stirrer. In the course of three or four hours, removing the film from time to time, the surface of the melted metal assumed a much brighter appearance, and on carefully testing it at this point the metal was found to be *absolutely free from antimony.* To confirm this and to ascertain more exactly the conditions under which this separation takes place, a further quantity of impure bismuth was operated upon in a similar manner. This second quantity contained other impurities besides antimony, its analysis being as follows :—

Bismuth, by difference	96·20
Antimony	0·80
Tellurium	0·40
Lead	2·10
Copper	0·50
Arsenic	traces
	100·00

The same simple process of fusion and stirring was again adopted—the quantity being about 350 kilos.—and when the same oily film commenced to rise to the surface the temperature of the molten mass of the alloy was taken by means of the le Chatelier pyrometer. A portion of the film removed showed, on being tested, a percentage of over 30 per cent. of antimony. A slightly perceptible fume of arsenic was apparent, thus proving what the author found to be the case in the separation of arsenic by simple fusion.

The point at which this separation of antimony occurs was found to be about 350° C., and at this temperature the metal was maintained for about five hours.

The evidence of an oxidising action became now much less, and although a very small amount of antimony was present there was still a little remaining in the alloy; the temperature, therefore, was slightly raised and maintained at 458° C., as shown by the pyrometer, for about four hours. at the end of which time the bismuth became absolutely free from antimony.

The form in which the antimony separated was peculiar —a transparent glass, consisting of antimony oxide—containing about 10 per cent. of bismuth; but, of course, in the removal of the antimony oxide a small proportion of the bismuth was mechanically carried with it, resulting in the production of several very interesting and very beautiful metallurgical specimens.

The great advantage of this process is—like that of the foregoing separation from arsenic—its extreme simplicity, the low temperature which renders it possible to work upon very large quantities at one time, and the very small amount of time necessary for this separation in comparison with the process hitherto adopted, and the absence of loss in the bismuth operated upon by volatilisation. It is obvious that where metals can be so easily treated in large quantities, the labour and skill hitherto necessary is very considerably reduced, and there is the additional advantage that the loss attending large operations is minimised.

In this and in previous papers upon bismuth, the author has been able to point to simple dry processes for its separation from gold, lead, copper, arsenic, and antimony, and all these processes are available for treating with care large quantities at one time. When it is remembered what is involved in having to dissolve any quantity of bismuth in acids, and its subsequent precipitation from solution, it surely will be admitted that much of the difficulty in purifying crude bismuth has been effectively removed, as the methods given have been found possible in practice, and advantageous.

PATENTS.

Improvements in the Treatment of Low Steel. H. A. Harvey, Orange, U.S.A. Eng. Pat. 401, January 10, 1888. (Second Edition.)

This patent relates to the heating of low-grade steels imbedded in powdered charcoal so as to produce higher grade steels for tempering. If a high degree of hardness is required, the material under treatment is submitted to a high temperature (about 3,000° F.). A low-temper steel is obtained with the temperature of about 1,500° F., and intermediate temper steels between these limits of temperature.—A. W.

Improvements Relating to the Manufacture of Steel. Compagnie des Hauts-Fourneaux, Forges et Aciéries, &c., St. Chamond, France. Eng. Pat. 19,860, June 11, 1891.

This is a process for desulphurising the materials employed in the manufacture of steel by adding a molten slag of suitable composition at the moment of or after the fusion. The slag must contain silicon about 12 per cent., earthy or alkaline earthy bases about 65 per cent., and various metallic oxides about 10 per cent. Manganese is recommended among the metallic oxides on account of its great affinity for sulphur.—J. H. C.

Improvements in the Concentration of Pyritic Ores, some Constituents of which are Removed by Hydrochloric Acid, with or without the Addition of Haloid Salts of the Alkalis or Alkaline Earths. H. W. Wallis, London. Eng. Pat. 17,621, October 15, 1891.

Pyritic ores are treated with hydrochloric acid in order to separate the sulphides soluble in acid from those which are insoluble, such as silver, gold, and copper sulphides. Refractory ores are heated to a temperature below that of redness before the treatment with acid, care being taken to exclude free access of air. The peroxides are reduced by the sulphuretted hydrogen evolved during the process, and are thereby made soluble. Should the ore contain an insufficient quantity of sulphides which yield sulphuretted hydrogen on treatment with acid, the necessary amount of an artificial sulphide must be introduced. Chlorides of alkalis or alkaline earths greatly promoting the solubility of chloride of lead should be added if much lead is present.—K. E. M.

Improvements in Furnaces for Burning Ores containing Sulphur and Sulphur Compounds. J. S. McDougall, Manchester. Eng. Pat. 22,504, December 24, 1891.

See under VII., *page* 155.

Improvements in the Manufacture of Steel. G. W. Clark, Birmingham. Eng. Pat. 1530, January 26, 1892.

Blow-holes are diminished or removed from steel, and sulphur is at the same time eliminated by forcing beneath its surface or stirring into it while in a molten state a fusible slag composed of clay, calcium hydrate, and charcoal in certain specified proportions, and with or without additions of fluorspar, common salt, or other ingredients. In some cases the molten steel is surrounded with an atmosphere of coal-gas during the operation.—J. H. C.

Improvements in Cupolas or Furnaces for Melting Iron. T. C. Fawcett, T. C. Fawcett, jun., and G. Dyson, Leeds. Eng. Pat. 1901, February 1, 1892.

The spent heat and waste gases arising from the furnaces are employed in heating the air for the blast, which is made to enter through a coiled pipe placed under the dome of the furnace and above the charging door.

To prevent the entrance of cold air while charging, the charging-opening is closed with a sliding door, in front of which is a hopper, in which the coke and metal are placed until they are required to be introduced, when, by sliding away the door they fall at once into the furnace, and the opening is immediately closed.—J. H. C.

Improvements in the Extraction of Tin and other Products from the Refuse Slags and Débris of Tin Smelting Furnaces. W. Muir, Edmonton. Eng. Pat. 1907, February 1, 1892.

The slag or *débris* is powdered and then mixed with ferrous chloride, ferric chloride, calcium chloride, "bleaching powder," or magnesium chloride, or with a mixture of two or more of these. The whole is then suitably heated in a reverberatory or other furnace. In this way soluble chlorides of tin, tungsten, antimony, arsenic and iron are formed, which may be dissolved out with water or dilute hydrochloric acid, and the metals or their sulphides are separately precipitated by suitable precipitants.—J. H. C.

Improvements relating to the Extraction of Lead and to Apparatus therefor. B. Rosing, Charlottenburg, H. Foerster and K. Foerster, Berlin, Germany. Eng. Pat. 2261, February 5, 1892.

In the interaction of oxide and sulphide of lead in the ordinary reduction process the sulphurous acid which is evolved is dilute and mixed with smoke owing to the materials being artificially heated in the furnace. To avoid this, the patentees first separately melt the oxide and heat the finely-powdered sulphide and pour the former on to the latter or add the latter to the former in a suitable furnace. No further heating is required as sufficient heat is generated in the reaction to keep up the decomposition. The sulphurous acid is thereby obtained in a concentrated form suitable for collection and use.—A. W.

An Improvement in Blast Furnaces. W. Hawdon and R. Howson, Middlesbrough. Eng. Pat. 9592, May 20, 1892.

In the ordinary blast furnace the interior begins to widen immediately above the tuyeres, forming the bosh. The authors elevate this bosh to a position midway between the tuyeres and the hopper where the furnace material is still in a solid and inadhesive state. The lower half of the furnace is cylindrical or it may have a small bosh close to the tuyeres. The large bosh higher up the furnace may be divided into two or more stages or tiers. The object of these changes from the present form is to prevent the formation of scaffolds caused by the portion of the charge which is in a semi-fluid state becoming wedged and adhering to the inclined walls of the bosh.—A. W.

Improvements in Metallurgical Furnaces. T. N. Lauth, St. Louis, U.S.A. Eng. Pat. 18,125, October 11, 1892.

The improvement consists in making the melting chamber larger in size as the stack is approached, by gradually increasing the height of the arch.—J. H. C.

Improved Method of and Apparatus for Decarbonizing Iron. W. A. Baldwin and F. G. Wheeler, New York. U. S. A. Eng. Pat, 19,155, October 25, 1892.

In the converter instead of the tuyeres being in the base they are divided and placed at opposite sides preferably three on each side. Those on one side are inclined upward and open into the converter just below the surface of the molten metal whilst those on the other side are inclined downward and enter the converter a little way from its base. The blast coming through both sets of tuyeres at the same time gives the molten metal a vertically gyratory motion. In addition to this the tuyeres may enter the converter slightly obliquely in the horizontal plane so that the metal will have in addition to the above motion a horizontal circular movement imparted to it.—A. W.

An Improved Solder for Aluminium. W. A. Briggs, Dundee. From J. W. Richards, Philadelphia, U.S.A. Eng. Pat. 20208, November 9, 1892.

The film of oxide which forms in soldering aluminium surfaces is prevented by diffusing throughout the solder a reducing agent whose affinity for oxygen is greater than that of aluminium and whose oxide is substantially non-film-forming, so that it can act during the period of actual soldering, and hence no opportunity afforded for the formation of a film of aluminium oxide. The agent used is phosphorus in conjunction with aluminium, zinc, and tin. The proportions may vary, but the following is given as an example of the preparation of the solder. One part by weight of aluminium is melted in a crucible and eight parts of zinc added. In another crucible thirty-two parts of tin are melted and one part of phosphor tin (5 per cent. P.) added. The diluted phosphor tin is then poured into the melted alloy of zinc and aluminium and cast into suitable bars. These proportions are found to be most suitable for general use. An increased percentage of tin will give a lower melting point whilst an increased percentage of aluminium and zinc will make a stronger solder.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements Relating to the Electrolysis of Metals. E. Placet and J. Bonnet, Paris, France. Eng. Pat. 22,854, July 17, 1891.

In a previous patent (No. 9344, 1890) the addition of acid to the bath to prevent the deposit of oxides at the negative was recommended. Since then it has been found better to form the baths of solutions of salts acid in themselves. For instance, in the case of chromium the bath recommended is as follows:—

	Grms.
Chrome alum	10 to 15
Bisulphate of soda potash or ammonia, or a mixture of these bi-sulphates.	10 „ 15
Water	100

or preferably:—

Chrome alum	10 to 15
Alkaline bi-sulphate	10
Neutral alkaline bi-sulphate	10
Water	100

The advantages found in the employment of bisulphates are also found in the case of the bi-phosphates, bi-chlorides, bi-acetates, and other acid salts in the state of bi-salts or polyatomic salts produced from organic as well as mineral acids. What applies to chromium applies also to baths of other metals, such as aluminium, copper, nickel, cobalt, tin, antimony, silver, &c. *See* following patent No. 22,856. of 1891.—G. H. R.

Method of Extracting Chromium by the Aid of Electrolytic Baths with Chromic Acid Base. E. Placet and J. Bonnet, Paris, France. Eng. Pat. 22,856, July 17, 1891.

The bath may be formed of 1 to 2 grms. of chromic acid in 100 grms. of water, but the more concentrated the solution the more abundant the deposit. The shade of the metal deposited may be varied by adding to the solution a small quantity (5 to 10 grms. per litre) of one of the following acids:—

Phosphoric, sulphuric, oxalic, benzoic, formic, gallic, pyro-gallic, picric, phemic, salicylic acids, which give white deposits of chromium.

Acetic and hydro-fluosilic acids give brilliant deposits, but darker.

Boric acid gives dull deposits, but very abundant.

Finally, sulphuric, nitric, hydrochloric, arsenious, tartaric, citric, lactic, tannic acids, give deposits of a shade more or less dark according to the quantity employed. To prepare the bath chromic acid obtained by the ordinary processes may be employed, or it may be produced during the deposition by using for the bath a solution of an alkaline bi-chromate into which is poured, by successive small quantities, sulphuric, nitric, hydro-fluosilic or any other acid, which by combining with the alkaline base liberates chromic acid.—G. H. R.

Improvements in the Production of Chlorine conjointly with the Purification of Lead and the Recovery of Silver. F. M. and C. H. Lyte, London. Eng. Pat. 17,745, October 16, 1891.

See under VII. *page* 155.

Improvements in the Electrolytic Treatment of Copper and Silver Ores. C. Hoepfner, Giessen, Germany. Eng. Pat. 22,030, December 16, 1891.

In the lixiviation of copper and silver ores or mattes with cupric chloride, as described in a former specification No. 4626 of 1888, part of the iron contained in the ore is always dissolved. When such a liquor, containing the chloride as cuprous chloride, is subjected to electrolysis, and the cuprous chloride is thus reconverted into cupric chloride, the cupric chloride solution obtained, and which must be used again for lixiviation, will, on account of the presence of too great a quantity of iron, be liable to become too exhausted for the lixiviation, and the cycle will be gradually disturbed. To obviate this the iron must be removed from the liquors with regeneration of the cupric chloride employed for its solution. This is effected either indirectly by the addition of alkalis, alkaline earths, or their carbonates, whereupon the precipitate produced is by filtration or otherwise separated from the clear liquor, the latter being acidified and oxidised by means of oxygen, or else directly by treatment of the neutral ferriferous liquor with oxygen or air, which may be effected by the introduction of oxygen or air into the solution, or with cuprous oxychloride, ferric oxide being precipitated and the equivalent quantity of cuprous chloride being transformed into cupric chloride, as represented by the following equation:—

$$2\ Cu_2Cl_2 + 2\ FeCl_2 + 3\ O = 4\ CuCl_2 + Fe_2O_3.$$

Improvements in Bleaching and Disinfecting Starch and Fecula by Electrolysis. E. Hermite, Paris. Eng. Pat. 1061, January 19, 1892.

See under XVI., *page* 168.

Improvements in or Relating to Tanning by Electricity. R. Pinna, Turin, Italy. Eng. Pat. 1786, January 29, 1892.

See under XIV. *page* 166.

Improvements relating to Galvanoplastics or the Electro-Deposition of Metals. P. H. Bertrand, Paris, France. Eng. Pat. 3120, February 17, 1892.

This invention relates to the use of orthophenol-sulphurous acid, metaphenol-sulphurous acid, and paraphenol-sulphurous acid, which are easily soluble in water and powerful solvents of tin, in place of pyrophosphate of soda for all electro-plating purposes.—G. H. R.

Improved Process of Recovering Tin from Tin Scraps. J. P. Bayly, London. From J. J. Naef, Paterson, U.S.A. Eng. Pat. 11,297, June 16, 1892.

The tinned scrap is suspended in netted bags of twine in a solution of stannic chloride or any other suitable stannic salt in a vat, the inside of which is lined with lead plates which are connected with the negative pole of a dynamo. The bags of scrap are connected with the positive pole, and the current of electricity removes the tin from the scrap and deposits an equivalent amount on the lead plates either as crystals or as powder.—A. W.

Improvements in the Manufacture of Carbons for Electric Arc-Lamps. G. F. Redfern, London. From C. Braun, Nuremberg, Germany. Eng. Pat. 11,779, June 23, 1892.

According to this process a solid core-wick, previously made separately, is guided into the inside of a mandrel contained in a press, in such a manner that it only projects a little beyond this mandrel into the mass of the carbon; and the carbon mass spreading round the mandrel under the action of the plunger of the press advances towards the outlet of the press while taking a form corresponding with the conical shape of the point of the mandrel and forming a hollow body of constantly-diminishing size until, having reached a point immediately in front of the point of the mandrel, it closely surrounds the core-wick projecting from the latter and draws it with itself into the mouthpiece of the press in which the outer surface of the ensheathing or completed carbon is finally effected. This cored carbon may now be used as the core-wick, thus forming a carbon with a double concentric core-wick.—G. H. R.

Improvements in Electric Battery Plates. E. P. Usher, Grafton, U.S.A. Eng. Pat. 14,813, August 16, 1892.

In carrying out this invention a metallic skeleton lead plate is first prepared having a marginal frame, and flanged and grooved vertical bars with an open space between them. The grooves between the edge flanges of the bars constitute open vertical wells in which the acid may rise and circulate. This form of plate is used preferably as the positive. One side of this plate is covered with glue, and on to this is pressed a sheet of lead-foil so as to cover the entire plate, bridge over the open spaces, and fit down into the grooves. The plate is now turned over, the spaces filled with some oxide of lead, and a sheet of lead-foil fitted over the plate as before. The edges of the plate are coated with the before-mentioned gum, which is preferably composed of two parts each of beeswax, pitch, and rosin, and one part each of sulphur and tallow, all thoroughly mixed, and applied while hot.—G. H. R.

Improvements in Storage Batteries. E. P. Usher, Grafton, U.S.A. Eng. Pat. 14,815, August 16, 1892.

The novelty consists in sealing the several plates and interposed separators at and near their lower edges so as to hold the parts in their proper relation and prevent any active material which may crumble from the positive plate from making contact with the negative. This sealing is effected by erecting the plates in a mixture composed preferably of two parts each of beeswax, pitch, and rosin, and one part each of sulphur and tallow, all thoroughly mixed, and used while hot. The mixture is allowed to cool and harden among the parts. Separator plates of kiln-dried wood applied directly to the face of the positive plates are also used.—G. H. R.

Improvements in the Electrolytical Decomposition of Alkaline Chlorides for the Production of Chlorine and Alkalis, and in Apparatus therefor. C. A. Faure, Paris. Eng. Pat. 16,262, September 10, 1892.

See under VII., *page* 156.

Improvements in or relating to the Electrolytical Decomposition of Metallic Salts, and in Apparatus therefor. C. Kellner, Vienna, Austria. Eng. Pat. 17,169, September 26, 1892.

In order to obviate the drawbacks which have hitherto attended the use of mercury as a cathode, it is used according to the present invention in the form of a thin vertical layer which is separated from the anode space containing the solution of the electrolyte by partition walls that conduct the current, the metal separated being removed immediately after its formation either in a mechanical or in an electrical manner from the undecomposed portion of the electrolyte. This separation is effected in a mechanical manner, according as the metals are to be obtained from the salts treated, in the form of hydrates, or in the metallic state, or as solutions of any desired salts by causing respectively water, or mercury, or an acid or other body that is to be united or combined with the cation, or is intended to carry away the cation, to flow through the cathode spaces during the electrolytical process, whilst the separated anion is drawn off from the anode spaces or is allowed to escape freely therefrom.

The mercury employed as a cathode is in the form of a vertical thin layer and acts in this case as an intermediary between the electrolyte (which is separated therefrom by the partition wall) and the water, or mercury, or acid or other body flowing in contact therewith, because it takes up through the partition wall in a metallic state the metal separated as a cation, and constantly gives it up to the water or to the other body employed in place thereof according to the product required, as above explained. When water is employed it forms a hydrate with the metal, with the evolution of hydrogen and generation of heat, whilst when mercury is employed an amalgam with the metal is produced, from which the latter can be separated in a metallic state, it may be by a second electrolysis. When an acid or other solution is used to combine with the cation, there is obtained a solution of the corresponding salt.

The separated metal can be removed in an electrical manner from the scope of action of the electrolyte to be decomposed, by employing as the anode of a second cell the metal which separates at the mercury cathode, the said cell being arranged in the decomposing cell and its cathode being electrically connected with the mercury.—G. H. R.

Improvements in Insulators for Electrical and other Purposes. H. H. Lake, London. From Johns-Pratt Co., Hartford, U.S.A. Eng. Pat. 19,146, October 25, 1892.

In the use of mica as an insulator hitherto the thickness of the sheet has been interposed between the objects or parts to be insulated, that is to say, the sheets of mica have been wrapped, for example, around the piece of metal to be insulated so that the insulation is effected in the direction of the thickness of the mica. According to this invention the sheets of mica are laid one upon the other, compressed firmly together, with the part or parts to be insulated embedded within them in such a manner that the insulating material is radially disposed relatively to them. Mica thus compressed may be turned and polished when it presents an appearance similar to horn.—G. H. R.

Improvements in and relating to the Electro-deposition of Metals. E. N. A. Picard and J. A. Tanièré, Paris, France. Eng. Pat. 18,516, October 15, 1892.

This invention relates to improvements in the electro-deposition of metals and consists in subjecting the metal being deposited by electrolysis to a beating or hammering process. A carriage rests on a frame and receives a longitudinal reciprocating movement parallel to the tank, and is provided with an electro-magnet and a vibrating arrangement similar to that employed in electric bells; which produces a quick succession of strokes. This movement is transmitted to the hammers through rods jointed at one end to an extension from the armature, and at the other to a bent lever forming part of the hammer levers, and the said hammers which are fixed to the levers in a suitable manner are put in operation by means of the electro-magnet and of a spring which causes them to strike upon the cathode directly the current ceases to pass into the electro-magnet. The hammers are advantageously made of hard stone, ivory, or the like.—G. H. R.

Improvements in Dry Cells or Galvanic Batteries. H. Koller, Vienna I., Austria. Eng. Pat. 18,844, October 20, 1892.

The diaphragms employed consist of perforated sheets of waterproof insulating material, such as gutta-percha paper, paraffined paper or paper saturated with wax. The exciting material inserted between the electrodes consists of gelatinous plates formed of leaves of agar-agar soaked and boiled in about 16 to 20 times their weight of water until they have lost all structure. In order to diminish the subsequent shrinkage 1 to 6 parts by weight of sugar syrup may be advantageously added to it. The amount of the metallic salt or salts to be mixed with the agar-agar should be such as to impart to the gelatinous mass approximately that percentage of salt which is considered most favourable in the case of a fluid electrolyte. It is very important to introduce such metallic salts into the agar-agar only just before it solidifies, as otherwise a crumbling sticky product will be the result.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Conditions of Tender for Mineral Lubricating Oils prescribed by the Prussian State Railways. M. Albrecht. Dingl. Polyt. J. **285**, 67—70; 114—115.

The author criticises in this lengthy article the conditions laid down by the authorities. His remarks about the discrepancies of viscosimeters supplied by different makers have been satisfactorily replied to in a later article by Engler. The apparatus for testing the fluidity of oils at low temperatures ("Kältebeständigkeit") (this Journal, 1892, 941) is in the author's opinion far too delicate and too sensitive to be admissible in dealing with goods which are exposed in barrels for months to all changes of weather, during which period the oil may easily absorb minute traces of moisture, which influence the readings of the apparatus to a larger extent than the rules of the railways would allow. The requirement that the oils should be free from acids ought to refer to mineral acids only; a quantity of more than 0·1 per cent. organic acid calculated for SO_4—should be allowed in the opinion of the author. (See also this Journal, 1890, 654.)—J. L.

Notes on the Industry of Fats, Oils, Mineral Oils, &c. Dingl. Polyt. J. **285**, 164—167.

Saponification under Pressure.—The anonymous author has followed by means of quantitative tests the process of saponification under a pressure of 10 atmospheres and using 3 per cent. of lime, and has found that the samples taken after the—

1st	half-hour	contained	58·27	per cent.	of free	fatty acids.
2nd	„	„	71·93	„	„	„
3rd	„	„	77·90	„	„	„
4th	„	„	85·68	„	„	„
5th	„	„	89·00	„	„	„
6th	„	„	93·61	„	„	„
7th	„	„	95·01	„	„	„
8th	„	„	95·65	„	„	„
9th	„	„	95·87	„	„	„
10th	„	„	96·20	„	„	„
11th	„	„	96·93	„	„	„
12th	„	„	97·20	„	„	„
13th	„	„	97·40	„	„	„
14th	„	„	97·50	„	„	„
15th	„	„	97·60	„	„	„

This shows that the reaction proceeds extremely slowly during the latter hours, and the question arises whether it is profitable to work the autoclaves for so long a time. There is, however, a want felt for a rapid method of determining the amount of fatty acids, the time required for such a test being, in the author's opinion, "1—1½ hours."

Comparative tests made with lime and magnesia gave the following results:—

Fatty Acids.	Saponification with	
	3 per Cent. of Lime.	2·7 per Cent. of MgO.
	Per Cent.	Per Cent.
After the 1st hour............	38·5	27·09
2nd „	77·4	44·7
3rd „	83·9	59·6
4th „	87·5	70·6
5th „	88·6	76·9
6th „	89·3	81·1
7th „	93·0	86·6
8th „	97·5	89·9
9th „	98·1	92·1
10th „	98·6	92·8

Saponification by means of MgO is less complete than with CaO besides which the $MgSO_4$ formed in the process of glycerin recovery is more soluble in the glycerin than the $CaSO_4$ is.

Besides tallow, palm oil, malabar tallow, and other vegetable fats are subjected to saponification under pressure, and it has been found that the saponification is the less complete the more free fatty acids the raw material contains. In fact, a material once saponified and testing 88 per cent. of free fatty acids gave, on being saponified for a second time, 89 per cent. only. This seems to point to the correctness of Pelouze's view that during lime saponification different phases are discernible, viz.: formation of a basic or neutral lime soap which is at last transformed into an acid soap. In the presence of large quantities of fatty acids in the raw fats the acid lime-soap may be formed at once and thus prevent a more complete saponification. Fatty acids with such large quantities of neutral fat cannot be distilled with advantage, as the following figures show, which were obtained on distilling the crude fatty acids of a Malabar tallow containing 89·2 per cent. of fatty acids, the titre test (Pohl) being 50°—46·7° C.:—

No. of Sample.	Fatty Acids.	Melting Point (Pohl).	Solidifying Point.
	Per Cent.	° C.	° C.
1	96·8	50·0	47·0
2	96·5	49·2	47·2
3	96·4	49·8	47·8
4	96·0	50·7	48·3
5	95·4	51·0	48·9
6	95·0	51·9	48·9
7	95·0	52·5	49·0
8	94·6	53·3	49·3
9	94·3	54·1	49·5
10	94·0	54·0	49·5
11	94·0	53·9	49·4
12	93·9	54·0	49·5
13	93·5	53·9	49·5
14	93·4	53·8	49·4
15	93·0	53·9	49·8
16	92·7	53·6	50·6
17	90·8	53·5	50·9
18	87·5	53·2	50·0
19	86·2	53·0	49·6
20	83·6	53·2	48·5

The products of decomposition go on increasing the further the distillation is pushed. The author concludes that saponification under pressure is not suitable for fats containing large quantities of fatty acids and requiring subsequent distillation; but it becomes advantageous when combined with acid saponification.—J. L.

Analyses of Horse-Fat. C. Amthor and J. Zink. Zeits. Analyt. Chem. **31**, 1892, 381—383.

In the following table are given the results of analyses of fat from various parts of the horse.

	Horsefat.			
	Kidneys.	Neck.	Side ("Speck.")	Foot.
Consistency.	Like ointment, soft.	Resembling moderately firm, fresh butter.	Almost like butter.	Semi-fluid.
Colour.	Golden Yellow.	Deep Orange.	Golden Yellow.	Pale Yellow.
Spec. gr. at 15° C.	0·9320	0·9330	0·9319	0·9270
Melting point...........	39° C.	34—35° C.	36—37° C.	..
Solidifying point........	22° C.	30° C.	20° C.	..
Melting point of the fatty acids.	36—37° C.	41 – 42° C.	39-40·5°C.	..
Solidifying point of the fatty acids.	30-30·5° C.	32—33° C.	31-32·5°C.	..
Hehner's number.......	95·47	95·42	94·78	..
Reichert's number......	0·33	0·22	0·38	..
Saponification equivalent	198·7	199·5	197·8	..
Free acid (mgrms. KOH per 1 grm. of fat).	1·73	2·44	1·84	..
Acetyl number..........	6·64	13·74	11·62	..
Iodine number..........	81·09	74·84	81·60	90·30
Iodine number of fatty acids.	83·88	74·41	83·37	..

Horse fats become more fluid and almost colourless by long keeping, and at the same time deposit a crystalline sediment.—H. T. P.

The Oil of Sanguinella ("*Cornus Sanguinea.*") G. De Negiri and G. Fabris. Pubblicazioni della Rivista di Merciologia, Milan, 1892.

The oil of sanguinella is of yellowish-green colour, resembling in odour the inferior qualities of olive oil; it becomes semi-solid at 0°, and completely solidifies at −15°; it remains fluid on exposure; its specific gravity at 15° = 0·921. It is readily soluble in ether, benzene, and chloroform, almost insoluble in 98 per cent. alcohol in the cold, but dissolves readily in an equal bulk of boiling alcohol.

The following constants are given:—

Temperature rise (Maumené)................	52°
Iodine number..............................	100·8
Saponification equivalent	192·5
Fatty acid equivalent	198·10

The oil contains a small quantity of a non-saponifiable substance. The free fatty acids are of a greenish colour, melting at 34°—37° and solidifying at 29°—31°. The oil gives greenish-yellow colourations with hydrochloric acid and with Heydenreich, Welman, and Hauchecorne's reagents a dirty-brown colouration, with Brullé's reagent, a slight brown colouration, with Bechi's reagent, no appreciable colouration with silver nitrate. The fatty acids when washed with hot water give no colouration with silver nitrate, but if dissolved directly in alcohol give a brownish-red colouration under the same conditions.

Thus in many of its characteristics the oil of Sanguinella resembles olive oil, but differs notably from it in its density, fusing point of fatty acid, and iodine number. In its colour reactions, especially in the production of green tints with acids, the oil resembles that of hemp-seed, but is distinguished therefrom by its lower iodine number, and in not being so easily siccative.—V. H. V.

Oleomargarin. G. C. Caldwell. J. Franklin Inst. 1892, **134**, 190—219.

See under XVIII., *page* 170.

PATENTS.

Improved Filtering Receptacle for Substances from which Oil or other Liquid is to be Expressed by Hydraulic and other Presses. L. Roumieu, Saint Mandrier, near Toulon, France. Eng. Pat. 541, January 11, 1892.

In this improved receptacle with permeable walls, for the passage through them of oils, &c., expressed from grain or other material subjected to pressure within such receptacle, a series of metal rods or bars is arranged side by side in a circle. The ends of these bars fit into annular grooves formed in annular plates at each end. The plates themselves are tied together by means of flanges. Suitably fixed bars on the outer surface of the cylinder prevent the receptacle bending outwards when the ram of the press compresses the material inside the receptacle.—J. L.

Improvements in Apparatus relating to Expressing Oil from Crushed Seeds. H. Lambert, and Greenwood and Batley, Lim., Leeds. Eng. Pat. 3706, February 25, 1892.

This apparatus may be conveniently termed a labour-saving apparatus, its chief purpose being to have the various operations hitherto done by hand in oil-mills, carried out by machinery. The crushed seeds are placed in a heating-kettle and driven therefrom into measuring boxes, the tops and bottoms whereof are closed by slides, which are caused by machinery to open and close at the proper time in order to receive or to discharge the proper quantity of seed. The meal falls into bags, which are folded up by hand, and passed on to a hydraulic press, where the bags undergo a preliminary pressing. This hydraulic press being set at an angle, the pressed or "consolidated" bags, on releasing the ram, slide off and fall down through a shoot on to an endless band, which conveys them to the hydraulic presses, where the oil is expressed. The return part of the endless band conveys the expressed cakes to a table, where the cakes are taken out of the bags. By means of an elevator the empty bags are finally brought under the measuring boxes to be refilled with fresh seed.—J. L.

An Improved Apparatus for Purifying Oil and Separating New Oil from Drippings, applicable also as an Oil-Tank. E. Noppel, Philadelphia, and B. Grosche and T. E. Tack, New York, U.S.A. Eng. Pat. 11,173, June 14, 1892.

The oil to be purified is caused to rise through a layer of water in a specially constructed apparatus. For the details of the latter the specification and drawing must be consulted.—J. L.

Improvements in the Manufacture of Soft Soap. J. Brown, Morley. Eng. Pat. 18,527, October 17, 1892.

This invention consists in the making of soft soap by boiling potash ley with "saponified" oleïn.—J. L.

Improvements in the Manufacture of Hard Soap. J. Brown, Morley. Eng. Pat. 18,533, October 17, 1892.

This hard soap is made from caustic soda, "saponified" oleïn, and palm-nut oil. For this soap, like the preceding one, remarkable properties are claimed.—J. L.

Improvements in Percolators for Extracting Oil. R. Haddan London. From J. W. Evans, Cleveland, U.S.A. Eng. Pat. 20,682, November 15, 1892.

The improvements refer to an apparatus patented by the same inventor (Eng. Pat. 5971, 1888; this Journal 1888, 507), and consist mainly of an internal closed heater. For the details the drawing and the specification must be consulted.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Balata. Dingl. Polyt. J. **285**, 167.

Balata is obtained from the milky juice of the bullet-tree, occurring in Guiana as a caoutchouc-like mass which can be kneaded at a temperature of 49° C., and melts at 149° C. Balata is said to be superior to gutta-percha, possessing a greater elasticity and being less soft at the ordinary temperature, and less hard in the cold; it also possesses more resistance to the action of light and air. Balata costs more than gutta-percha, its price being, of the crude products 4s. per gall., whilst that of the pure and dry article is 1s. per lb.—J. L.

PATENTS.

Improvements in the Combination and Treatment of certain Materials for the Production of Substances as a Substitute for India-Rubber and Leather, and for other Substances and Purposes for which it may be applicable. A. A. Blandy, London. Eng. Pat. 13,864, September 3, 1890.

Any of the "fixed" oils, preferably linseed oil, is converted by oxidation into a more or less solid and elastic mass, two parts of which are heated and mixed together with five parts of refined Trinidad asphalte until a liquid, free from sediment, results, which is then poured upon a cold surface and thus cast into sheets or any other form suitable for subsequent operations. This mixture will blend with all hydrocarbons, resins, and india-rubber, and equal parts of it and Mozambique rubber and sulphur, together with about one half of one part of lime, properly mixed and vulcanised, will produce an ebonite suitable for cells, vessels, washers, and other articles which are not used with strong acids. By substituting litharge for the lime, and increasing the sulphur by one-quarter of a part, an ebonite is obtained that will practically stand almost any acid at ordinary temperatures.

If the first-named mixture of oil and asphalte is dissolved in coal-tar naphtha and then recovered rubber or "vulcanised waste" and a suitable quantity of sulphur is added to it, a "dough" may be obtained suitable for waterproofing and the manufacture of rubber sheets, hose, imitation leather, washers, tyres, and belts.—C. O. W.

Improvements in the Manufacture of White Lead and Apparatus therefor. R. B. Johnson and T. C. Palmer, London. Eng. Pat. 22,391, December 22, 1891.

The invention consists in a drying-stove in which endless bands, carrying the white lead, travel over steam-heated shelves. The white lead is automatically distributed upon and removed from the endless belts.—C. O. W.

Improvements in Ornamented India-Rubber, Waterproofed Fabrics, and in the Mode of Producing the Same. C. Mandleberg, Manchester. Eng. Pat. 22,386, December 22, 1891.

See under V., *page* 144.

Improvements in Ornamented India-Rubber, Waterproofed Fabrics, and in the Mode of Producing the Same. C. Mandleberg, Manchester. Eng. Pat. 22,382, December 22, 1891.

See under V., *page* 144.

Improvements in the Manufacture of Oil Paints and Paint Medium. M. Williams, Wigan. Eng. Pat. 22,809, December 31, 1891.

The invention consists in grinding colours or pigments (Eng. Pat. 382; this Journal, 1889, 992) in an oil or medium which is obtained by oxidising resin oil, conjointly or separately, with cold or hot air and steam. The oil so obtained is treated or boiled with any suitable dryers to make it more siccative.—C. O. W.

Improvements in Obtaining Pigments. D. Swan, Glasgow. Eng. Pat. 1882, February 1, 1892.

PROTOCHLORIDE of iron and chloride of zinc, advantageously in the proportion of 1 part of the latter to 100 parts of the former, are mixed together in solution, and the metallic oxides are then precipitated with carbonate of lime. The mixture of these oxides is then subjected to calcination. —C. O. W.

An Improved Manufacture of Varnish. R. J. Clark, West Ham Abbey. Eng. Pat. 2201, February 4, 1892.

GUM or resin is amalgamated with oil or turpentine in the usual manner, then from 25 to 30 per cent. of water are added, and the mass, while being agitated, subjected to the passage of an electric current.—C. O. W.

Improved Mode of Preparing "Variegated Rubber" for Manufacturing Purposes. J. Burbridge, Tottenham. Eng. Pat. 8765, May 9, 1892.

LAYERS or sheets of rubber of different colours are formed into a block by hydraulic pressure. The block so obtained is cut into strips, and, by twisting these strips, joining the two ends, and vulcanising the ring so formed, bands cut from this ring in the lathe show a variegated appearance, the various colours used crossing each other in all directions. —C. O. W.

Improvements in Protective Paints or Compositions for Ships. L. Pflug, Kiel, Germany. Eng. Pat. 12,732, July 11, 1892.

THE inventor adds to paints or compounds suitable for protective coatings hydrazine or hydroxylamine, or the salts of these bases, for preventing the adhesion of living organisms to ships' bottoms.—C. O. W.

An Improved Method of and Apparatus for Treating Linseed Oil to Obtain a Product applicable as a Varnish. H. Pfanne, Rixdorf, Germany. Eng. Pat. 13,240, July 19, 1892.

PURIFIED linseed-oil is thoroughly mixed and agitated with sulphuric acid and water, and subjected, for about two to three hours, to the passage and action of an electric current, so that the oxygen produced in the nascent state, produced by the action of the current upon the water, converts the oil into varnish.—C. O. W.

Improvements in Paints. R. Kieffert, Paris, and H. Thirion, Gargan Livey, France. Eng. Pat. 14,888, August 17, 1892.

THE object of this invention is the manufacture of a paint which shall thoroughly protect stone, plaster, iron, wood, and other surfaces, and it consists of the following ingredients:—

	Parts.
Litharge	50
Lime	20
Resin	10
Linseed-oil	10
White lead	5
Turps	5

—C. O. W.

An Improved Polish for Articles of Iron, especially Stoves and Grates. W. Tiedeman, London. Eng. Pat. 17,118, September 26, 1892.

THIS is a solution of gelatin in dilute acetic acid with addition of glycerin, nitrobenzene, vegetable-black, and plumbago.—C. O. W.

Process and Apparatus for Waterproofing Woven Fabrics. F. Doller and R. Wolffenstein, Berlin, Germany. Eng. Pat. 19,776, November 3, 1892.

THIS is a new machine for waterproofing (shower-proofing) fabrics with such materials, which, like paraffin, stearin, wax, ozokerit, are easily melted. The cloth to be waterproofed passes, under pressure, over a steam-heated revolving cylinder; from below the mass to be used for waterproofing is gently pressed against this cylinder, which thus is covered with a fine film of that mass, and this film is then deposited on the fabric.—C. O. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in Machinery employed in Splitting, Levelling, Bevelling, Edging, Burnishing, and other Processes in the Manufacture of Leather. J. Hall, Leeds, Yorks. Eng. Pat. 22,597, December 28, 1891.

THE improvements are of a purely mechanical nature, and cannot be appreciated without the numerous drawings by which the specification is accompanied.—A. G. B.

Improved Processes for treating Hides and Skins. S. Thorn, Cleckheaton, Yorks. Eng. Pat. 838, January 15, 1892.

THE hides and skins are unhaired, bated, put through a bath of alum and salt, and dried. The alum and salt is then soaked out of the hides, which are next scoured and immersed for a few minutes in a bath containing one ounce of gelatine (notably isinglass) and eight ounces of animal or fish oil per two gallons of water. Stocking or drumming, drying and staking, in the manner known to the trade, conclude the process. Hides and skins in the hair can be equally well treated by this process.—A. G. B.

Improvements in or Relating to Tanning by Electricity. R. Pinna, Turin, Italy. Eng. Pat. 1786, January 29, 1892.

THE hides are submitted to the action of weak alternating currents while immersed in the tanning liquor. An electrical conductor, of some metal insoluble in tannin, and of the same superficial area as the hides or skins to be tanned, is placed at the bottom of the pit, and the hides are piled one upon the other on this conductor. The tanning liquor is then run in until it rises above the uppermost hide. The second electrode is in a wooden frame, and is maintained above the liquid; it is either solid or reticulated, and must be equal in size to the lower electrode; its surface may thus vary in shape to suit the required current density, which should be from 0·04 to 0·10 ampère per square decimetre, according as the hides or skins are light or heavy. The alternating current should be of small and alterable tension (50 volts), and the frequency of the alternations should be not less than 5,000 per minute. A rheostat should be provided to enable the current density to be kept within the limits named, and the temperature below 35° C. The arrangement described can obviously be adopted in the usual pits, but the vertical suspension of the hides side by side between vertical electrodes has given better results, and permits individual hides to be examined during the process. It is claimed that 100—400 hours, according to the quality of the skins or hides, is sufficient for the tanning process when thus hastened.—A. G. B.

New or Improved Manufacture of Material suitable for Use as a Substitute for Whalebone. L. Munk, Hamburg, Germany. Eng. Pat. 11,521, June 20, 1892.

The new material is made from hide as follows:—The hide is soaked and unhaired, as usual in making leather, and dried without pickling; this makes the hide harder and more elastic. It is then immersed for 24—36 hours in a bath of weak potassium dichromate solution and dried while stretched on frames in the daylight, first at the ordinary temperature and finally at 50°—60° C. The application of great pressure consolidates this material into a mass like whalebone, which may be waterproofed by any ordinary varnish.—A. G. B.

XV.—MANURES, Etc.

Note on the Direct Utilisation of Phosphates Rich in Iron. L. Schucht. Zeits. f. angew. Chem. 1892, 356—357.

An improvement on the author's older process (this Journal, 1892, 255) of converting ferruginous phosphates into superphosphates. Ground phosphorite, containing more or less iron, is treated with sufficient strong sulphuric acid to decompose and convert it into a semi-fluid mass; after which, the ferric salts present are reduced by means of sulphur dioxide. Water must be added at this stage in order that the gas may be absorbed; but this objectionable addition may be avoided by employing alkaline sulphites or sulphur dioxide (liquid or gaseous) under pressure. Ammonium sulphate is next added with the double object of causing the mass to solidify and of increasing the stability of the ferrous salts. The amount used must be at least sufficient to react with the free phosphoric acid to form NH_4HSO_4 and $NH_4H_2PO_4$, as well as to convert any ferrous sulphate into the corresponding ammonium double salt, bearing in mind that only two-thirds of the ferric phosphate originally present will be transformed into ferrous sulphate during reduction. Ammonium or potassium carbonate may be used instead of the sulphate; they are, however, dearer, and must be added with greater care, as it is essential to aim at the production of an alkaline dihydrogen phosphate, on which the stability of the ferrous phosphate depends. It is claimed that all the phosphoric acid in ferruginous phosphates, provided they do not contain too much silicate and clay, and that all the precautions detailed in the previous communication (*loc. cit.*) be observed, may be rendered permanently water-soluble. Oxidation of the ferrous salts (and consequent "reversion" of some phosphoric acid) need not be feared in practice. The calcium sulphate which crystallises out effectually protects the mass from the air; moreover, a portion of the iron exists as ferrous ammonium sulphate, which is quite stable. The superphosphate should be allowed to dry spontaneously or mixed with some absorbent substance, as charcoal or sawdust. The employment of artificial drying methods is not advisable.

Finally, the author considers the question of cost, from which it appears that, on the large scale, one kilo. of soluble P_2O_5 can be produced for about 5*d*.—H. T. P.

The Dissociation of Ferric Phosphate by Water and by Solutions of Salts. B. Lachowicz. Monatshefte, 1892, **13**, 357—370.

This investigation was undertaken with a view to settling whether the phosphoric acid in a ferruginous soil is available as plant food independently of any acid secretion from the roots of the plant.

Precipitated ferric phosphate of the formula $FePO_4$ (37·08 per cent. Fe and 62·91 per cent. PO_4) is rarely or never obtained. A carefully washed commercial sample contained 63·72 per cent. PO_4 and 36·51 per cent. Fe. A precipitate obtained by neutralising a hot mixture of ferric chloride and disodium phosphate solutions with ammonia contained, after it had been washed with cold water until free from chlorine, 64·41 per cent. PO_4 and 34·26 per cent. Fe. Another precipitate, thrown down by adding excess of sodium phosphate to ferric chloride, was boiled with much water for two hours, filtered and washed with hot water until free from chlorine; this contained 53·89 per cent. PO_4 and 34·26 per cent. Fe.

The following experiments were performed with the second sample mentioned above. In No. I. the phosphate was suspended in five times its weight of water for 24 hours, filtered, and these operations repeated 10 times; the filtrate reddened blue litmus-paper each time, and contained phosphoric acid, but only a minute trace of iron. In No. II. the same sample was five times boiled with the same quantity of water for two to three hours. No. III. was a continuation of No. II. In No. IV. the same sample was washed with hot water until no precipitate was obtained in the filtrate, by adding magnesia mixture and setting the test-portion aside for a quarter of an hour. The percentage composition of the sample after each experiment is given below:—

Experiment No.	I.	II.	III.	IV.
P_2O_5	46·33	45·17	42·56	39·82
Fe_2O_3..................	55·08	55·78	58·49	61·98

The composition after the fourth experiment approximates to the formula $3Fe_2(PO_4)_2 + Fe_2O_3$.

The influence of the presence of an excess of ferric oxide was studied by mixing the phosphate with different proportions of freshly precipitated ferric hydroxide. As might be expected, the proportion of phosphoric acid which goes into solution in distilled water decreases as the ferric hydroxide increases; but the decomposition is still evident when the proportion reaches $Fe_2(PO_4)_2 + 2Fe_2(OH)_6$, so that it appears probable that the complete removal of phosphoric acid from ferric phosphate is only a question of mass of water.

The influence of the presence of salts on the action of the water varies considerably with the nature of the salt, depending chiefly on its alkalinity; thus sodium acetate and sodium phosphate follow the alkaline carbonates in the amount of phosphoric acid which they remove. The alkaline sulphates have a greater influence than the chlorides and nitrates, and these appear to have about the same effect as calcium "bicarbonate," but a greater effect than carbon dioxide solution. Humic acid was applied in solution in sodium bicarbonate and in ammonium carbonate; it dissolved the ferric phosphate as a whole, and did not appear to influence the decomposing action of the alkaline carbonate either way.—A. G. B.

Presence of Nitrogenous Compounds in Stassfurt Salts. Diehl and Niencke. Der Landwirt, 1891, 564.

Vogel found ammonium chloride in the rock-salt and brine from Hall, Kissingen, Dürkheim, &c. Now the authors have found even as much as $\frac{1}{4}$ per cent. of this salt in Stassfurt karnallite; but as the average would be less than $\frac{1}{10}$ per cent. there is no prospect of commercial extraction being resorted to.—D. A. L.

XVI.—SUGAR, STARCH, GUM, Etc.

The Examination of Starch Sugars. Zeits. f. Spiritus-ind. 1892, 79.

The results of fermentation experiments made with a solution of glucose, previously sterilised and mixed with suitable nutrient salts, are given. Separate portions were "pitched" with pure cultivations of *Sacch. cerevisiæ* and *S. apiculatus*, and the matter fermented finally determined in various ways. The results were practically the same in each case; and it is therefore concluded that only dextrose, or a sugar of the same type, was fermented, since *S. apiculatus* can ferment no others. The residual reducing power (after fermentation) was calculated as isomaltose, and the dextrin determined by inversion with hydrochloric acid. In this manner the following results were obtained. For the sake of comparison, the numbers obtained by the usual method of analysis are also given:—

——	Solid Glucose.	Syrup A.	Syrup B.
Dextrose (fermentable)	62·38	30·10	32·76
Isomaltose (reducing-power = 84 per cent. of that of maltose).	13·67	22·48	22·64
Dextrin	3·22	26·91	25·13
Ordinary Method.			
Dextrose (total reducing-power)	69·14	41·20	43·93
Dextrin	10·09	38·20	36·53

—H. T. P.

Analyses of Dextrins. Reinke. Zeits. f. Spiritus-ind. 1892, 144.

The following results were obtained:—

Designation of Sample.	Water.	Soluble at 15° C.	Sugar.	Acidity No. of ccs. of Normal Alkali per 100 Grms.	Ash.	Remarks. Nature of Acid present.
	Per Cent.	Per Cent.	Per Cent.		Per Cent.	
Ia	9·44	70·20	3·64	1·29	0·35	Yellowish-white, nitric acid.
Ia	9·65	70·15	4·75	1·27	..	White, nitric acid.
	9·82	59·05	..	2·20	0·28	Velvet-like, yellowish, nitric acid.
	15·13	35·55	..	4·00	2·36	Granular, nitric and sulphuric acids, chlorine, much magnesia.
Apparatus	..	..	2·29	3·00	..	Yellow, nitric acid.
Chamber	..	..	3·54	2·00	..	Yellow, nitric acid.

One sample contained much vitrified starch, sand, carbon, fibre, and iron-mud.—H. T. P.

Pellet's Conducting Tube for Continuous Polarisation. R. Löhr. Zeits. f. angew. Chem. 1892, 377.

See under XXIII., *page* 180.

Pellet's Polarimeter Tube. A. Stift. Oesterr. Zeits. Zucker. 1892, 265.

See under XXIII., *page* 181.

The Detection of Sugar by Means of α-Naphthol. G. Rapp and E. Besemfelder. Deutsch. Zucker. 1892, 538.

See under XXIII., *page* 183.

The Determination of Ash in Sugar-Products. E. Donath and F. Eichleiter. Oesterr. Zeits. Zucker. 1892, 281.

See under XXIII., *page* 186.

PATENTS.

Improvements in Bleaching and Disinfecting Starch and Fecula by Electrolysis. E. Hermite, Paris. Eng. Pat. 1061, January 19, 1892.

This invention relates to improvements in bleaching starch and fecula by electrolysis. The water to be employed is purified by passing it through any form of electrolysis after the addition of a small quantity of sea-salt; soda is liberated, causing the precipitation of lime, which must be allowed to settle. If rapid action is required, aluminium chloride may be added to the sea-salt solution. The rasping and sifting of the potato are performed as usual, but for washing, the water purified by electrolysis and to which a small quantity of carbonate of soda has been added, is used. The fecula water is purified by electrolysis after the addition of a mixture of sodium and magnesium chlorides with a small quantity of "gelatinous magnesia" obtained by treating chloride of magnesium with caustic soda. The purification is effected by electrolysis in the refining vats, but it may be effected by the addition to the vats of electrolysed solution in the proportion of one litre of solution to every 4—6 litres in the vats. For this purpose the solution should be prepared as follows:—

	Kilos.
Chloride of sodium	50
Chloride of magnesium	5
Water	1,000

and it is electrolysed until it contains 2 grms. of chlorine per gallon, gelatinous magnesium being added to keep the solution neutral.—G. H. R.

Improvements in Refining or Purifying Sugar. A. G. Brookes, London. From F. Paetow, Berlin, Germany. Eng. Pat. 3241, February 19, 1892.

This patent refers to an apparatus for the continuous purification of raw sugar by washing with pure sugar syrup. It consists of two cylinders joined at their lower ends, one arranged vertically, the other inclined to the first at an angle of about 35°. The vertical cylinder has an enlarged funnel top, and is provided throughout its length with a central shaft carrying a number of stirring blades; whilst the interior of the inclined cylinder is fitted with a spiral elevator made of perforated steel. In operation, raw sugar and pure sugar syrup are fed continuously at suitable rates into the upper ends of the vertical and inclined cylinders respectively, the stirring apparatus and elevator being at the same time rotated. The result is that purified sugar is expelled from the top of the inclined cylinder, whilst the syrup which has served to wash the sugar flows off through a pipe near the upper end of the other cylinder.—H. T. P.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Decomposition of Starch during Fermentation. M. Delbrück. Zeits. f. Spiritus-ind. 1892, 95.

As the result of fermentation experiments with ordinary turbid wort from filter-bags, *i.e.*, containing fibre and starch granules in suspension, the author finds that the "alcohol-factor" (ratio of alcohol formed to loss of density of wort during fermentation) is normal only when the saccharometer indication of the unfiltered wort is employed in its calculation. When deduced from the density of the filtered wort, the factor comes out abnormally high. This peculiarity is undoubtedly due to the fact that practically the whole of the suspended starch is dissolved and fermented. An example will make this clear—

Saccharometer indication of wort (*a*) turbid 28·2
" " " (*b*) bright 26·2

After fermentation the following results were obtained :—

—	No addition.	Fermented with addition of		
		Lactic Acid.	Hydrofluoric Acid.	Sulphurous Acid.
Saccharometer indication.	5·0°	2·6°	3·65°	3·6°
Alcohol, per cent. by volume.	12·8	14·7	14·2	14·3
Increase in acid ...	1·1°	0·4°	0·6°	0·4°
Alcohol-factor deduced from—				
(*b*)	0·6	0·622	0·629	0·63
(*a*)..........	0·552	0·574	0·578	0·581

—H. T. P.

Notes on the Chemico-Legal Analysis of Wine. (Germany.) A. Bornträger. Zeits. f. ang. Chem. 1892, 358—362.

The only noteworthy portion of this paper relates to the estimation of extract and sugar. The extract is, as a rule, determined by evaporating a known volume of wine, must, &c., to a syrupy consistence, and subsequently drying for 2½ hours in a steam-chamber. From the percentage thus found, the amount of sugar, estimated by the Fehling-Soxhlet method, is subtracted, and the remainder regarded as true non-sugar extract. The sugar is almost without exception calculated as dextrose; although Mach has shown that the sugar of ripe grapes consists practically of invert sugar, whilst in unripe and over-ripe grapes, dextrose and levulose respectively preponderate. Since dextrose is more fermentable than levulose, it may practically be taken for granted that the sugar of wine is either invert sugar or a mixture of dextrose with an excess of levulose. As the reducing powers of these sugars differ distinctly, it is obvious that the manner of stating results must be of moment, especially in the case of wines or musts rich in sugar. For instance, a must containing 25·00 per cent. of sugar reckoned as invert, would contain only 23·99 per cent. calculated as dextrose. As it is impossible to determine the exact proportions of levulose and dextrose in wines, the author recommends that the reducing power be, in all cases, stated as invert sugar.—H. T. P.

Estimation of Tartar in Sweet Wines by Berthelot and Fleurien's Method. E. Ackermann. Zeits. anal. Chem. **31**, 1892, 405.

See under XXIII., *page* 186.

Apple-Jack or Apple Brandy. S. C. Upson, jun. J. Anal. and Appl. Chem. **6**, 1892, 195—196.

The manufacture of apple-jack or apple brandy is quite a large industry in some parts of Virginia, North-Eastern Georgia, North Carolina, Tennessee, and New Jersey, and, in fact, in every locality where the cultivation of apples is carried on.

At convenient localities there are usually licensed distilleries, to which the farmer hauls his apples, and in return receives the apple brandy which they produce, less, of course, the toll of the distiller.

The following is a description of the method employed at a large apple brandy distillery in Virginia. The distillery itself is a regular whiskey distillery outfit, with the addition of a large cider press.

There are two methods of making the apple-jack, and hence the brandy itself is known by two names, *i.e.*, apple-jack and jug brandy, according to the method employed in its production.

The usual method is to mash the apples and express the cider in the cider press. This cider is then allowed to stand in barrels under a shed, in the open air, until it becomes "hard cider." This usually takes, in dry autumn weather, from 10 to 18 days, according to the temperature of the air at that season. The cider is then taken into the distillery and distilled.

The first distillate is called technically "singlings" or "low wines." This is then redistilled, which gives apple-jack.

The second method consists in simply mashing the apples, and allowing the cider and mash to ferment together in large hogsheads, under sheds. This takes about 13 to 14 days.

The mash and cider are then put in the boiler and distilled.

But to keep the mash, which settles firmly at bottom of the boiler, from burning, and thereby giving to the brandy a disagreeable, bitter, and smoky flavour, the distillers add wood-ashes, which, mixing with the gummy residue, keeps it from adhering to the bottom. The boiling of the liquid keeps the residue in constant agitation. When pine-wood ashes are used, they impart to the brandy a resinous flavour, and this liquor is known as "pine-top brandy." Sand can be substituted for ashes, but rapidly wears out the copper boilers.

Sweet apples yield the most brandy.

The correct judging as to the time when the cider has reached the proper state of fermentation is of importance in obtaining the largest run of brandy; for, if allowed to stand too long, or at too high a temperature, the cider speedily goes into vinegar, and when once the acetic fermentation sets in, it goes on very rapidly.

If a farmer hauls one hundred bushels of apples to a distillery, he receives about nine gallons of apple-jack, which is usually less than one-half the total production.

Apple brandy is sold wholesale at the distillery for 1·25 dols. to 1·50 dols. per gallon. The Government tax is 90 cents per gallon.

The mash is thrown away, as it is considered unfit for use.

The author secured, several months ago, some apple brandy made in New Jersey. Underneath is an average result of the analysis :—

Analysis.

Specific gravity of brandy at 15° C.................... 0·9338

—	Constituents as in 100 cc.	Constituents as in 100 Grms.
	Per Cent.	Per Cent.
Alcohol, volume..................	56·0	..
Alcohol, weight	47·6	..
	Grms.	
Extract dried at 100° C............	0·328	0·351
Ash..............................	0·0036	0·0064
Free acid as malic	0·02104	0·0225
Fusel oil as amylic alcohol	0·1332	0·142

The methods of analysis employed were those given in Allen's Commercial Organic Analysis, Vol. I.

The fusel oil was determined by L. Marquardt's method. —Ber. **15**, 1370—1393.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

The Extraction and Estimation of Caffeïne in Teas. P. Cazeneuve and A. Biétrix. Monit. Scient. 1892, (4) **6**, 253.

See under XXIII., *page* 184.

Oleomargarin. G. C. Caldwell. Jour. Frank. Inst. 1892, **134**, 190—219.

After considering the difference chemically, between oleomargarin and butter, and comparing the present mode of manufacture with the older processes, the author quotes a number of hostile criticisms concerning the wholesomeness of artificial butter, and the nature of the materials employed in its production. These statements, made by agricultural, medical, and even legislative authorities, are most extravagant in character; according to them oleomargarin is prepared from all kinds of filthy and refuse fat, the carcases of diseased animals, &c. Moreover, the consumption of oleomargarin is said to cause indigestion, &c.; and the transmission of various infectious diseases from animals to man has also been ascribed to it. Some observers, indeed, claim to have discovered dangerous parasites in artificial butter.

According to the author many of these assertions are entirely unsupported by positive proof and must therefore be regarded as untrustworthy. He sums up his own opinion as follows: "When properly made from fresh and clean materials, oleomargarin differs but slightly in healthfulness from butter, and this difference is only on account of its somewhat less easy digestibility;" "that it is possible that it may be made from such unsuitable materials that it will contain germs of disease, and that disease might thus be communicated to man; but that there is no positive proof that it is now made of such materials, or ever has been, or that any disease has ever been communicated to man by its use; but that the possibility exists all the same, and the only way to make it of no effect is by careful inspection of the process of manufacture by capable officials."

As regards legislation on the subject, the manufacture and sale of oleomargarin is entirely prohibited in nine states of the Union; in several others the product must be coloured pink; whilst in the remaining states (25) it is only required that the article be sold under its own name and not as butter. Concerning the prohibitory enactments as well as the damaging assertions about the alleged use of noxious materials in the manufacture of oleomargarin, the author shows that they are dictated rather by anxiety to preserve another industry—dairy-butter production—than by any consideration of public health. In spite of restrictions, however, the output of oleomargarin is steadily increasing; for the year ending June 30, 1886, it was estimated to be 33,000,000 lb. In the following year it was nearly 35,000,000 lb.; in the next, 35,664,000 lb. During the year ending June 1891, 44,000,000 lb. were produced; and a still larger output is predicted for the succeeding year. In 1889 there were 23 manufacturers, distributed as follows: Colorado, 1; Connecticut, 6; Illinois, 7; Indiana, 1; Kansas, 2; Maryland, 1; Massachusetts, 1; Ohio, 2; Pennsylvania, 2; the last-mentioned notwithstanding her prohibitory law. On the other hand the butter industry seems to have benefited very little, if at all, although the evidence on this point is very conflicting.

The author draws attention to a serious mode of adulterating butter, which consists in churning it with its own volume of warm milk and a small quantity of a preparation of pepsin, called "gilt-edge butter compound." The emulsifying action of the ferment causes the butter to take up as much as 50 per cent. of water, without losing its solidity.

In conclusion the author briefly refers to some of the means of detecting oleomargarin in butter, and reiterates his opinion that oleomargarin is perfectly harmless when properly made, practically as readily digestible as butter, and therefore unquestionably to be regarded as a food-stuff.—H. T. P.

The Detection of Foreign Fats in Butter. J. Erdélyi. Zeits. Anal. Chem. **31**, 1892, 407.

See under XXIII., *page* 184.

PATENTS.

Improvements in the Method of Manufacturing Aërated Water, and in Apparatus for Effecting same. J. McEwen, Marple. Eng. Pat. 19,674, November 13, 1891.

The object of this invention is the manufacture of aërated waters by means of commercial liquid carbonic acid, thus dispensing with the use of a generator and gasholder. A uniform pressure on the liquid, throughout the process of charging, can be maintained by the employment of a valve, which opens by the pressure of the carbonic acid gas from the cylinder and allows the gas to pass through a side perforation in the valve-box, into the aerating vessel. Should the pressure within the aerating vessel rise above that of the gas delivered from the storage tube, a diaphragm (in communication with the vessel) will be acted upon, and closing the valve, stop the entire gas supply.

The carbonic acid gas is admitted in the aerating vessel by means of a perforated nozzle on the bottom of the vessel. The inlet pipe for the water reaches inwardly almost to the top of the vessel and is there provided with perforations which cause the water to fall on a tin sponge for still finer division and complete saturation with carbonic acid. The aerated water accumulates on the bottom of the vessel and can be drawn off when required.—H. A.

An Original and Chemical Preparation of Pure Mustard. J. L. Potter, London, and A. Jobling, Lymington, Hants. Eng. Pat. 393, January 8, 1892.

The following ingredients are made into a stiff paste with water: Pure mustard 1 lb., table salt 2 oz., castor sugar 2 oz. After the mixture has stood 20 minutes, 2 tablespoonfuls of Tarragon vinegar and the same quantity of Worcestershire sauce are stirred in, when the mustard is ready for use.
—H. T. P.

Improvements relating to Bread-making and to Machinery therefor. D. Young, London. From L. Dathis, Paris, France. Eng. Pat. 3138, February 17, 1892.

The object of this invention is to effect the moulding or shaping of bread by machinery, instead of, as hitherto, by hand. The machine for the purpose consists of two parts. One a sort of convex top rotating at great speed, provided with a fixed concave cover, which serves to preliminarily mould the weighed quantity of dough into a more or less circular shape. The ball of dough is then conveyed by an elevator to the shaping machine proper. This consists of two superimposed slabs or tables, to the lower one of which an up and down, and back and forward motion can be imparted. Between these slabs two endless cloths move alternately backwards and forwards, and in opposite directions. By this contrivance the dough is alternately squeezed and released and rolled out, any desired thickness being obtained by varying the distance between the slabs. Finally, the moulded rolls are transferred by means of a travelling apron to baskets placed to receive them.
—H. T. P.

The Preservation of Fresh Eggs. P. McArdle, Dublin. Eng. Pat. 3592, February 24, 1892.

The eggs are packed in layers in a suitable wooden or metallic vessel, all the intervening spaces being filled up by pouring over each layer a thick fluid mixture of lime, litmus and water. It is claimed that under these conditions eggs will remain good for 9—10 months.—H. T. P.

Improvements in Salt by Admixture and otherwise to render it more valuable for Dietetic and other purposes. G. Weddell, Newcastle-on-Tyne. Eng. Pat. 12,063, June 29, 1892.

Salts found to exist in natural grains and other vegetable foods, in bones and other portions of animals, which are generally wasted on account of their fibrous or indigestible nature are added to common salt.—K. E. M.

(*B.*)—SANITARY CHEMISTRY.

Detection and Isolation of Typhoid Bacilli in Cistern Water. A. L. Kotz, Jour. Anal. and Appl. Chem. **6**, 1892, 257—259.

Water containing typhoid bacilli generally contains many putrefactive germs also, that was so much so in a water coming under the author's notice, that the method ordinarily employed for the isolation of the typhoid bacillus failed; but Chautemesse and Widal's carbolising culture method succeeded; in fact, few other bacteria will grow on this medium, and in most most instances the typhoid bacillus alone will thrive. The culture medium should be employed in different degrees of carbolisation..—D. A. L.

PATENTS.

Improvements in the Clarification, Purification, and Softening of Water, Contaminated Water, or Sewage in the Preparation of Reagents, and in Apparatus for use therein. W. Lawrence, Shepherd's Bush. Eng. Pat. 22,546, December 24, 1891.

The improvement first described is the "shower" method of clarifying waters by the mechanical action of heavy particles falling through them, and so carrying down the finer particles. If the nature of the suspended matter is such that it will not aggregate when treated in this manner, it is subjected to the action of nascent solids, in the act of being precipitated, which adhere to it. The apparatus is so constructed that the heavy sediment having carried down the lighter sediment becomes separated from it and may be returned direct to the water. Another aggregating method is by the vortical or "swirling" movement of the water with the sediment; a depositing chamber is required with the means of separating the useful from the useless sediment with a view to returning the former to the water under treatment.

As heavy sediments, silica or magnetic oxide of iron, or other compound of iron which has an oxidising effect combined with lime are employed. In using lime-water, the whole quantity required for the amount of water to be treated is used from the beginning, the water being added in successive portions. The large excess of lime causes a sediment which serves as a nucleus for the next action. These processes may be conducted at the ordinary temperature or under heat. When heat is employed the vortical movement is unnecessary, as the heat induces sufficient motion.

A depositing or settling apparatus is next described. It consists of a stack of a pear-shaped, diamond-shaped, or roof-shaped tubes, through which the water is slowly passed. The tubes are slit along their lowest angles, so that as the sediment settles on the inclined sides of the tubes it slides out through the slits. The water can only pass through the tubes, being stopped from passing between the tubes by a screen. The sediment which settles on the bottom of the tank can be removed continuously.

If the impurities of the water require oxidising, the tubes may be of black iron and may be extra oxidised by burning.

The method to be selected will depend on the nature of the water and the degree of purity required. In the case of sewage a fractional precipitation is desirable, so that the heavy parts may be used again and the lighter (nitrogenous) parts be recovered for use as manure.

As regards the preparation of lime-water, the process is exactly contrary to that generally employed. The spent, or less soluble part of the lime is first subjected to the action of water and the more soluble lime afterwards. When possible it is preferable to do this with the aid of heat, a uniform temperature of 130°—140° F. being convenient.

In preparing solutions of readily soluble materials, water is caused to drop on to the reagent; the solution passes into a vessel containing a floating bulb which rises or sinks according to the density of the solution. By means of a device connected with this bulb, the inflow of water is guided so that the density of the solution determines the proportion of water shall pass over the reagent to the total amount which passes to the apparatus. The strength of the solution is thus kept uniform.

When water is treated at a high pressure and temperature the salts of lime and magnesium are thrown down without using reagents; lime, however, accelerates the precipitation, and the alkalinity produced by the lime may be neutralised by reintroducing the carbonic acid gas previously expelled.
—N. H. J. M.

Improvements in Sterilising and Disinfecting Apparatus, particularly for Sterilising Expectorated Matter and Disinfecting Spittoons. C. Herscher, Paris. Eng. Pat. 2,760, February 12, 1892.

The apparatus is intended for the sterilisation of organic and other substances, such as bedclothes used by people suffering from contagious diseases, the linen used in dressings, surgical instruments, &c. It consists of a boiler communicating with the sterilising chamber by means of two tubes, which open into the top and bottom respectively of the sterilising vessel. The lower end of the tube which reaches to the top of the sterilising chamber is always below the level of the water in the boiler, whilst the lower end of the other tube is slightly above the level. This latter tube has a tap. The pressure of the steam forces the hot water (or whatever solution is employed) into the sterilising vessel, from which it returns by the lower tube. A circulation is thus set up. When the water level in the boiler sinks below the opening of the lower tube steam will escape through this into the sterilising vessel, and thus cause the liquid in this vessel to be agitated. But the level in the boiler at once rises and the flow of the liquid recommences. There will thus be a continuous ebullition and a temperature of 100° or more according to the liquid employed.

There is also an overflow tube in the sterilising vessel; and over the boiler is a reservoir containing pure water, which is heated by the furnace gases.

When the sterilisation is completed the pressure in the boiler is relieved by means of a discharge-pipe, and the water returns to the boiler; pure water is then let into the sterilising vessel for the purpose of rinsing the sterilised articles.—N. H. J. M.

An Improved Method of and Means for Deodorising Sewers, and other Places similar and dissimilar thereto. J. Burton, Widnes. Eng. Pat. 3669, February 25, 1892.

By this patent, air-tight screens formed by combining two approximately semicircular frames covered with suitable material which is coated with creasote, tar, or other waterproofing substance, are fixed vertically at convenient intervals within sewers and are made to form water-seals at the lower end by extending into troughs formed between two low transverse partitions provided for the purpose. The sewer tubes, it is claimed, would thus be divided into air-tight chambers, of which any one can be cleansed or attended to without any fear of contamination by gases from an adjoining chamber; air-tight ports are placed in each screen for the admission of disinfecting apparatus. This patent further relates to the application of any suitable type of engine, blower, fan or force pump, combined with a flexible tube and nozzle or permanent stand pipe terminating in a nozzle for the purpose of injecting any suitable agent into the chambered sewers, or into dwellings, warehouses, &c., for purposes of disinfection.—D. A. L.

A New or Improved Process for the Utilising of Oxide of Iron obtained as a By-product in the Smelting or Extraction of Copper from Cupreous Ores, or from Spent Oxide obtained as a By-product in the Purificatton of Gas. C. Kilpatrick and the Ferric Sewage and Water Purification Company, Limited, Manchester. Eng. Pat. 4440, March 7, 1892.

The iron oxide is dissolved by agitating with hydrochloric or sulphuric acid in covered vessels heated with a steam coil or externally, the vessels are provided with a mid-feather to promote circulation, and if more than one are used they are arranged at different levels so that the liquid may flow automatically from one to another. When the acid is sufficiently saturated the solution of ferric chloride or sulphate is allowed to settle and cool, and is then ready for use either by itself or in conjunction with other materials:—for treating sewage, water, or pure liquids generally, for making Prussian blue and for decolorising sugar, syrup, &c. Should any ferrous oxide be present in the original oxide it is oxidised by the addition of nitric acid which is subsequently recovered.—D. A. L.

Improvements in Furnaces for Destroying the Refuse of Towns. W. Horsfall, Leeds. Eng. Pat. 20,207, November 9, 1892.

In this furnace, which is an improvement on those of Eng. Pat. 22,531 of 1891, and 8999 of 1887, it is sought to prevent the clinker from becoming fused to the sides by making these and the crown of the furnace form part of a steam boiler, and by moving the fuel forward by mechanical means. The fuel which consists of town refuse is charged in through a hopper at the back of the furnace and is gradually thrust down the slanting furnace bed by means of horizontal sliding plates or pushers which form a series of steps in the rear part of the furnace, and by their to-and-fro motion gradually thrust the fuel forward until it reaches the grate bars which also slant towards the mouth of the furnace and are of the moving or rocking type, described in Settle's Eng. Pat. 15,482 of 1885. Finally, the fuel is deposited on to a dead plate at the mouth of the furnace in the form of ashes and clinker. The thrust plates and rocking bars are respectively actuated by eccentrics and cams placed on a shaft rotated by some source of power. The furnace is surmounted by a saddle-shaped boiler which forms its top and sides as already mentioned. The air necessary for combustion is forced through the furnace bars by a steam jet or blower and the products of combustion pass upwards through tubes in the boiler and then down through flues at the sides of the boiler to a main flue. The steam generated in the boiler may be used for providing power for electric lighting, &c.
—H. K. T.

(C.)—DISINFECTANTS.

PATENTS.

Improvements in or Means for the Treatment of Trees or Plants for Destroying Caterpillars of Liparis Monacha and other Insects Injurious to Plant Life. B. Willcox, London. From the Farbenfabriken vorm. F. Bayer and Co., Elberfeld. Eng. Pat. 3301, February 19, 1892.

For the extermination of the caterpillars of *Liparis monacha* and other destructive insects, the only possible method is to sprinkle the trees with aqueous solutions. Experiments were made with a large number of compounds. It was found that when treated with a solution of potassium dinitro-orthocresol in 300 parts of water (the para-derivative is without effect), the caterpillars of *Liparis monacha* usually died after about 12 hours. With a more dilute solution (1 : 1000) about 66 per cent. of the caterpillars were killed. A solution of the strength 1 : 400 is sufficient to exterminate the insects. Spiders, mites, lice, and other insects destructive to flowers and plants, &c. are also destroyed by the same compound. The plants do not suffer in the least. Other salts of dinitro-orthocresol may be employed with good results.

Many injurious fungi as the Peronospera and Hymenomycetes, and also those which cause the rotting of wood, are destroyed by the salts of dinitro-orthocresol, even when much more dilute than when used for killing insects. It is therefore well adapted for impregnating timber and railway sleepers, &c. Solutions of the salt (1 part) and soft soap (0·25 part) in water (400—600 parts) rapidly destroy the species of *Aphis*. The additton of soap increases the destructive power.—N. H. J. M.

Process for the Preparation of Sulphonate Salts from Phenylised Ethane Derivatives and the Preparation of Disinfectants therefrom. G. Kraemer, Berlin, Germany. Eng. Pat. 3953, February 29, 1892.

One volume of phenylxylylethane or of its homologues, or of the residues containing these bodies, obtained from washing crude benzene with concentrated sulphuric acid, is introduced, with shaking, into a mixture of half a volume each of concentrated and fuming sulphuric acid, the temperature not being allowed to rise above 100°, when no further heat is evolved, the mixture is slightly warmed on a water-bath for some time, until the odour of sulphurous acid becomes strong; the mass is then diluted with half a volume of water, the upper layer separated, introduced into thin milk of lime, and filtered from the gypsum. The clear solution of phenylxylylethane sulphuric acid is converted by soda or potash into the sodium or potassium salt, and evaporated to a specific gravity of about 1·25; by adding 1 part of creosol or its homologues to 2 parts of this solution, a liquid termed "cresolsulphon" is produced, which may be diluted with water to any extent. A creolin-like disinfecting agent can also be prepared by mixing crude tar oil with the above sulphuric salt solution.
—D. A. L.

Improvements in and Relating to Disinfectants, Blight Preventives and Moth and Insect Exterminators. J. B. Dewhurst, London. Eng. Pat. 5036, March 15, 1892.

Forty oz. of naphthalene is melted and 1 oz. of camphor flowers and 1½ oz. of eucalyptus oil added. The mixture is poured into moulds so as to form tablets or blocks, &c., which may be fixed to wires so as to be hung where required. Being greatly affected by temperature, the proportions of the ingredients may be varied to suit different climates and seasons.—N. H. J. M.

XIX.—PAPER, PASTEBOARD, Etc.

PATENT.

Manufacture of a New Material, applicable as a Non-Conductor of Heat, for Producing Light Receptacles, and for other Purposes. H. R. Knoch Alt-Chemnitz, Saxony. Eng. Pat. 2537, February 9, 1892.

A thin, hot paper pulp is obtained by agitating "paper stuff" from the paper mills, which is then kneaded with small particles of cork or of nutshells (shells of *arachis hypogaea*), or of cellulose, tanner's bark, chaff or other light fibrous material, in the proportion of 50 parts of "paper stuff" to 12 parts of other stuff. Heat is maintained during the kneading, and the thick mass thus produced is made into any desired shape and baked at 60°—100° C. The new material has a specific gravity of 0·9—0·24, and is tough, fatty, elastic, a bad conductor of heat, and waterproof. Greater cohesion is attained by adding 2 to 3 parts of gum tragacanth to the paper stuff, and incombustibility by 2 to 5 parts of soda solution.—A. G. B

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Manufacture of Pepsin and the Determination of its Proteolytic Power. Pharm. J. and Trans. 1893, 588—592.

Pepsin is at present almost exclusively prepared from pigs' stomachs, the digestive secretions of the sheep and ox being less active. None of the manufacturing processes yield an absolutely pure product; one of the earlier ones, which consisted in precipitating an aqueous extract, obtained by mascerating the stomachs in acidulated water, with basic lead acetate, decomposing the lead precipitate, suspended in water, with sulphuretted hydrogen, and evaporating the filtrate with or without the addition of milk sugar, was not only tedious, but the product had a putrid odour, often contained lead, and possessed but little digestive power.

Beal's Process.—This is the process adopted by the British Pharmacopœia: it yields a product sparingly soluble in water, the principle constituents of which are mucus and epidermal tissue. A preparation complying with all the requirements of the British Pharmacopœia has been manufactured by simply freeing the inner coatings of pigs' stomachs from the outer fleshy portions, washing, drying, and powdering them. An article which is sold under the name of insoluble pepsin is now extensively manufactured in America as follows:—The fresh cleansed inner coatings of pigs' stomachs are trimmed from adhering fat, scrubbed in cold water to free them from mucus and blood, packed in barrels and allowed to remain there in contact with ice and water for one night, after which they are again scrubbed. The membranes are now spread out on linen sheets stretched over frames, taking care to avoid overlapping, and are thus dried at as low a temperature as possible. At this stage they are coarsely powdered, and the fat extracted with benzene, ether, or chloroform; when dry they are reduced to a fine powder and sifted. As the first siftings have the greatest digestive power, the pulverising is not carried too far, but is stopped as soon as the siftings are found to be deficient in strength. The pepsin obtained by this process readily dissolves 2,000 times its weight of finely divided coagulated egg albumin. There is no doubt that all the ready formed pepsin is removed during the washing, but fresh peptic secretion is produced in the glands, and the peptic ferment "when reduced to powder in the very glands where it has been generated" seems to retain its digestive power to so high a degree that the product is equal, if not superior, to any pepsin manufactured by a more complex and scientific process.

Scheffer's Process (Pharm. J. and Trans., 1871):—Pepsin is partially precipitated on saturating a solution of it with common salt, but the precipitate cannot be separated as it floats in the salt solution without rising or falling. Scheffer avails himself of the fact that pepsin is readily precipitated along with ordinary albuminous matter in a condition suitable for separation when a solution of the two substances is saturated with common salt. The inner coatings of 200 pigs' stomachs, weighing about 103 lbs., and measuring about 10 gallons, were immediately after slaughtering the animals, separated from the outer fleshy portions which weighed and measured a trifle more. These two portions were well washed, and after being minced were placed separately into two 70 gallon casks, which were each filled with water containing 32 ozs of concentrated hydrochloric acid. The contents of the casks were stirred from time to time, and allowed to remain over night; on the following day, the stirring was repeated, and the aqueous extracts strained off through canvas bags. The liquor from the inner portions strains more easily than that from the outer portions, and when the former appears milky, sulphurous acid and a little talc may be added, and after the deposit has subsided the liquor strained again. The quantity of liquor from the outer portions, which must be added to that from the inner portions in order that a precipitate, capable of being separated and pressed, is produced on addition of sodium chloride, is ascertained by experiment. A quantity of this mixture is then made in a 70 gallon cask filling it to five sixths, the remaining space being taken up by common salt which latter must be added quickly and at once. Stirring is kept up until the salt dissolves, but it is discontinued as soon as the precipitate commences to rise to the surface in order not to break it up, as the larger flakes are the more convenient for straining and pressing. After remaining for about 12 hours, the mixture is transferred to a strong straining cloth $2\frac{1}{2}$ feet square, where it is allowed to drain for one day, being occasionally assisted by passing a long spatula between the precipitate and the cloth. On the following morning the mass is folded in a double cloth and well pressed, the pressure must be gradually increased. the mass being withdrawn once or twice from the press, crumbled with the hand and again submitted to pressure When too salt, the mass is digested with 30 per cent. alcohol, again drained and pressed as before, after which it is broken up, transferred to shallow trays, and dried at a temperature not exceeding 100° F. It is then coarsely powdered, the fat extracted with benzene, ether, or alcohol, and the dried residue reduced to a fine powder.

Scale and Crystal Pepsin.—The inner coatings of 125 pigs' stomachs, weighing about 65 lb., were cleansed and freed from fat as above described, and minced; the mass was digested with 80 lb. of distilled water and 16 oz. of concentrated hydrochloric acid at 100° F. for about six hours. The mixture is gradually converted into a uniform transparent glairy magma, which, on stirring, loses its homogeneity, becomes thinner, and fine red particles separate; at this stage it is cooled, 2 oz. of chloroform and some sulphurous acid added, and allowed to remain undisturbed over-night. The amount of peptone formed increases with the height of the temperature and the duration of the digestion. On the following day any dust is carefully removed from the surface, and the yellowish-green solution is strained; if not clear the temperature of the digestion may have been too high or too low, and it cannot be used for scaling. The yield from the above quantities, in a successful operation, should be 95—100 lb. of clear limpid syrup, leaving about 25 lb. of residue. It is evaporated to about 30 lb., either *in vacuo* or on shallow trays, at a temperature not exceeding 112° F., after which it is again strained and scaled on glass plates; an experienced operator with a good scaling room can get 5—6 lb. of scales from the above quantity. The concentrated solution of pepsin keeps well for two days, but it is best to add about 1 oz. of chloroform to each gallon of the liquid. The term "crystal pepsin" is a misnomer, and this preparation is made in exactly the same manner as the scales, except that the concentrated syrup is dried into thicker sheets, which are subsequently broken up into small pieces. "Peptone pepsin" is likewise an inappropriate term, the unavoidable impurities in this class of preparations being syntonin with, at most, a little peptone. The impurities of the pepsin prepared by Scheffer's method consists of salt and inert albuminous matter, whilst "scale" and "crystal pepsin" contain mucus, syntonin, and peptone.

Purification of Pepsins.—For this purpose the following method has been proposed:—Sodium sulphate is added to the acidulated pepsin solution, at a temperature of 94° F., and sufficient sulphurous acid run in until its odour is just perceptible. The mixture is kept at this temperature until the pepsin separates, when the latter is removed. The product is tolerably free from peptones, which remain in the mother-liquor, and when drained and pressed yields fairly pure and active pepsin. Inasmuch as pepsin dialyses very sparingly, whilst sodium sulphate, peptone, and syntonin dialyse more readily in acid solution, recourse is had to dialysis for further purifying the product, the solution of which is subsequently evaporated, *in vacuo*, either to dryness or to the concentration necessary for scaling. The scales are somewhat opaque, and have a bitter taste, recalling sodium sulphate. C. Jensen patented the manufacture of "crystal" and "peptone pepsin"; he lays more stress upon the production of the impurity—peptone—than the pepsin itself. J. Le Roy Webber patented the use of sodium sulphate as a precipitant, and of sulphurous acid as an aid, in clarifying and dialysing impure pepsin solution; whilst J. B. Russel patented the dialysing process in general for the removal of peptones, soluble salts, &c. Some of the advantages claimed by these patents are doubtful, and some of the processes were in use before the patents were filed. Good pepsins should have a light colour; the scales being a light lemon, slightly greenish, and nearly transparent; the powder white, or nearly so. They should be soluble in water, but not hygroscopic, should have a characteristic but not putrescent odour, and a digestive power approximating 2,000 times their weight.

Tests for Pepsins.—By simply noting the amount of albumin which a sample of pepsin will dissolve in a given time, erroneous conclusions may be drawn as to its quality, inasmuch as a weak pepsin may dissolve a certain weight of albumin, converting it simply into syntonin, without, however, carrying the digestion to the stage of peptone; whilst a stronger one may, in the same time, dissolve the same quantity of albumin, but produce both peptone and syntonin. To ensure uniformity of results, all experiments must be carried out under like conditions; thus, pepsin, if allowed to act upon more albumin than it can digest, will convert it chiefly into syntonin, this being the primary stage of the digestion; furthermore, pepsin, as a colloid, cannot penetrate the albumin, and exerts its solvent action only on the outer surface of the latter; consequently, the more finely divided the albumin is, the more readily will it be acted upon. As it is difficult to estimate the undissolved albumin, which at the end of four hours is in a more or less advanced stage of digestion, the amount of albumin used should be adjusted by one or two preliminary tests, so that at the end of the experiment it is as nearly as possible dissolved. The eggs employed must be fresh, and should be placed in cold water and boiled for 15 minutes, when they are again transferred to cold water, and the coagulated white squeezed through a sieve of 30 meshes to the square inch. Two hundred grains of this finely-divided albumin are triturated in a mortar with distilled water, containing 5 minims of hydrochloric acid to the fluid oz.; the mixture is placed in a wide-mouth bottle and made up to 2 fluid oz. with acidulated water. 0·1 grain of pepsin is now added, and the whole digested for four hours at 104° F., the mixture being shaken every 10 minutes. It is well to make a simultaneous test with a sample of the best pepsin obtainable, and compare it with that under examination; also to make a blank experiment, without pepsin. If it be necessary to estimate the amounts of peptone and syntonin formed during the digestion, the action of the pepsin is arrested by boiling the mixture, the undissolved albumin collected on a filter, and the syntonin precipitated from the filtrate by neutralising it with sodium carbonate. The difference between the weight of syntonin plus that of the undissolved albumin and that of the albumin used in the experiment gives the amount of peptone.—A. R. L.

Observations on American Menthol. J. H. Long. Jour. Amer. Chem. Soc. 1892, 149.

The menthol obtained from American oil of peppermint differs considerably in its physical appearance from that obtained from the English or Japanese oil, appearing in commerce as long slender needles, while the Japanese product occurs in small prismatic crystals. American menthol is produced from the oil distilled in New York and Michigan, by cooling it by means of a freezing mixture of salt and ice, draining the resulting crystals and drying them by exposure to the air. The author shows that the commercial product, obtained from several sources, is nearly constant in composition as shown by the rotatory power as determined on 10 per cent. solutions in 95 per cent. alcohol. Having purified a sample by digestion with water at 70° C. and subsequent distillation of the dry body under reduced pressure, he finds its sp. gr. 0·890 in the solid state, and 0·881 in the melted condition, the latter constant for the Japanese product being 0·878; its melting point 42·3°, as against 42·6° for the Japanese, and its boiling point, 212·5°, as against 210°—213°. The specific rotation of the melted substance he finds to be expressed by the formula $[\alpha]_{D} = -49{\cdot}86^\circ$. He quotes the results of a lengthy series of experiments on the rotatory power deduced from the rotation of solutions in various solvents, showing that, in the case of alcohol, the value of $[\alpha]$ decreases with the concentration, or increases with the amount of solvent present. From his results he deduces the fact that $[\alpha]_{D}$ for the pure substance at the temperature of the melting point, $= -49{\cdot}5^\circ$. The rotatory power calculated from solutions in benzene is higher than that from solutions in alcohol, and increases with the concentration of the solution. Acetic acid (glacial) is not a good menstruum, although the results are regular, the specific rotation in the concentrated solutions falling below that of the liquid menthol, owing to the formation of a body having a slightly lower specific rotation, which gives place on standing to the acetate, a body with a much higher rotation than menthol. The Japanese product has a slightly higher specific rotation than the American one, when dissolved in alcohol and in acetic acid, but the author considers that the differences between the physical properties of the two are not important enough to point to a difference in chemical structure, but are probably due to the presence in the Japanese product of a trace of menthone, a body having a boiling point only slightly lower than that of menthol, and with a + rotation.

—J. G. W.

Birch Oil. Dingl. Polyt. J. **285**, 20.

Most of the winter-green oil of commerce is obtained from the twigs of North American birches, especially *Betula lenta*, but the genuine oil should be prepared from *Gaultheria procumbens*.—J. L.

Process for Preparing Camphor Artificially. Ger. Pat. 64,180, December 23, 1890.

Hydrochloric acid gas is passed through liquid terebenthene, distilled from crude turpentine, whereby a hydrochloride is obtained. This is then separated from its liquid isomerides and purified, after which it is heated with an alkaline carbonate to nearly 120° C. in a retort with inverted condenser. Thus camphor is formed, and in a state sufficiently pure to be vaporised, and in this condition to be submitted to the action of ozone or ozonised air, whereby the camphene $C_{10}H_{16}$ is converted into camphor, $C_{10}H_{16}O$. The camphor thus prepared, is then compressed in a suitable manner, melted, or submitted to sublimation in the ordinary way.—W. S.

Camphor, Methods of Growth and Manufacture in Formosa. E. Bedloe. Jour. Anal. and Appl. Chem. **6**, 1892, 116—120.

Whilst the camphor tree grows in numerous places, it finds most luxurious development in Japan, and, above all, in Formosa, in which island it forms the predominent forest growth. The trees are to be numbered not by hundreds of thousands, but by millions. The camphor expert selects a tree, and scrapes into the trunk in different places, using an instrument resembling somewhat in appearance a rake, with teeth of curved gouge-shaped edges "that cut pulling." This scoops out the wood in little crescent-shaped chips. A tree is not valuable for camphor purposes until it is 50 years old. The scrapings or chips are pounded in a stone or iron mortar and boiled in a large iron caldron, over which is placed, with the concave side covering its mouth, an earthenware bowl-shaped vessel. On boiling, the camphor sublimes and condenses on the inside of the big bowl, which is removed from time to time to scrape off the camphor. The quantity of the camphor produced depends upon the labour engaged. The iron pots and bowls make up a set, and are worked by four men. About 150 lb. a month are obtained.

But owing to bad social and fiscal conditions the output of the entire island in 1890 was only about 60 tons. There is, however, at present some prospect of a speedy change, and if a wiser and better policy should be introduced in Formosa, this will no doubt act beneficially on the export of an article which has from the earliest times been a practical necessity to man, and which is now extensively used in the manufacture of celluloid, zylonite, and smokeless powder.—L. de K.

Improvement in the Method for Estimating Aldehydic and Ketonic Oxygen (Carbonylic Oxygen) and Acetone. H. Strache. Monatsh. Chem. 1892, 13, 299.

See under XXIII., *page* 185.

Testing Oil of Cloves. Dingl. Polyt. J. 285, 19.

See under XXIII., *page* 184.

The Identity of Caffeine and Theine and the Interactions of Caffeine and Auric Chloride. Wyndham R. Dunstan and W. F. J. Shepheard. Proc. Chem. Soc. 1893, 212.

Mays (*Journ. Physiol.*, **7**, 458; *Therapeutic Gazette*, 1866, 587) and more recently Lauder Brunton and Cash (*Roy. Soc. Proc.*, **42**, 238; *Journ. Physiol.*, **9**, 112) having concluded that "theine" from tea differs in its physiological action in certain respects from "caffeine" from coffee, the authors have deemed it desirable to compare the products from the two sources: they conclude that their identity is beyond question. The observed differences in physiological action must be ascribed either to impurities in the materials used, or to differences in the animals to which they were administered; the circumstance that "theine" has been found to be more active and to be capable of producing effects not produced by "caffeine" tends to support the view that the "theine" was impure, especially as it is known that tea contains other alkaloids.

It is found that when an aqueous solution of caffeine aurichloride is heated, a yellow, flocculent precipitate of *aurochlorocaffeine* is gradually formed, the $C_8H_{10}N_4O_2 \cdot HAuCl_4$ being resolved into 2HCl and $C_5H_9(AuCl_2)N_4O_2$; this substance is insoluble in alcohol, chloroform and ether, but dissolves in chlorhydric acid, being reconverted into the aurichloride; it is contended that the production of this compound is better shown by Medicus's formula of caffeine than by that proposed by Emil Fischer. A compound of caffeine and potassium aurichloride is described, crystallising in dark-red needles; it readily dissolves in alcohol and water, but apparently dissociates.

Contributions to our Knowledge of the Aconite Alkaloids. Part IV. On Isaconitine (Napelline). Wyndham R. Dunstan and E. F. Harrison. Proc. Chem. Soc. 1893, [119], 31—32.

The authors have investigated the nature and properties of the alkaloid found together with aconitine in the roots of *Aconitum napellus* (*see* Part II.), to which it was proposed to assign the old, disused name of napelline; this alkaloid always occurs in the roots to as large an extent as aconitine and in some cases to a larger extent. The preparation of the pure substance is fully described in the paper. Its separation from aconitine is based on the superior solubility of the latter in ether, while its superior solubility in chloroform affords a means of separating it in greater part from the other associated alkaloids; it is finally purified by recrystallising its hydrochloride. It is found to be *isomeric* with aconitine, and the name *isaconitine* is therefore now adopted instead of napelline, to which objections were raised on a former occasion.

Isaconitine has hitherto always been obtained in a colourless, friable, varnish-like form, resisting all attempts to crystallise it; it it is readily dissolved by alcohol and chloroform, less readily by ether, and it is only slightly soluble in water, though more so than aconitine. The alcoholic solution is feebly dextro-rotatory.

The *hydrochloride*, $C_{33}H_{45}NO_{12}.HCl$, crystallises from water in rosettes soluble in alcohol, containing 1 mol. prop. of water. The aqueous solution is intensely bitter, and is lævorotatory to almost the same extent as the aconitine salt, $[\alpha]_D = -28 \cdot 74$.

The corresponding *hydrobromide* and *hydriodide* form similar crystals, but are anhydrous; the latter salt is lævorotatory, $[\alpha]_D = -26 \cdot 94$. All these compounds somewhat resemble the corresponding aconitine salts in their physical properties.

Isaconitine exhibits a remarkable behaviour with auric chloride which sharply distinguishes it from aconitine, and, indeed from most other alkaloids. Hitherto no definite *aurichloride* has been obtained, but it is found that when solutions of the hydrochloride and of auric chloride are mixed, a yellow, amorphous precipitate is produced as in the case of aconitine; on recrystallising this from alcohol, nearly colourless crystals are obtained of an *aurochlorisaconitine*, of the formula $C_{33}H_{44}(AuCl_2)NO_{12}$. This is apparently a derivative of the alkaloid in which one atom of hydrogen is displaced by the group $AuCl_2$. The first known alkaloidal derivative of this type, namely, aurochlorcaffeine, was described a short time ago by Dunstan and Shepheard (this Journal, previous abstract). The production of such a compound from napelline was altogether unexpected. Aurochlorisaconitine differs, however, from aurochlorcaffeine in not being reconverted into the aurochloride by the action of hydrogen chloride.

When isaconitine is heated either with water in closed tubes or under ordinary pressure with mineral acids, it is gradually hydrolysed. The hydrolysis is more rapidly effected by aqueous solutions of soda or potash, which act even in the cold. It yields the same products as aconitine and the same proportions, viz., aconine and benzoic acid, $C_{33}H_{45}NO_{12} + H_2O = C_{26}H_{41}NO_{11} + C_7H_6O_2$.

The physiological action of isaconitine has been compared with that of aconitine by Professor Cash, who finds that the action of the two alkaloids is entirely distinct. A solution of a pure isaconitine salt does not produce the tingling sensation on the tongue which is so characteristic of aconitine; and while aconitine is a most violent poison, even in excessively minute doses, relatively considerable quantities of isaconitine must be administered to small animals in order to produce a toxic effect, which effect is the result of a physiological action in the main distinct from that of aconitine. It seems doubtful whether isaconitine would prove toxic to man, except when given in very large doses.

It may be added that the new alkaloid now described under the name of isaconitine is entirely different from the mixtures of amorphous alkaloids called napelline by the earlier workers. It also differs in composition and properties from the picraconitine of Wright and the amorphous bases since obtained from the roots of *Aconitum napellus* by other investigators. Having regard to the manner in which these amorphous bases were prepared, and to the extreme difficulty which is experienced in preparing pure isaconitine, it may be safely concluded that they were not single substances.

Contributions to our Knowledge of the Aconite Alkaloids. Part V. The Composition of some Commercial Specimens of Aconitine. Wyndham R. Dunstan and Francis H. Carr. Proc. Chem. Soc. 1893 [119], 32—33.

The authors have examined a number of English and foreign specimens of aconitine. For several of these they are indebted to Dr. J. W. L. Thudichum, who collected them some years ago; others have been purchased during the last two years. Dr. Thudichum had found that the various specimens differed enormously in their toxic power, many being nearly inert, while a few were highly poisonous.

The process used in examining these "aconitines" was essentially that described in the preceding communication by means of which aconitine, isaconitine, homisaconitine (homonapelline), and aconine could be isolated, and the quantity of each approximately determined. The method of estimating aconitine first proposed by Wright, and recently advocated in a slightly modified form by Allen, in which the benzoic acid produced on hydrolysis of the mixture of alkaloids is reckoned as derived from aconitine, is valueless, since isaconitine furnishes benzoic acid in the same proportion as aconitine when hydrolysed. Sixteen specimens of "aconitine from *A. napellus*" and its salts were examined. Most of the samples were amorphous; these were invariably found to contain but a very small proportion of aconitine, in some cases none, but were chiefly composed of the amorphous alkaloids aconine, isaconitine, and homisaconitine, all of which appear to be very slightly, if at all, toxic. It would seem that, as a rule, "amorphous aconitine" represents the total alkaloids of the root. Of the crystalline specimens of alkaloid only two were pure, most of them being contaminated with more or less amorphous alkaloid. The specimens of aconitine salts examined were found, in nearly every case, to be chiefly isaconitine salts containing only small quantities of aconitine compounds. Hence it is not surprising that great differences have been observed in the mode of action and toxic power of commercial "aconitine." It is most important that in future nothing but pure crystalline aconitine possessing the characters fully described in Part I. (this Journal, 1891, 477) of the inquiry should be used in medicine, and it is satisfactory that a pure alkaloid can now be obtained in commerce.

Prof. Dunstan, in discussion, added that German aconitines were not all amorphous and valueless (as was sometimes supposed); moreover, it was a mistake to suppose that a sample was pure because it was crystalline. *A. heterophyllum*, which had been alluded to, had a very bitter taste; as this was characteristic of isaconitine, perhaps this alkaloid was present.

Piperazine. W. Majert and A. Schmidt. Proc. Chem. Soc. 1893 [119], 35—36.

Piperazine, which was not known in its pure crystalline condition until prepared by the authors in August 1890, by treatment of dinitrosodiphenylpiperazine with alkali, is a crystalline substance melting at 104°—107° in capillary tubes, although when the melting-point is determined on large quantities it is found to be 112°, the differences being due to the hygroscopic nature of the base; it boils at 140°—145°. It is very readily soluble in water and alcohol, the aqueous solution having a distinctly alkaline action. It is very hygroscopic and readily absorbs carbon dioxide, being thereby converted into the carbonate melting at 162°—165°.

Piperazine is especially characterised by the formation of an insoluble pomegranate-red double salt with bismuth iodide and by a dibenzoyl compound melting at 191°.

The basic substance diethylenediamine prepared by Hofmann by the interaction of ammonia and ethylene bromide consisted of a liquid mixture of bases boiling appproximately at 170°. That this mixture contained a small quantity of a base identical with piperazine is undoubted, but it was only after piperazine had been prepared from dinitrosodiphenylpiperazine that Hofmann succeeded in identifying it and isolating the pure crystalline product from the mixture, which, besides higher ethylene bases, contained also a number of vinyl compounds.

Owing to the difficulty of purifying small quantities of the base, Ladenburg's experiments with diethylenediimine, obtained by the decomposition by heat of ethylenediamine hydrochloride, were unsuccessful; the product described by Ladenburg as the base was undoubtedly impure piperazine carbonate, as proved by its melting-point, 159°—163°.

In conclusion, it may be interesting to mention that the authors have succeeded in preparing the following series of hydrates of piperazine, that most readily formed being a hexhydrate which crystallises from dilute aqueous solutions:—

	Melting-Point.
$C_4H_{10}N_2.H_2O$	75°
$C_4H_{10}N2H_2O$	56°
$C_4H_{10}N3H_2O$	39°—40°
$C_4H_{10}N4H_2O$	42°—43°
$C_4H_{10}N5H_2O$	45°
$C_4H_{10}N6H_2O$	48°

The Solubility of Various Inorganic Salts in Acetone and of Acetone in Solutions of Dextrose. W. H. Krug and K. P. McElroy. J. Anal. and Appl. Chem. **6**, 1892, 184—186.

The authors have investigated the solubility of some inorganic salts in acetone, the results being embodied in the following tables:—

Chlorides.

Sodium chloride	Insoluble.
Potassium chloride	Insoluble.
Ammonium chloride	Insoluble.
Calcium chloride	Very sparingly soluble.
Barium chloride	Very sparingly soluble.
Strontium chloride (anhydrous)	Very sparingly soluble.
Ferric chloride	Freely soluble.
Zinc chloride (in sticks)	Freely soluble.
Cobaltous chloride (anhydrous)	Freely soluble.
Nickelous chloride (anhydrous)	Insoluble.
Cadmium chloride (anhydrous)	Somewhat soluble.
Mercuric chloride	Very freely soluble.
Mercurous chlorides	Insoluble.

Bromides.

Potassium bromide	Slightly soluble.
Sodium bromide	Slightly soluble.
Cadmium bromide (anhydrous)	Freely soluble.

Iodides.

Potassium iodide	Soluble.
Mercuric iodide	Soluble.

Cyanides and Sulphocyanides.

Mercuric cyanide	Freely soluble.
Potassium sulphocyanide	Freely soluble.
Ammonium sulphocyanide	Freely soluble.
Ferric sulphocyanide	Soluble.
Cobaltous sulphocyanide	Soluble.
Nickelous sulphocyanide	Insoluble.

Nitrates and Nitrites.

Sodium nitrate	Very slightly soluble.
Potassium nitrate	Very slightly soluble.
Ammonium nitrate	Slightly soluble.
Barium nitrate	Insoluble.
Bismuth nitrate	Insoluble.
Lead nitrate	Very slightly soluble.
Silver nitrate	Soluble.
Potassium nitrate	Very slightly soluble.

Carbonates.

Potassium carbonate	Insoluble.
Sodium carbonate (anhydrous)	Insoluble.

Sulphates and Sulphites.

Copper sulphate (anhydrous)	Insoluble.
Potassium sulphate	Insoluble.
Ferric sulphate (anhydrous)	Insoluble.
Ferrous ammonium sulphate (crystalline)	Insoluble.
Ferrous sulphate (anhydrous)	Insoluble.
Calcium sulphite	Insoluble.

Acetates.

Zinc acetate (crystalline)	Soluble.
Copper acetate (crystalline)	Slightly soluble.
Lead acetate (crystalline)	Slightly soluble.
Magnesium acetate	Insoluble.
Sodium acetate	Insoluble.
Calcium acetate	Insoluble.

Miscellaneous.

Potassium ferricyanide	Insoluble.
Boric acid	Freely soluble.
Mercuric sulphide	Insoluble.
Potassium chlorate	Very slightly soluble.
Ferric pyrophosphate	Insoluble.
Ammonium molybdate	Insoluble.
Ammonium oxalate	Insoluble.
Ammonium tartrate	Insoluble.
Cupric chloride (crystalline)	Freely soluble.
Nickelous sulphate (crystalline)	Very sparingly soluble.
Lithium chloride (crystalline)	Soluble.
Cobaltous nitrate (crystalline)	Freely soluble.
Nickelous nitrate (crystalline)	Sparingly soluble.
Malic acid	Freely soluble.
Tartaric acid	Freely soluble.
Oxalic acid	Freely soluble.

The solubility at 25° C. has been determined quantitatively for the following:—

Substance.	100 Parts Acetone, by Weight, Dissolve.
Potassium iodide	2·930
Potassium bromide	·023
Mercuric chloride	59·990
Mercuric iodide	2·090
Cobaltous chloride (anhydrous)	8·620

The behaviour of acetone with dextrose solutions is similar to that with sugar solutions. The solubility of acetone in dextrose solutions ranging from 10 to 50 per cent. was determined for 25° C. The method used was the same as that applied to determine the solubility of acetone in sugar solutions.

100 *grms. Dextrose Solutions Dissolve at* 25° *C.*

Dextrose.	Acetone.
Per Cent.	Grms.
10	747·86
20	237·71
30	146·30
40	72·72
50	32·70

—D. A. L.

*Note on the Specific Gravity of Aqueous Solutions of Acetone.** K. P. McElroy and W. H. Krug. J. Anal. and Appl. Chem. 6, 1892, 187—188.

In the following table are given the specific gravities of acetone solutions as determined for every 5 per cent. Determinations were made in a piknometer carrying a thermometer stopper, and were all done from duplicate solutions. The acetone used had a boiling-point of 56·4. It was prepared from the crude acetone sold by Hasslacher, in New York, by boiling the redistilled article over calcium chloride under a reflux arrangement for three days, and then distilling. Samples prepared by first converting the acetone into acetone-sulphite of soda, liberating the acetone with sodium carbonate, distilling, dehydrating, and again distilling, gave figures identical with those for the acetone used. Acetone purified by allowing a dilute solution to stand over permanganate for a day, dehydrating, distilling, &c., gave closely agreeing figures. In the tables, specific gravity is taken to mean the weight in grms. of 1 cc. (not corrected for vacuo) at the temperature of observation. In other words water at 4° is taken as unity. The values given by Rossetti's table (Biedermann's Chem. Kalendar, 26,) for the density of water at different temperatures were used to determine the capacity of the piknometers.

Table.

Per Cent. Acetone.	Weight of 1 cc. in Grms. at 15°	Weight of 1 cc. in Grms. at 20°	Weight of 1 cc. in Grms. at 25°
100	79,726	79,197	78,630
95	..	80,748	80,205
90	..	82,197	81,653
85	..	83,588	83,073
80	..	84,981	84,454
75	86,442	86,129	85,533
70	88,085	87,545	87,073
65	89,271	88,785	88,282
60	90,447	89,953	89,477
55	91,526	91,054	90.603
50	92,549	92,051	91,673
45	93,518	93,091	92,678
40	94,488	94.075	93,691
35	95,293	94,931	94.547
30	96,092	95,748	95.411
25	96,783	96.490	96,221
20	97,444	97,210	96,961
15	98,038	97,831	97.604
10	98,681	98,513	98,342
5	98,921	99,169	98,979
0	99,160	99,826	99.712

Specific Gravity of Acetone Used.

15°	0·79726
16°	0·79620
17°	0·79514
18°	0·79408
19°	0·79302
20°	0·79197
21°	0·79107
22°	0·78988
23°	0·78869
24°	0·78750
25°	0·78630

The Solubility of Acetone in Solutions of Carbohydrates at 15°, 25°, *and* 35° *C.* W. H. Krug. J. Anal. and Appl. Chem. 6, 1892, 188—189.

The author has continued the experiments on the solubility of acetone in solutions of carbohydrates.

In the case of dextrose it was found that with a 10 per cent. solution, the rule which had been observed with other solutions, viz., that the solubility decreases with a rise in temperature, was reversed.

In a 10 per cent. dextrose solution, the solubility of acetone increases as the temperature rises, while in more concentrated solutions the solubility follows the common rule.

The solubility in 10, 20, and 30 per cent. sugar solutions was also determined, and this was found to act similarly to maltose.

It seems, therefore, that sugars of the group $C_{12}H_{22}O_{11}$ behave similarly with acetone, while sugars of the group $C_6H_{12}O_6$ act differently from the above.

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* Read before the Washington Chemical Society, March 10, 1892.

Solubility of Acetone in Dextrose Solutions.

100 grms. dextrose solution dissolve grms. acetone at—

Dextrose.	15°	25°	35°
Per Cent.			
10	736·75	747·86	761·54
20	255·28	247·71	240·80
30	157·54	149·83	142·53
40	86·95	79·57	74·03
50	36·16	33·02	31·18

Solubility of Acetone in Maltose Solutions.

100 grms. maltose solution dissolve grms. acetone at—

Maltose.	15°	25°	35°
Per Cent.			
10	353·63	348·09	342·03
20	185·40	181·17	176·86
30	119·90	115·99	112·37
40	78·35	74·73	70·53
50	46·17	42·95	39·82

Solubility of Acetone in Sucrose Solutions.

100 grms. sucrose solution dissolve grms. acetone at—

Sucrose.	15°	25°	35°
Per Cent.			
10	597·23	581·84	574·84
20	272·53	263·19	251·82
30	172·40	162·55	150·61

—D. A. L.

A Method for the Preparation of Acetylene. M. W. Travers. Proc. Chem. Soc. 1893 [118], 15—16.

Wöhler showed that acetylene could be produced by the action of water on calcium carbide CaC_2, which may be prepared as follows on a large scale :—

45 grms. of sodium are placed at the bottom of an iron bottle, and on the top of it is poured an intimate mixture of 110 grms. of calcium chloride and 32 grms. of powdered gas-carbon well dried on a hot iron dish. The top of the bottle is then screwed on and the bottle placed in a furnace and heated to a red heat for half an hour; it is then removed, cooled with water, and the contents broken out

The resultant mixture is dark grey in colour, and contains 16 per cent. of calcium carbide mixed with excess of carbon, added to make the mass more brittle, sodium chloride, and some cyanide. To prepare acetylene a portion is placed in a dry distilling flask fitted with a tap-funnel and a wash-bottle containing caustic soda, and hydrogen is passed through to eliminate any chance of explosion from small particles of free sodium which are occasionally present; water is then run in slowly and the acetylene evolved in a steady stream.

The bottle used consists of a 12-in. length of 2-in. gas-pipe, welded up at one end and screwed at the other to fit a 2 in.—½ in. reducing-socket, which is fitted with a 2-ft. piece of ½-in. pipe, serving both as neck and handle.

For every grm. of sodium used 250 cc. of acetylene are obtained, which is half the calculated equivalent.—M. W. T.

PATENT.

The Treatment of Amido-Guanidine for the Manufacture of a New Compound, and of Products derived therefrom. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 2194, February 4, 1892. (Second Edition.)

See under IV., *page* 142.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENT.

Magnesium Light Cartridge for Photographic Purposes, and Process for Producing Same. E. Hackh, Stuttgart, Germany. Eng. Pat. 20,119, November 8, 1892.

The combustible mixture used in the cartridge is prepared by thoroughly mixing 50 to 60 parts of meal powder with 50 to 40 parts of magnesium powder in a revolving drum, in an atmosphere of carbon dioxide or nitrogen; fibres of asbestos may be mixed with the powder in order to make the cartridge burn more readily. The mixture is then made up into cartridges without being exposed to the air.—F. S. K.

XXII.—EXPLOSIVES, MATCHES, Etc.

A Method for the Preparation of Acetylene. M. W. Travers. Proc. Chem. Soc. 1893 [118], 15—16.

See under XX., *page* 178.

Powder-Nitrometer. F. M. Horn. Zeits. f. Angew. Chem. 1892, 358.

See under XXIII., *page* 185.

PATENTS.

Improvements in Apparatus for Igniting Safety-Fuses. H. T. Robinson, Camborne. Eng. Pat. 1640, January 27, 1892.

The object of this invention is to provide an apparatus for igniting safety-fuses without exposing flame or sparks. The apparatus is made "in the form of a pistol, having its barrel divided longitudinally, the one half hinged to the other so that it can be closed on it like a lid, and held closed by a fastening at the side."

The barrel being opened, the fuse with a cap on it is placed in the groove thus exposed, and then the lid is shut down and fastened. The fuse and cap are kept in position by sharp pins on the inside of the groove. The hammer is made with a recess which entirely encloses the end of the cap when it strikes it, and thus prevents issue of sparks or flame.—W. M.

Improved Manufacture of Explosives. O. Imray, London. From M. M. Rotten, Berlin, Germany. Eng. Pat. 6258, March 31, 1892.

The object of this invention is to prevent the evaporation of certain constituents from some explosive mixtures formed of such organic compounds as naphthalene, anthracene, phenanthrene, alizarin, camphor, naphthol, their sulpho and amido compounds, drying oils or resins, &c., and "nitrates, chromates, or picrates of the alkali metals, or of cellulose or starch." For this purpose "non-nitrating tar-oils of coal and anthacite distillation are added," which enclose the volatile constituents. Such explosive mixtures are rendered non-hygroscopic by the further admixture of a "varnish or lac composed of collodion, nitrocellulose, nitro-starch, caoutchouc, gutta-percha, or resins."—W. M.

An Improved Dynamite Rocket. H. J. Haddan, London. From the American Carrier Rocket Company, New Bedford, Mass., U.S.A. Eng. Pat. 18,277, October 12, 1892.

This invention consists in "the combination with a self-propelling projectile or rocket of a tube forming the tail of the projectile, adapted and arranged to carry explosives, and a time and percussion fuse." Three means of firing the main explosive fuse are provided: a time-fuse which is ignited by the burning mixture; failing this a percussion-fuse contained in the apex of the rocket will fire the charge when the rocket comes in contact with the ground vertically; or if it strike in a slanting direction certain weights held in position by small pins will break the latter and be driven against fulminating-caps, and thus fire the charge of explosive.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

The Estimation of the Thermal effect of Fuels by the Calorimeter. W. Hempel. Zeits. f. angew. Chem. 1892, 389—393.

H. Bunte's researches clearly prove the correctness of Dulong's formula (in most practical cases) for calculating the heat of combustion of fuels from the results of an organic analysis. The calorimetric methods have been meanwhile simplified to such an extent that determinations, including all preparations, may now be easily carried out in the space of one hour. From purely practical reasons, therefore, calorimetric determinations are simpler than those implying an organic analysis. The author, who has worked out his method long before P. Mahler (this Journal, 1892, 840), endeavours to burn carbon at the lowest pressure necessary for its complete combustion. Experiments prove that in an atmosphere of oxygen 1 grm. of carbon burns completely into carbonic acid at a pressure of 12 kilos. per square cm., when employing an apparatus of 250 cc. capacity. Under the atmospheric pressure the formation of soot and tar could not be avoided, even in pure oxygen.

An average sample of the coal to be tested is compressed into a cylinder by means of an iron mould similar to that used by W. Spring in his investigations on the chemical combination of the elements by means of pressure. Care is taken to insert in the coal-cylinder a platinum wire 0·15—0·2 mm. diameter and 6 cm. long.

The mould consists of a longitudinally perforated screw A in two sections, which can be compressed by means of a female-screw B. The cylindrical stamp C, made of hardened steel, fits into the mould. The platinum wire is fitted into the bottom-piece, as seen in Fig. 3, by securing its ends with wax in the holes *e* and in the channels *f*. The mould is now compressed by means of the screw, then charged with 1·5 grms. of coal-dust, and the stamp C of the press is forced down upon it, thus exerting with ease a pressure of several thousand atmospheres. The coal-cylinder is separated from the mould, is carefully scraped from any loose particles, and its weight is then reduced to about 1 grm. The weight of the platinum wire has to be deducted from the exactly ascertained weight of the cylinder.

Fig. 1.

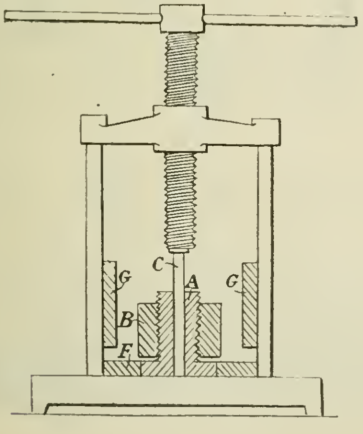
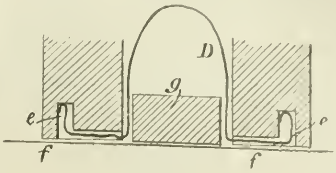
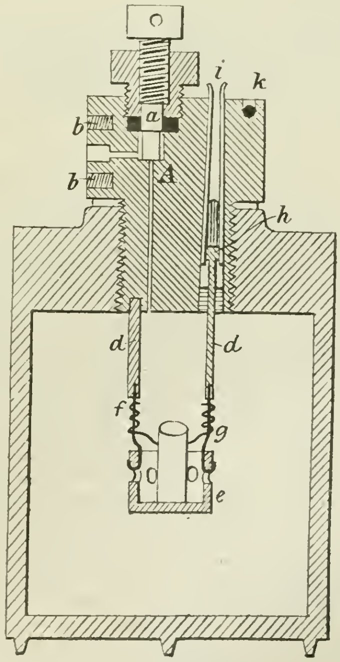


Fig. 2.



The combustion is effected in the iron autoclave represented in Fig. 3. This is composed of an iron tube by screwing and soldering in a bottom 10 mm. thick and a tap about 30 mm. thick; the vessel so formed holds about 250 cc. and must be tested to 50 atmospheres pressure. The head-piece A is provided with a screw-valve *a*, and can be fixed to a flange by means of bolt-holes *b*. It holds an iron peg *c* and an insulated iron peg *d*, in which are screwed and soldered two platinum wires 0·8 mm. thick, *f* and *g*, fastened to the fireclay basin *e*.

Fig. 3.



Peg *d* is insulated by means of a thin piece of rubber-tubing *i*, which is passed through the perforation and slipped over the conical extension of *d*; the upper end of the rubber-tubing is pulled and peg *d* sharply inserted. To prevent the combustion of the insulated rubber-tubing the same is protected with a layer of asbestos. The wires of the coal-cylinder are wound round the platinum wires *f* and *g*, the head-piece put on, and a tight joint produced by means of lead strips.

The vessel is now charged with oxygen up to 12 atmospheres, preferably with compressed oxygen, which contains only 0·2 per cent. of carbonic acid and 4—5 per cent. nitrogen. The pressure is again released in order to eliminate the bulk of the nitrogen, the apparatus is recharged to 12 atmospheres, and suspended in the metal vessel G containing 1 litre of water. This again is suspended in the wooden vessel H, leaving a space of about 2 cm. between the sides. A thermometer K admitting the reading of $\frac{1}{100}$° and a mixer N complete the apparatus. The thermometer remaining constant for about five minutes, connexion is made with the poles of a battery by means of mercury cups *i* and *k*, and the agitator kept in motion until the temperature begins to recede, which may take place in a quarter of an hour.

The thermal capacity of the whole apparatus is estimated by the combustion of pure sugar or sugar-carbon, the heat of combination of which is known, and employing it in quantities sufficient to produce about the same heat as 1 grm. of average coal. Errors due to radiation, formation of nitric acid from nitrogens, &c. are thus allowed for, and this way of estimating the thermal capacity is unquestionably preferable to the usual method of weighing the vessel.

There is always a certain quantity of sulphurous and sulphuric acid formed, due to the presence of sulphur in coals. Direct experiments prove, however, that internally-oxidised iron vessels may be used without causing any error.

In analysing substances rich in hydrogen the pressure in the autoclave varies and would have to be recalculated; this is, however, not the case with pure carbon, pure cellulose, and all similar carbohydrates.

The following table contains comparative figures obtained by calorimetric determinations and by organic analyses, employing for the latter the formula—

$$\text{Heating value} = 80{\cdot}8\,C + 344{\cdot}6\,(H - \frac{O}{8}) \times 25\,S$$

substituting for C, H, O, and S the percentage amount of the respective elements.

Coals.	Ash.	Water.	S	N	C	H	O	Heating Value	
								Found.	Calculated.
No. 1	9·5	6·85	1·5	2·6	67·45	5·3	6·8	6,958	7,019
2	9·2	6·64	1·5	2·6	67·31	5·3	7·45	6,958	7,016
3	5·31	7·25	0·97	1·8	72·30	5·3	7·17	7,471	7,351
4	5·38	6·97	0·97	1·4	72·70	5·1	7·18	7,471	7,345
5	4·4	9·1	0·75	3·1	72·25	5·7	4·7	7,540	7,613
6	2·4	1·7	1·4	..	72·10	0·4	0·4	5,619	5,981

These figures are taken from a series of experiments on the firing of boilers, undertaken for the Saxon Government. All calorimetric determinations not agreeing to 0·02° have been rejected. The errors of the method are very likely within 0·5 per cent., and in many instances complete agreement has been obtained.—H. A.

The Gas Flame as a Source of Error in Chemical Operations. A. Lieben, Monatshefte, **13**, 1892, 286—298.

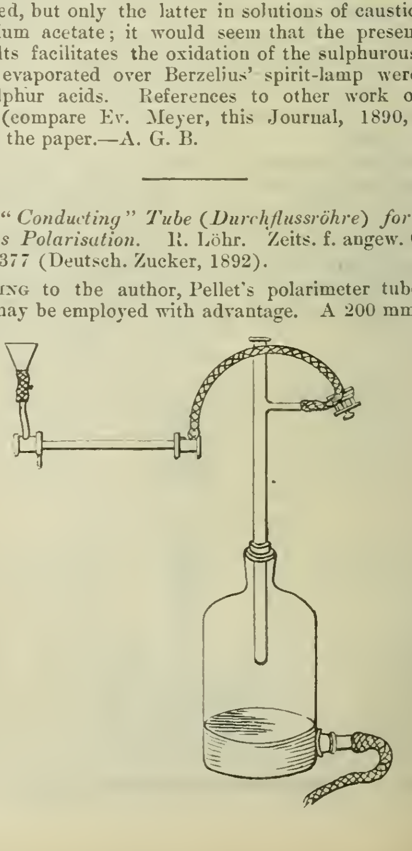
The author finds, as others have found before, that in almost every case where a liquid is evaporated over a gas-flame, even when a water-bath is between the evaporating basin and the flame, sulphuric acid or a sulphate is to be detected in the liquid after a time. Most sulphuric acid was absorbed by solution of bases; neutral solutions of salts of strong acids, *e.g.*, sodium chloride, came next in order of quantity absorbed, then distilled water, then barium chloride solution acidified with hydrochloric acid, and finally hydrochloric acid itself, in which no sulphuric acid could be detected after evaporation. The following quantitive results were obtained by evaporating in dishes covered with a funnel on the water-bath; the funnel may be reasonably supposed to increase the amount of sulphuric acid absorbed by drawing the products of combustion more directly over the dish:—(1.) Two litres of a solution of formic acid, free from sulphuric acid, were neutralised with barium carbonate and evaporated with excess of barium carbonate; the dry residue left 0·0763 grm. of barium sulphate when dissolved in hydrochloric acid. (2.) A solution of barium acetate was evaporated for 42 hours, the volume being kept constant by addition of distilled water; 0·213 gram. of barium sulphate was precipitated. (3.) Very dilute baryta water was evaporated for 35 hours, the volume being kept constant by addition of distilled water; 0·109 grm. of barium sulphate was obtained.

It is better to evaporate without any cover; dilute sodium hydroxide solution thus treated absorbed sulphuric acid equivalent to 0·036 grm. of barium sulphate in 35 hours It was found that calcium carbonate and alkaline carbonates contain sulphates when they have been ignited in a platinum crucible over a gas-flame.

The author conclusively proved that the coal-gas was the source of the sulphur; his supply contained no sulphuretted hydrogen, so that other sulphur compounds must have been present. No determinations of the sulphur in the gas were made. The products of the combustion contained both sulphur dioxide and sulphuric acid, and both could be detected in distilled water which had been evaporated, but only the latter in solutions of caustic soda and sodium acetate; it would seem that the presence of these salts facilitates the oxidation of the sulphurous acid. Liquids evaporated over Berzelius' spirit-lamp were free from sulphur acids. References to other work on the subject (compare Ev. Meyer, this Journal, 1890, 968) conclude the paper.—A. G. B.

Pellet's "Conducting" Tube (Durchflussröhre) for Continuous Polarisation. R. Löhr. Zeits. f. angew. Chem. 1892, 377 (Deutsch. Zucker, 1892).

According to the author, Pellet's polarimeter tube (see figure) may be employed with advantage. A 200 mm. tube



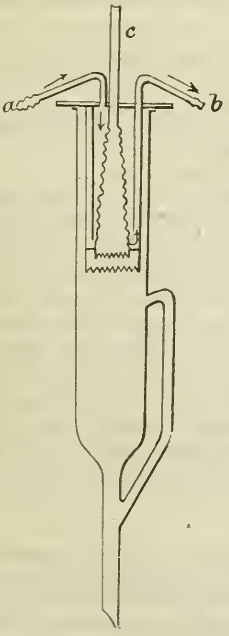
of 7 mm. internal diameter holds about 8 cc. of liquid, and 40 cc. of solution at most are required to displace the same. The tube as supplied by the maker is fitted with a straight filling tube; consequently, if by accident the funnel overflows, the polarimeter may be soiled. To avoid this, Müller and also Clerc give the side-tube a curved form, thus ∽, so that the lower portion of the curve projects beyond the trough of the polarimeter. The tube may be prevented from tumbling over when in the instrument by means of a rubber band passing round the trough and attached to two hooks screwed into the metal disc at the funnel end of the tube.—H. T. P.

Pellet's Polarimeter Tube. A. Stift. Oesterr. Zeits. Zucker, 1892, 265.

In using Pellet's polarimeter tube it is almost impossible to prevent the presence of air-bubbles. In Schmidt and Haensch's modification the filling tube no longer communicates directly with the interior of the polarising tube, but by means of a canal, 0·5 mm. in diameter, parallel to it, ending within 2 mm. of the cover-glass, and thence connected with the tube interior by a small groove. The above dimensions are reduced to 0·3 mm. and 0·9 mm. in the case of Kusche's improved tube. Air-bubbles hardly ever stick in such tubes; or if they do, can be easily expelled by lifting one end of the tube and blowing down the feed-pipe. (See previous abstract.)—H. T. P.

Metallic "Inverted" Condenser. E. Donath. Zeits. f. angew. Chem. 1892, 355—356.

The condenser, which is figured below, is to be recommended on account of its small size and compactness, and the fact that no cork connexions are required. In the drawing (one-fifth real size) it is shown adapted to an extractor. The condenser is suspended in the latter by means of a flat brass collar resting on the edge of the extractor, which must be ground perfectly true in order to secure a good contact.



The condenser proper consists of two concentric metal cylinders, in the centre of which is situated a condensing cone made of corrugated brass. Brass rings with jagged edges are slipped over the ends of the cone and outer cylinder respectively and serve to effect the equable distribution of the condensed liquid over the material being extracted. Cooling water is supplied by means of the tubes *a* and *b*. It will be seen that condensation takes place, not only in the inner cone, but also on the outer surface of the condenser.—H. T. P.

A Modified Combustion Furnace. F. Fuchs. Ber. 25, 1892, 2723—2724.

By several improvements, notably in the form of tiles and regulators, the author claims to have attained considerably enhanced protection for the glass tube, better regulation of the temperature, and considerable economy of gas.

—T. L. B.

PATENTS.

An Improved Thermometer. J. Brückner, Thuringia, Germany. Eng. Pat. 20,114, November 8, 1892.

In this thermometer the bulb or container is replaced by several small tubes, circular or semi-circular in cross-section, which are united together by a stay or core, and opening at their upper ends into a single chamber communicating with the capillary tube, the object being to provide a thermometer which will indicate changes of temperature more quickly.—J. C. C.

Improvements in Funnels and the like. G. A. Hartle, Stoke-on-Trent. Eng. Pat. 2800, February 12, 1892.

The object of this invention is to provide a funnel which is not liable to tip over; also an increased freedom of escape for the liquid when once it has passed through the filtering medium; to render the funnel applicable as an ordinary strainer, and to permit the free escape of air from the receiving vessel. The funnel carries near its apex an external collar, which is designed to rest upon the receiving vessel. On the inside are tapered ribs, which are deepest at the apex, and an internal circular rib a little above the apex, which serves to support a wire-gauze or other suitable strainer. On the outside of the spout are grooves terminating in the collar, so as to allow the escape of air from the receiving vessel.—J. C. C.

INORGANIC CHEMISTRY.— QUALITATIVE.

Test for Strontium in Presence of Calcium. K. P. McElroy and W. D. Biglow. J. Anal. and Appl. Chem. 6, 1892, 266.

The mixture of carbonates of calcium and strontium obtained in the ordinary course of analysis is dissolved in hydrochloric acid and evaporated to crystallisation on a water-bath. The residue is dissolved in 50 per cent. aqueous acetone, mixed with a solution of potassium chromate in the same solvent and rendered alkaline by a drop of ammonia; anhydrous strontium chromate immediately commences to separate, and after about 10 minutes no more strontium remains in solution. Whereas the calcium is not precipitated, although after some hours a few crystals of the chromate may form. The acetone may be replaced by dilute alcohol (compare Fresenius and Ruppert, this Journal, 1892, 776).—D. A. L.

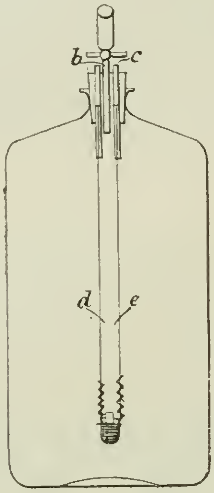
INORGANIC CHEMISTRY.— QUANTITATIVE.

A Method for Estimating Sulphur in Coal and in Organic Substances. W. Hempel. Zeits. f. ang. Chem. 1892, 393—394.

Berthelot estimates the sulphur contained in organic compounds by simply burning the material in his calorimetric bomb. Experiments show that the same reaction may be carried out quantitatively in a glass flask, and a very exact and quick method is thus obtained.

The substance to be analysed is preferably compressed in the shape of a small cylinder as described in the author's article on "The Estimation of the Thermal Effect of Fuels, &c." (this Journal, 1893, p. 179). The combustion is carried out in a glass flask holding 10 litres, and which can be closed with an india-rubber stopper provided with three perforations. One of the glass tubes passing through these perforations is provided with a tap and a cylinder holding say 50 cc. Two long platinum wires about 6 mm. in diameter are fused into the other two glass tubes; one wire holds at its lower end a small platinum basket, made by folding up a small piece of platinum gauze, and standing about 25 mm. above the bottom of the flask. Tubes *b* and *c* (see Fig. 1) are charged with mercury in order to obtain better contact with the poles of a battery of six cells. When not in use these tubes are corked up.

Fig. 1.



When carrying out an experiment the india-rubber stopper is taken out of the flask, the substance placed in the platinum basket, and its igniting wire wound round the wires *d* and *e* in such a manner as to cause the current to pass through the same. The flask is now filled with distilled water, closed with an ordinary cork, inverted, and placed in a basin of water in such a manner that the neck is just immersed in water. The cork is now taken out and the flask filled with oxygen, the cork replaced, and the bottle reversed. The stopper is taken out (whereby no appreciable quantity of the heavier oxygen is replaced by air) and the platinum basket lowered in the flask. The rubber stopper is tied to the flask with some wire, the apparatus connected to the poles of a battery, and the combustion allowed to proceed. The reaction being completed the apparatus is cooled by water so as to condense the bulk of the aqueous vapours. A mixture of 100 cc. of distilled water, 5 cc. of hydrochloric acid, and a small drop of pure bromine are now introduced by opening the tap of the cylindrical vessel, and the whole allowed to rest until the vapours have completely disappeared, which might take an hour. The sides of the flask are rinsed out with the contained liquor, the flask, basket, and wires washed systematically, each with 75 cc. of water, the whole liquid is filtered, then precipitated with barium chloride, and the barium sulphate is subsequently ignited, purified, and weighed.

Carried out in this way, two analyses of a milk-casein yielded concordantly 0·74 per cent. of sulphur. According to Hammarsten's exact determinations the sulphur varies between 0·74—0·79 per cent.

Different varieties of brown coal give the following comparative results, showing that the method leaves nothing to be desired as regards simplicity, speed, and exactness:—

——	In the Glass Flask.	By Eschka's Method.
	Per Cent S.	Per Cent S.
Sample I................	0·74	0·66
Sample II..............	0·86	0·85
Sample III.............	0·95	0·91

—H. A.

The Estimation of Aluminium in Steel. W. Schöneis, Stahleisen, 1892.

From 5 to 10 grms. of borings are dissolved in nitric acid of 1·2 sp. gr., the solution evaporated to dryness, and the residue carefully heated to ignition, in order to eliminate all nitrous fumes. The oxides thus obtained are finely ground in an agate mortar, fused in a silver dish with solid caustic potash free from alumina, and ignited. The mass is cooled, treated with hot water, filtered, and washed. The filtrate is now acidified with hydrochloric acid, the alumina precipitated with ammonia, and weighed. Basic Martin-steel yields an alumina free from silica, whilst that obtained from acid Martin-steel, crucible-steel, and ferro-aluminium is contaminated with silica. It may be purified by treatment with hydrofluoric acid solution on the water-bath.—H. A.

Estimation of Lead. L. Medicus. Ber. **25**, 1892, 2490—2492.

The author aims at getting for technical purposes a rapid method for estimating lead in galenas. The proposal is to obtain the lead as chloride by means of hydrochloric acid, to dissolve this in potash and precipitate the carbonate by means of carbon dioxide. The carbonate is next dissolved in nitric acid and electrolysed, whereby peroxide of lead is obtained. Results of trials with chloride of lead agree very well. Experiments were also carried out by precipitating the lead as peroxide from the potash solution by means of bromine, but the numbers obtained were too high.—T. L. B.

Iodometry. T. Salzer. Zeits. Analyt. Chem. **31**, 1892, 976—381.

This paper is of a controversial character and refers chiefly to Topf's work entitled "Some Errors in Iodometry." Zeits. Analyt. Chem. **26**.

The conclusions arrived are:—

1. A decinormal solution of pure sodium thiosulphate may be regarded as of correct strength so long as a sample when treated with a slight excess of iodine, followed by barium nitrate, gives no precipitate of barium sulphate.

2. Such a solution to which 0·2 per cent. of ammonium carbonate has been added, remains almost absolutely unchanged for a very long period of time; but only gives correct results when its strength as determined in different ways (*a*. By titration against iodine until *disappearance* of the yellow or blue colour; *b*. By titration with iodine until *appearance* of the colour) is found to be the same. A more or less prolonged period of storage, depending apparently on the composition of the ammonium carbonate, is required before this requirement is attained. Of course the test given under 1 also applies in this case.—H. T. P.

The Estimation of Aluminium Phosphate by Precipitation with Ammonia or an Alkaline Acetate. C. Glaser. Zeits. Analyt. Chem. **31**, 1892, 383—388.

The ordinary method of determining aluminium and ferric phosphates in phosphatic minerals, by precipitation with ammonia or an alkaline acetate, may lead to very discordant results, especially in presence of much alumina, owing to the fact, discovered by the author, that aluminium phosphate readily parts with more or less of its phosphoric acid, tending to form a basic salt. When ammonia is employed as precipitant this loss appears to be unavoidable; but a precipitate normal in composition is obtained by the acetate method by operating at a temperature not exceeding 70° C. The following process is therefore recommended:—A few drops of a solution of methyl-orange are added to the acid solution of the phosphate and then ammonia until the reaction is only very faintly acid. In presence of free chlorine, ammonia must first be added in slight excess, then the indicator, and finally dilute hydrochloric acid until the liquid just becomes clear. From this solution the aluminium and ferric phosphates are completely precipitated by warming to 70° C. with a sufficiency of ammonium or sodium acetate. The precipitate must be redissolved in hydrochloric acid and reprecipitated with acetate and a little sodium phosphate as before, in order to remove traces of mechanically retained calcium phosphate. The precipitate is then washed with water at 70° C., dried, ignited, and weighed as usual. If the precipitate has not been fused by excessive heating the iron may be separated by melting it for 10 minutes with pure sodium carbonate, dissolving the fused mass in hot water and filtering off the ferric oxide. The latter must be purified from adhering alkali by resolution and reprecipitation with ammonia. When an insufficient quantity of sodium carbonate is employed in the above process, the filtrate from the ferric oxide sometimes deposits, on cooling, a white, dense precipitate consisting of basic aluminium phosphate ($Al_3P_2O_7$); it is well, therefore, to filter and wash as hot as possible. The bad results furnished by the old acetate and ammonia methods are probably due to the formation of this compound.—H. T. P.

Estimation of Nitrogen in Nitrates. C. Arnold and K. Wedemeyer. Zeits. Anal. Chem. **31**, 1892, 389—392.

The authors have improved on Arnold's older combustion process (this Journal, 1885, 370), which, although generally applicable, has not been largely employed, owing to the number of precautions to be observed. The new method is easy and rapid and gives excellent results when applied to organic and inorganic nitrates (with the exception of pyridine and quinoline nitrates). With nitro-bodies and nitrites, however, the results are not satisfactory, being 1—2 per cent. low. But in these cases the original method yields good results. The details of the process are as follows:—A combustion tube, 45 cm. long, 10—12 mm. internal diameter, is first charged with a column (5 cm.) of a mixture of one part of sodium formate and nine parts of soda-lime, and then with a layer (25—28 cm.) of the substance to be analysed incorporated with a mixture of sodium formate, soda-lime, and powdered crystals of sodium thiosulphate, each one part; dehydrated sodium thiosulphate two parts; and finally with a column (10 cm.) of the soda-lime and formate mixture. The various mixtures are coarsely powdered and tapped well down in the tube, so that no air-channel is left. After placing the tube in the furnace the front portion is rapidly heated, and the combustion proceeded with, no particular precautions being observed. Only, care must be taken that the evolution of gas is not too rapid, and the receiver containing the standard acid, should be placed in cold water. Finally the rear end of the tube is heated, and heating is continued until no more water distils over. The whole operation requires about 50—60 minutes. The distillate is only occasionally slightly turbid. The substitution of copper-foil, pumice, &c., for the front layer of soda-lime and formate rendered direct titration impossible, owing to the large quantities of sulphur which distilled into the receiver.

—H. T. P.

The Separation of Iron, Manganese, and Calcium by the Acetate and Bromine Methods. R. B. Riggs. Journ. Anal. and Appl. Chem. **6**, 94—100.

The author found that when precipitating iron as basic acetate a large excess of ammonium acetate should be avoided, and the precipitate should not be digested too vigorously, nor too long. In neutralising the solution, previous to the acetate separation, a slight precipitate of manganese, due to oxidation, is nearly always formed. It cannot be wholly avoided, though the presence of ammonium salts lessens the amount. In precipitating manganese from an ammoniacal solution by means of bromine the presence of acetates is desirable. But the bromine should be added to the hot ammoniacal solution, as this will insure a more uniform oxidation.

When the quantity of manganese or calcium exceeds 0·02 grm., a double precipitation is necessary.—L. de K.

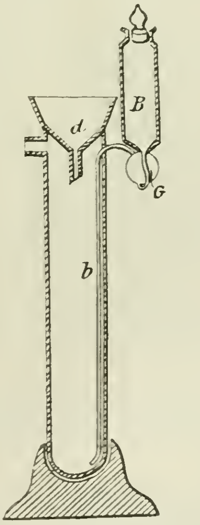
Estimating Small Proportions of Silver and Gold in Base Metals, Mattes, &c. C. Whitehead. Jour. Anal. and Appl. Chem. **6**, 1892, 262—266.

The following method is suitable for the bullion valuation of zinc, iron, nickel, &c., as well as of the arsenides of iron and copper. A convenient quantity of the substance is heated with sufficient nitric acid for complete solution until nitrous fumes cease to be evolved, the solution is diluted, stirred with plenty of lead acetate, and when that is dissolved, 1 cc. of dilute sulphuric acid is added; any suspended gold then speedily settles with the lead sulphate and is collected, cupelled, &c., in the ordinary manner. The solution is divided into two portions, which are separately precipitated with a strong solution of sodium bromide; the precipitates are each collected and washed thoroughly with cold water, and the two lots of silver bromide reduced, cupelled, &c., separately in the ordinary way, using a low temperature for the cupellation.—D. A. L.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Detection of Sugar by Means of α-Naphthol. G. Rapp and E. Besemfelder. Deutsch. Zucker, 1892, 538.

The authors employ the apparatus shown below. It consists of a stout test-tube, 2 cm. in diameter, connected by means of a capillary tube *b*, reaching right to the bottom, with a bulb G and a stoppered vessel B. The funnel *d* is fused to the neck of the tube. The apparatus is employed as follows: 2—3 drops of an alcoholic solution (20 per cent.) of α-naphthol are placed in the funnel *d* and then the liquid to be examined is poured in until the tube is one-quarter filled. The stopper of the vessel B (previously filled with strong sulphuric acid) is then removed, so that the acid may flow into the lower portion of the tube. In presence of sugar, a violet zone appears at the line of demarcation of the two liquids, which gradually spreads by diffusion. A solution of sugar containing only one part per 10,000,000 still yields a pale lilac coloration; whilst in presence of more than 0·2 per cent. of sugar blackening occurs immediately. It is stated that the apparatus has already done good service, in detecting leakages in evaporating stations.—H. T. P.



The Detection of Foreign Fats in Butter. J. Erdélyi. Zeits. Anal. Chem. 31, 1892, 407—410.

The test described is a qualitative one and is based on the fact that a solution of pure butter in cumene when cooled to 0° C. remains perfectly clear for at least one hour—in most cases very much longer—whilst in presence of foreign fats a more or less pronounced turbidity is developed after 1—1¼ hour's standing. In all the cases examined by the author the differences in behaviour between pure and adulterated butters were most marked, so that no difficulty was experienced in diagnosing impure samples. The test is carried out as follows:—The clear filtered butter is allowed to stand in a cool place (ice-chest) for 24 hours; 2 cc. are then measured into a clean, perfectly dry test-tube, and 6 cc. of cumene are added. After standing for 24 hours at the ordinary temperature, the tube is placed for one hour in a vessel containing crushed ice, and is then withdrawn at intervals for a moment for examination. A list of examples is given.—H. T. P.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Extraction and Estimation of Caffeïne in Teas. P. Cazeneuve and A. Biétrix. Monit. Scient. 1892 [4] 6, 253—256.

Extraction of Caffeïne.—This alkaloid is most advantageously extracted from tea, which contains in the mean from 2 to 4 per cent. of caffeïne, coffee containing only 0·8—1 per cent. The oldest method of extraction consists in precipitating an aqueous infusion of tea with ammoniacal lead acetate, subsequently filtering, removing the excess of lead by sulphuretted hydrogen, and evaporating. A method proposed by Cazeneuve and Caillol in 1877 is to mix the tea with half its weight of lime, moisten with water, and dry on the water-bath. It is then extracted for two hours with chloroform. On distilling off the chloroform, taking up with a little hot water, and decolourising by animal charcoal, the caffeïne is obtained. For this process Petit substituted the following, which was introduced into the "*Codex*":—The pulverised tea to be heated for some minutes on the water-bath with twice its weight of water, and then the moist powder to be extracted with chloroform, &c. To this modification there are, however, grave objections, for the tea so extracted when subsequently treated with lime and again extracted gives a further yield of caffeïne; and, furthermore, the extraction with chloroform of a moist material seems scarcely rational.

Estimation of Caffeïne.—For quantitative purposes it is pointed out that the use of lime (or oxide of lead) is absolutely necessary, otherwise the resulting product is impure.

Loche proposed to take 10 grms. of tea and treat repeatedly with hot water, filter, mix the filtrate with 15 grms. of magnesia, evaporate to dryness, extract the residue with chloroform, remove the latter by evaporation, and dry at 105°.

Paul and Cownley (Pharm. J., 1877) give the following method:—Five grms. of tea are moistened with warm water and then dried on the water-bath, the dried residue is extracted with 86 per cent. of alcohol, the alcohol is evaporated off, and the aqueous solution of the extract is treated with a few drops of sulphuric acid to remove lime and decolourise; the liquid is then shaken with chloroform several times, and the chloroform solution shaken with dilute caustic-soda solution to decolourise. The caffeïne is obtained on evaporation of the chloroform. This process is accurate, but long and tedious, and is not reliable, especially seeing that caffeïne is more soluble in chloroform than in alcohol.

An examination of the whole of these processes shows further that the process of the "*Codex*" is suited neither for extraction nor for estimation; that Loche's process does not allow a complete extraction; but that the method of Cazeneuve and Caillol is simple, rapid, and sufficiently accurate.

The subjoined comparative table is interesting:—

Process.	Per Cent. of Caffeïne.	Appearance of the Caffeïne.	Duration of Operation in Hours.
"Codex"	3	Resinous, greenish	7—8
Loche	3	Very resinous, blackish.	12—24
Paul and Cownley	3·80	Almost colourless	6
Cazeneuve and Caillol.	3·73	Almost colourless	3—4

The authors append some results of caffeïne estimations which they have made:—

Green Teas.

Mark: Pingsuey.

	Per Cent. of Caffeïne.
Gunpowder tea, extra	2·16
„ "Imperial"	2·20
„ Young Hyson	2·73

Mark: Country.

Gunpowder tea, Nos. 1—3	3·735
„ "Imperial"	3·00
Young Hyson	2·40—4·91

Black Teas.

From Province Kiansé.

	Per Cent. of Caffeïne.
Ningchow, superior quality	3·77
Keemum, „	3·93—3·97
Hohow, „	2·725

From Hankow.

Sheong Sow Raï, ordinary quality	3·235
Lyhing, „	3·15
Tao Yen Confa, „	3·245
Pinking, „	3·67

From Foochow.

Pakling, good ordinary quality	2·670—2·725
Paklum, „ „	2·315—2·59
Jonfrong-Young, „	3·17
Yung Kow, „ „	3·29
Chingwoo, very ordinary	2·70

From Province Fokien.

Souchon, No. 1	3·73
„ No. 2	2·87
Pekoe, extra	3·50
Tea of ordinary aroma	2·80

These figures confirm what is already known, viz., that the richness in caffeïne does not indicate the value of a tea, of which the quality depends mainly on the essential oils and aroma. The results of such determinations may, however, when considered in conjunction with botanical character, serve to distinguish a tea.—T. L. B.

Testing Oil of Cloves. Dingl. Polyt. J. 285, 19.

For the commercial valuation of oil of cloves Thoms proposes to determine the eugenol in the form of its benzoyl-derivative. Five grms. of the oil are mixed in a beaker with 20 grms. of a 15 per cent. caustic soda solution, and 6 grms. of benzoylchloride. The etherification of the eugenol takes place rapidly if the substances are well stirred. When the mass has cooled down, 50 cc. of water are added, and the crystalline mass is liquefied by warming. The supernatant liquid, when cool, is filtered off, and the same operation repeated in order to remove the sodium salt and the caustic soda by washing. The sesquiterpene contained in the clove-oil is removed from the benzoyl-eugenol by warming it in the beaker with 25 cc. of alcohol of 90 per cent. until all is dissolved, and shaking it, whilst cooling to 17° C., so that the benzoyleugenol crystallises out in the form of small crystals. The crystals are thrown on a filter of 9 cm. diameter, and the filtrate is collected in a graduated cylinder. The crystals on the filter are washed with 90 per cent. alcohol until 22 cc. of filtrate have been collected. They are then dried at 101° C. and weighed. To this weight must be added the quantity of benzoyleugenol dissolved by the alcohol, 25 cc. of which retain 0·55 grm. at 17° C.

The author has found that the specific gravity of oil of cloves varies in direct proportion to its percentage of eugenol. Oils of sp. gr. 1·055 to 1·065 contained from 77 to 85 per cent. of eugenol, whilst an oil of the sp. gr. 1·0655 indicated 90·64 per cent. of eugenol.—J. L.

Method of Determining Nitrogen in Organic Substances. F. Blau. Monatshefte **13**, 1892, 277—285.

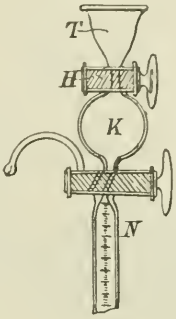
The objections to the Dumas method are (1) the difficulty of exhausting the air from the powdered copper oxide, involving an error of $\frac{1}{4}$—$\frac{1}{2}$ per cent. in excess; (2) its inapplicability to liquids; (3) the necessity for refilling the tube for each analysis. The principle of the author's method has been already described by Johnson (Chem. News, 1884, **50**, 191) and consists in burning the substance in a stream of oxygen after all the air has been expelled from the combustion tube by carbon dioxide; the excess of oxygen is absorbed by red-hot copper and the carbon dioxide by a strong solution of potash. The combustion tube is open at both ends; one end is fitted with a delivery tube and the other with a T-piece, the vertical limb of which is connected with the gas generator, the third opening of the T being closed with a cork. The tube is filled as follows, starting from the delivery end:—Copper oxide (8 cm.), copper (12 cm.), copper oxide (35 cm.), space occupied by boat containing the substance to be burnt (25—30 cm.). The copper oxide is granulated and the copper reduced from the granulated oxide. The copper oxide and copper are first heated to redness in a stream of carbon dioxide until the issuing gas is all absorbed by potash; the substance is then burnt to a coke, the combustion being completed by a stream of oxygen. The last traces of nitrogen are finally swept into the measuring tube by carbon dioxide. The T-piece permits the introduction of a new boat without the admission of more than a trace of air.

The apparatus for evolving the carbon dioxide and the oxygen constitutes the novelty of the process. It consists of a flask ($\frac{3}{4}$—$1\frac{1}{2}$ litres) two-fifths full of 50 per cent. sulphuric acid. It is closed with a two-holed rubber cork; through one hole passes a $1\frac{1}{2}$—2 mm. tube bent four times at right-angles, and having a small bulb (1·5 cc.) on the middle limb, which contains $\frac{1}{2}$ cc. of mercury; the other end of this tube is connected with a separating funnel containing a very strong solution of potassium carbonate (sp. gr. = 1·45—1·5), and situated at 60—70 cm. above the level of the liquid in the flask. Through the other hole in the cork passes the narrow portion of a drawn-out tube (10—12 cm. long and $2\frac{1}{2}$—3 cm. diameter) filled with small lumps of potassium bichromate, and closed with a two-holed rubber cork Through one of the holes of this latter cork is a tube exactly like that described above, also containing a mercury seal; this tube is connected with a separating funnel containing 3—5 per cent. hydrogen dioxide acidified with 15 per cent. sulphuric acid. Through the other hole of the same cork passes a delivery-tube provided with a stop-cock (rubber tube and pinch-cock) and connected with a small wash-bottle of water to serve as an indicator of speed.

To evolve carbon dioxide, the potassium carbonate solution is allowed to flow into the flask, the stop-cock on the delivery-tube being open; the gas passes over the potassium dichromate and through the wash-bottle. A solution of potassium carbonate of this strength dissolves only a trace of air, in which respect it is superior to one of sodium carbonate. The oxygen is generated by allowing the hydrogen dioxide to flow on to the potassium dichromate; it is contaminated, at first, with carbon dioxide, and also with aldehyde vapour from the alcohol contained in the hydrogen dioxide; neither of these impurities is of consequence. Dissolved nitrogen is eliminated from the hydrogen dioxide by introducing a few small crystals of potassium dichromate into the funnel. A cut accompanies the original paper.—A. G. B.

Powder Nitrometer. F. M. Horn. Zeits. f. ang. Chem. 1892, 358.

The nitrometer, a drawing of which is reproduced below, is said to be especially suitable for the examination of smokeless powders prepared from nitrocellulose. The tap H is provided with a wide bore through which the grains of powder are dropped bodily into the bulb K.



4—5 cc. of concentrated sulphuric acid, previously warmed to about 30° C., are then added through the funnel T and the tap H closed. After solution of the powder, which may be hastened by warming the bulb gently, the mass is drawn into the nitrometer tube N, the bulb rinsed several times with fresh acid, and the analysis proceeded with in the usual way.—H. T. P.

Improvement in the Method for Estimating Aldehydic and Ketonic Oxygen (Carbonylic Oxygen) and Acetone. H. Strache. Monatsh. Chem. **13**, 1892, 299—315.

The original method (Monatsheft, **12**, 524) has not been described in this Journal. It is based upon the fact that the hydrazones which phenylhydrazine forms with the aldehydes and ketones do not reduce Fehling's solution with evolution of nitrogen, whereas phenylhydrazine itself does do so. A weighed quantity of the substance is dissolved in a suitable solvent together with a known excess of phenylhydrazine hydrochloride, and some sodium acetate (or acetic acid). The solution is heated at 100° for some minutes, and the whole, or an aliquot part of it, then run into a flask containing an excess of hot Fehling's solution and provided with means for measuring the evolved nitrogen. From the volume of nitrogen the quantity of uncombined phenylhydrazine ($N_2H_3C_6H_5$) is calculated; this is subtracted from the total phenylhydrazine employed and the remainder calculated into its equivalent of carbonylic oxygen ($CO:N_2H_3C_6H_5$).

The author has discovered two errors in the method outlined above. (1.) The reaction between Fehling's solution and phenylhydrazine is incomplete except at the boiling-point of the liquid. (2.) No allowance was previously made for the tension of the vapour of benzene which always accompanies the nitrogen.

The apparatus now employed is figured in the original paper. It consists of a flask ($\frac{3}{4}$—1 litre) containing 200 cc. of Fehling's solution and fitted with a three-holed cork. Through one of the holes in the cork passes, to the bottom of the flask, a tube which is connected with another flask for the supply of steam. Through the second hole passes a separating funnel, the end of which reaches to the bottom of the flask and is drawn out and curved upwards, whereby the escape of gas up it is rendered impossible. The third hole carries a bent tube which delivers the nitrogen into the measuring tube. The Fehling's solution is brought to the boiling-point, and steam is passed through the flask until the air has been expelled as far as possible. The phenylhydrazine solution, prepared as described above, is then allowed to run very slowly, in order to avoid cooling the liquid and creating a back-suck, into the boiling Fehling's solution from the separating funnel, whose stem has been previously filled with water. The nitrogen is rapidly evolved and swept on by the current of steam, the operation being over in 2 or 3 minutes. If the quantity of the Fehling's solution be adjusted for the purpose, the apparatus may be used again for another determination immediately.

Before measuring the nitrogen it is advisable to allow a drop or two of benzene to rise up the tube in order to ensure the saturation of the gas with the vapour. The tension of a mixture of benzene and water vapours at various temperatures is as follows:—

15°.	16°.	17°.	18°.	19°.	20°.
Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
72·7	76·8	80·9	85·2	89·3	93·7

21°.	22°.	23°.	24°.	25°.
Mm.	Mm.	Mm.	Mm.	Mm.
98·8	103·9	109·1	114·3	119·7

The difficulty of expelling all the air from the flask tends to make the volume of gas measured too large. Thus, 1 grm. of phenylhydrazine hydrochloride yielded, as an average of eight experiments, 159·7 cc. of nitrogen, instead of 154·6 cc. But this error is fairly constant and can be determined once for all, for the same apparatus, and allowed for.

Numerous examples as to the applicability of the method are given. The estimation of acetone is very quickly effected, the operations being, categorically, as follow:—(1.) Weighing the phenylhydrazine hydrochloride and dissolving it together with about 1·5 times its weight of sodium acetate, in warm water. (2.) Adding a known volume of the acetone solution. (3.) Warming the mixture for a quarter of an hour on the water-bath. (4.) Cooling, making up to 100 cc., and pipetting 50 cc. into the separating funnel. (5.) Allowing the liquid to flow into the boiling Fehling's solution and collecting the nitrogen. (6.) Letting a few drops of benzene up the tube, measuring the nitrogen, and correcting its volume. The acetone (A) is calculated from the formula—

$$A = [g.160^{*} - 2\,Vo].0{\cdot}002595,$$

g being the weight of phenylhydrazine hydrochloride taken, and Vo the corrected volume of nitrogen.

A very dilute solution of acetone may be boiled in a flask connected with an absorption tube containing the phenylhydrazine solution; if air be passed through the liquid at the same time the acetone will speedily be volatilised into the phenylhydrazine solution, which can then be treated as above.

The author is applying the method to the estimation of aldehyde, and of alcohol by first converting it into aldehyde.
—A. G. B.

The Estimation of Tartar in Sweet Wines by Berthelot and Fleurieu's Method. E. Ackermann. Zeits. Anal. Chem. **31**, 1892, 405—407.

Reference is made to an analysis published some years ago by Petrowitsch (Zeits. Analyt. Chem. **25**, 198) of a pure Karlowitz wine, which was stated to be free from tartar because it yielded, when examined by Berthelot and Fleurieu's method, no crystalline precipitate of tartar, but only a tough, slimy, brown deposit. This deposit was assumed, without further examination, to consist chiefly of colouring matter. The author has observed the same peculiarity in the case of a sweet Greek wine. The deposit, however, was found to be chiefly sugar, mixed with a little tartar, although a considerable portion of the latter remained in solution. That tartar was really present in the wine was proved by repeating the test on a sample which had previously been completely fermented. A crystalline deposit was obtained free from any slimy admixture. It appears, therefore, that Berthelot and Fleurieu's method, is not directly applicable to sweet wines. They must be completely fermented first. Experiments were made showing that no tartar is destroyed by such treatment.—H. T. P.

The Determination of Ash in Sugar Products. E. Donath and F. Eichleiter. Oesterr. Zeits. Zucker. 1892, 281.

Experiments made with Alberti and Hempel's method (this Journal, 1892, 273) have shown that pure alkaline chlorides and sulphates, when ignited with quartz and pure sugar, lose considerably in weight, whilst no loss is observable when ordinary sugar-products are burnt with quartz. The difference in behaviour is possibly due to the presence of alkaline carbonates in ordinary sugar-ash. The authors are of opinion that the method probably gives more correct results than any other process. Platinum vessels are, however, strongly attacked by the quartz, so that it is better to use porcelain capsules.—H. T. P.

Standardising Acid for Kjeldahl's Method. F. C. Wells. J. Anal. and Appl. Chem. **6**, 1892, 191—193.

The author has compared the various methods recommended and adopted for standardising acid for use in the Kjeldahl method, and concludes that the gravimetric method with silver nitrate gives results too low, whilst distillation of an ammonium salt with sodium hydroxide gives results too high, but that the true value of standard solutions may be obtained very closely either with soda, potassium tetroxalate, oxalic acid, or sodium hydrogen carbonate. Cochineal is useless as an indicator for oxalic acid and ammonia.—D. A. L.

Notes on the Chemico-Legal Analysis of Wine (Germany). A. Bornträger. Zeits. f. ang. Chem. 1892, 358.

See under XVII., *page* 169.

The Conditions of Tender for Mineral Lubricating Oils Prescribed by the Prussian State Railways. M. Albrecht. Dingl. Polyt. J. **285**, 67 and 114.

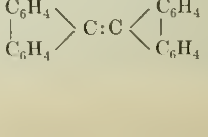
See under XII., *page* 163.

ANALYTICAL AND SCIENTIFIC NOTES.

Bidiphenylene Ethane, a Red Hydrocarbon. C. Graebe. Ber. **25**, 1892, 3146—3149.

From various publications on colouring matters it appears that the existence of coloured hydrocarbons is denied, or at least regarded as highly improbable. This view has no doubt received additional confirmation from the fact that it has been possible to decolourise by further purification certain hydrocarbons which were originally considered to be coloured, for instance, the hydrocarbon chrysene. Evidence as to the occurrence of coloured hydrocarbons is therefore wanting, although it has recently been shown by Arnaud that carrotene, the dark-red colouring matter extracted from carrots, is a hydrocarbon.

On passing fluorene over heated lead oxide, De la Harpe and Van Dorp obtained a hydrocarbon $C_{26}H_{16}$ of reddish colour which could not be decolourised. Mantz prepared the same substance by heating fluorene with bromine to 240°—300°. It was also obtained by the action of chlorine on fluorene heated to 280°—290°, and by heating fluorene with sulphur. De la Harpe and Van Dorp expressed the constitution of their hydrocarbon by the formula—



$$\begin{matrix} C_6H_4 \\ | \\ C_6H_4 \end{matrix} \!\!>\! C{:}C \!<\!\! \begin{matrix} C_6H_4 \\ | \\ C_6H_4 \end{matrix}$$

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* Presumably for the author's apparatus.

The following observations made by Mantz confirm the correctness of this formula:—(1.) The hydrocarbon combines readily with two atoms of bromine or chlorine. (2.) Oxidation results in the formation of diphenylene ketone as chief product. (3.) The vapour of the hydrocarbon passed over zinc-powder yields fluorene. (4.) On reduction De la Harpe and Van Dorp obtained a colourless hydrocarbon $C_{26}H_{18}$, which Mantz prepared by heating the bromo-additive compound with alcoholic potash.

From the author's investigations it appears that the hydrocarbon discovered by De la Harpe and Van Dorp is identical with that obtained by Mantz. When perfectly pure it forms yellowish-red needles melting at 187°—188° (corr.). It is best prepared by heating fluorene and lead oxide in a retort over an oil-bath, at first to the boiling-point of fluorene, and subsequently for a short time to a temperature of 350°. The residue is extracted with carbon bisulphide, and the product purified by crystallisation from alcohol and chloroform or carbon tetrachloride. Unsuccessful attempts were made to decolorise the hydrocarbon by crystallisation, treatment with sulphuric acid, or purification of the picrate. It was, moreover, found that the red colour increased in brilliancy with the purity of the hydrocarbon. As a further proof of the fact that the hydrocarbon is coloured the following experiment is quoted. It is possible to prepare a perfectly colourless bromo-additive compound $C_{26}H_{16}Br_2$. On dissolving this in a sufficient quantity of toluene and heating with sodium, the colourless solution gradually changes to red, the colour increasing in intensity with the progress of the reduction.

For the coloration of bidiphenylene ethane the group $>C=C<$ is evidently essential, seeing that both the bromo-additive product and the hydrocarbon $C_{26}H_{18}$ are colourless. The atomic grouping of the red hydrocarbon appears to be analogous to that of azobenzene, although the doubly-bound carbon atoms do not seem to promote the coloration to the same extent as the nitrogen atoms, as both diphenyl-ethane and tetraphenyl-ethane are colourless. To effect the coloration a further condensation of carbon, such as exists in the diphenylene group, is necessary.

The same phenomenon is noticeable in the case of the highly-coloured diphenylene ketone as compared with the colourless or but slightly-coloured benzophenone.

The author is now engaged in the study of the derivatives of bidiphenylene-ethane, the object being to ascertain what influence the substituted elements exercise over the coloration.—D. B.

Properties of Ruthenium. Journ. des Mines. January 26, 1893.

Ruthenium is one of the rarest, and therefore most expensive, of metals; it is also of all known elements that which presents the most original properties. M. Joly, Professor at the Chemical Laboratory of the Parisian Normal School, has already made known the well-defined compounds of ruthenium, principally those resulting from the combination of this element with nitric oxide.

Pursuing the examination of this singular metal, the Professor has submitted to the Academy of Sciences several samples of a red colouring substance, resulting from a combination not yet studied (ammoniacal oxychloride of ruthenium), giving a dyeing power comparable with that of the richest colouring materials derived from coal-tar; with fuchsine, for example.

One five-millionth part of this substance is sufficient for colouring water; it dyes silk directly, and the colour thus obtained is fixed. The chemical reactions of this new colouring product are equally interesting. Acids make it turn yellow and alkalies bring it back again too red.

Unfortunately the rarity of the metal which enters into the composition of this substance is against its use in industry. It is, in fact, a scientific curiosity to which great interest lends itself, for here is seen a metal playing the *rôle* of carbon in a substance which has all the properties of an organic material.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Oil of nutmeg is dutiable at 25 per cent. under paragraph 76, N.T., as an essential oil not specially provided for.

So-called liquid paraffin, a distilled oil, and not the article commercially known as paraffin, is dutiable at 25 per cent. *ad valorem* under paragraph 76, N.T.

Kittool, a vegetable fibre, not crude, but dyed and prepared fit for use in brushes and other like articles, is dutiable at 20 per cent. *ad valorem* under section 4, Act of October 1st, 1890, as a non-enumerated manufactured article.

Bleached cotton pulp, dried in sheets or cakes, and used for filtering purposes, is dutiable as a manufacture of cotton, at 40 per cent. *ad valorem* under paragraph 355, Act of October 1st, 1890.

Noir solide, known as "steam black," prepared dye and a chemical compound or combination of such compounds, some of the original elements thereof being extract of logwood and salts of chromium and alumina, in the combination of which an acid has been used, not being a simple extract or decoction of logwood, is dutiable at 25 per cent. *ad valorem* under paragraph 76, N.T.

Olive oil, unfit for salad purposes, for use as machinery oil, is free of duty under paragraph 661.

Camphor in the form of a powder, except that the powder has gathered more or less into lumps, is dutiable as refined camphor at 4 cents a pound under paragraph 15, N.T.

"Toluidin sulfosaure" is dutiable at 35 per cent. *ad valorem*, as a coal-tar colour or dye, under paragraph 18, N.T. This article is toluidine sulphoacid, sometimes known as thio chromogen, and is a chemical compound and a coal-tar colour or dye.

Phenylene diamine, a chemical compound, its dominant chararteristic element being derived from coal-tar, the same being a coal-tar preparation, not a colour or dye, is dutiable at 20 per cent. *ad valorem*, under the provisions of paragraph 19, N.T.

Toluidine base is dutiable at 20 per cent. *ad valorem* as a coal-tar preparation, not a colour or dye, under paragraph 19, N.T.

Natural grass dyed is dutiable at 30 per cent. *ad valorem*, under paragraph 460.

Binitro toluol is dutiable at 20 per cent. *ad valorem*, under paragraph 19, N.T., as a coal-tar preparation, not a colour or dye.

Naphthionate of soda is dutiable at 20 per cent. under paragraph 19, N.T.

Papain, vegetable pepsin, or powdered "carica papaya," is dutiable under the tariff of 1890, at 50 cents per pound, as provided in paragraph 74 of the Act.—*Board of Trade Journal.*

Two important decisions relating to the metals have recently been made by the United States Court of General Appraisers. One is in regard to the duty on pig lead, whether the two cents per pound should be levied on the gross weight of the imported metal, or on the weight of the lead therein contained.

The court holds that the duty is to be assessed on the gross weight of the pig lead.

The other decision relates to the importation of pyrites for acid purposes, containing copper, a brief notice of which appeared in the Society's Journal, November 1892, page 948.

The importance of the case warrants us in quoting the decision in full :—

The question is the proper mode of determining the amount of copper in sulphur ore which contains copper. Paragraph 133 provides that sulphur ore containing more than 2 per cent. of copper shall pay an additional duty of one-half of one cent per pound for the copper contained therein.

In the present case the assay was made by the electrolytic process. The appellants claim that the fire assay should have been adopted. By the first method a portion of ore is dissolved, and the absolute amount of copper contained is precipitated. On account of loss in working, ore is usually bought and sold by what is termed a fire assay. But from the simplicity and accuracy of the electrolytic method and by common agreement in the trade, the so-called fire assay or commercial assay is determined by deducting 1·3 per cent. from the sum given by the electrolytic or wet process.

In deciding a case of this kind, S.S. 10,037, May 26th, 1890, the department says that after conferring with the Superintendent of the Mint the conclusion is reached that the "fire or dry assay" should be used by Customs officers in such cases. Congress is supposed to have had cognizance of the method of assay followed by the department just prior to the passage of the Act of October 1st, 1890; and as there is no substantial change in the phraseology of the new law in the provision for sulphur ores containing copper, there appears to be no reason to modify the regulations of the department as given in the decision named.

We hold that the amount of copper should be determined by fire assay, and that the fire assay may be ascertained according to conventional usage by deducting 1·3 per cent. from the electrolytic assay. To that extent the protests are sustained.—*Eng. and Mining Journal.*

MANUFACTURE OF PERFUMERY AND ESSENCES IN BOND.

The following letter has been received by the Secretary of the London Chamber of Commerce from the Customs authorities, granting further facilities in connexion with the above manufacture :—

Custom House, E.C.,
February 2nd, 1893.

SIR,

WITH reference to your letters of the 25th August last and the 11th ultimo, on the subject of the hours during which the manufacture of perfumery, &c. is allowed to take place in bonded warehouses, I am now directed by the Board of Customs to acquaint to you, upon full consideration, they are prepared to accede to the request put forward on behalf of the manufacturers of perfumery and essences in bond for exportation only, to be allowed to carry on their manufacture between the hours of 8 a.m. and 6 p.m. throughout the year, on the condition that any expenses incurred by the Crown for supervision beyond the usual hours as set out in section 9 of the Act 44 Vict. c. 12, be defrayed by the manufacturers. Those hours are 8 a.m. to 4 p.m. from the 1st March to the 31st October, and 9 a.m. to 4 p.m. during the remainder of the year.

I am, Sir,
Your obedient servant,
(Signed) R. T. PROWSE.

The Secretary,
London Chamber of Commerce,
Botolph House,
Eastcheap, E.C.

CUSTOMS TARIFF OF NEW SOUTH WALES.

Articles.	Rates of Duty.	s.	d.
Arrowroot, baking-powder, yeast, and farinaceous foods, prepared, not being wheaten flour or oatmeal, or otherwise exempted.	Per lb.	0	1
Milk, condensed	,,	0	1
Butterine and margarine	,,	0	6
Gelatine, glue, and size	Per lb.	0	1
Starch and starch powder	,,	0	1
Wax and stearine	,,	0	1
Candles	,,	0	1½
Sugar :—			
Refined	Per cwt.	6	8
Raw	,,	5	0
Molasses and treacle	,,	3	4
Glucose :—			
Liquid and syrup	,,	3	4
Solid	,,	5	0
Spirits	Per proof gall.	14	0
Methylated spirits	Per gall.	1	0
Bitter essences, fluid extracts, medicines, infusions, and preparations containing—			
Not more than 25 per cent. of proof spirit.	,,	3	6
Not more than 50 per cent. of proof spirit.	,,	7	0
Not more than 75 per cent. of proof spirit.	,,	10	6
If containing more than 75 per cent. of proof spirit.	,,	14	0
Oils, except linseed-oil, raw or boiled, sperm, black whale, palm, and cocoanut.	,,	0	6
Grease, lubricating	Per ton	60	0
Paints and colours ground in oil	,,	60	0
Dry colours	,,	30	0
Putty	,,	20	0
Varnishes containing spirit	Per gall.	2	0
All other varnishes	,,	1	0
Naphtha and gasoline	,,	0	6
Cement, plaster, and hydraulic lime	Per barrel	2	0
Vinegar (other than aromatic or raspberry)	Per gall.	0	6
Acetic acid	,,	2	6
Sulphuric acid	Per cwt.	2	6
Aërated waters	Per doz. pts.	0	6
Salt	Per ton	20	0
Soda crystals	,,	40	0
Paper, brown and wrapping	Per cwt.	3	0
Opium and any preparation thereof	Per lb.	20	0
Blasting powder	,,	0	1
Dynamite	,,	0	1
Soap :—			
Fancy	,,	0	2
Other than fancy	Per cwt.	3	0
Zinc (manufactured)	,,	3	0
All goods not otherwise enumerated	10 °/o *ad val.*		

The following is a list of exemptions :—

Alum, antimony ore, asbestos packing, bismuth ore, blue, bluestone, bone-dust, bones, brewers' isinglass, brimstone, caustic soda, caustic potash, charcoal, chrome ore, cobalt ore, copperas, copper ore and regulus, dyeware and dyes, hides and glue pieces, isinglass, Kauri gum, lead ore, lead pig, lime juice, limestone, liquid driers, malt, manures, matches, mineral pitch, mustard, nickel (unmanufactured), oil-cake, oils (cocoanut, palm, black whale, sperm, linseed), pitch, printers' and writing paper, quicksilver, rags, resin, silicate, soda-ash, spelter, sulphur, tallow, tar, terebene, tinplates, turpentine, type metal, yellow metal in sheets, zinc (sheet), chlorodinitrobenzol, dextrine (shoemakers'), india-rubber, nitrate of ammonia, seal oil, albuminised paper, shellac, yeast, crude drugs, gums, essential oils (except lemon and eucalyptus), chlorate of potash, soda crystals, bitumen, artists' colours.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Sale of the Government Nitrate Properties in Chili.

Mr. Lewis Joel, Her Majesty's Chargé d'Affaires at Santiago, in a despatch to the Foreign Office, dated the 5th December, with regard to a proposal to sell the Government nitrate properties in Chili, states :—

The Standing Committee on Finance has reported a Bill providing for the sale of the Government nitrate properties. The sale is not to take place until it shall have been advertised for six months in the *Diario Officiel*, and for three months in London, Berlin, and Paris newspapers. The minimum price must not be less than that paid by the Government, with interest at the rate of four and a half ($4\frac{1}{2}$) per cent. per annum from the date of acquirement to the date of sale. Fifty (50) per cent. of the price realised is to be paid at once, and the remaining moiety in two yearly instalments of twenty-five (25) per cent., with interest at the rate of four and a half ($4\frac{1}{2}$) per cent. per annum.

The President of the Republic is not allowed to dispose of the proceeds of the sale, except according to a special Bill to be passed for this purpose.—*Board of Trade Journal.*

GENERAL TRADE NOTES.

The Industries of the Caucasus.

The industrial resources of Caucasia form the subject of an exhaustive article by the Austrian official Herr G. Sedlaczek, published in the *Handels Museum* of January 15th, from which the following particulars have been extracted.

There are about 232,000 acres devoted to viticulture in Caucasia, yielding about 35,000,000 galls. of wine every year. The average profit per acre is something between 140 and 148 roubles.

The production of spirits from wine, which in 1887 amounted to 467,000 galls. of pure alcohol, has since fallen to 229,000 galls.; a decrease due on the one hand to the ravages of phylloxera, and on the other to the increased demand for wine.

Most of the spirits are now distilled by the vine-growers, except in the case of the Mohammedans, whose faith forbids the manufacture of spirituous drinks, and who dispose of their grapes to their Christian neighbours at almost nominal prices.

Mulberries, pears, cherries, and other fruits are also used for the manufacture of spirits, but the production from these sources greatly depends upon the vine crop, in regard to which the producers endeavour to cover their losses by having recourse to the above-named fruits for distillation.

The annual production of spirits from fruit other than the vine during the last five years has been about 175,000 galls.

For the brewing industry an open field still remains in Caucasia. The experience of the last decade shows that there is an increasing demand for beer, and breweries are multiplying. There is room for improvement, however, as regards both the quantity and the quality of the beer produced. In consequence of the Customs duty, foreign beer, which is greatly superior to Russian, is too dear to command an extensive consumption in Russia, but even the Russians, who are not particularly fastidious in this respect, are dissatisfied with Caucasian beer. An increased consumption could, in a short time, be easily ensured by the production of good qualities of beer, and there is no scarcity of barley in the country.

Little need be said as to the enormous development of the naphtha industry. The production of crude naphtha at Baku, which in 1873 was only 3,951,375 pouds, reached 282,000,000 pouds in 1891, and, so far as can be ascertained, amounted to 300,000,000 pouds for 1892. The remaining naphtha fields of Caucasia are in the Governments of Kouban, Ter, Daghestan, Tiflis, and Elisabetpol, but they are not being actively exploited.

The Caucasian mining industry has a great future before it. At present operations are conducted in too primitive a manner, and with too little technical knowledge, to allow this branch of enterprise to occupy the position which the mineral wealth of the country would entitle it to hold. The chief obstacle to its prosperity is the lack of suitable means of communication.

The annual output of copper amounts to about 150,000 pouds, chiefly produced in the Governments of Tiflis, Elisabetpol, and Koutais. The cost of production is about 25 copecks per poud of ore, and 5·84 roubles per poud of pure metal.

The output of lead and silver ore is about 3,000 pouds per annum. This branch of mining is entirely neglected.

Zinc blende is produced in the Artvin district of the Government of Koutais in quantities varying between 8,000 and 10,000 pouds per annum, and is exported raw to Hamburg. Brownstone (manganese) is produced in the same Government in quantities which are increasing from year to year. There were 10,468,000 pouds produced in 1890, three-fourths of which were sent abroad. The price at the mines varies between 4 and 6 copecks a poud.

The district of Daghestan is rich in sulphur ore, the production of sulphur being about 20,000 pouds per annum, notwithstanding the most primitive methods of procedure.

Coal is obtained in the Governments of Koutais and Kuban, but the output does not exceed 6,000 pouds per annum, part being sent to Odessa, where it realises from 18 to 20 copecks a poud. The quality is rather inferior.

About 2,000,000 pouds of salt and about 300,000 pouds of glauber salt are produced annually in Caucasia.

Sulphur Exports from Sicily.

Writing from Palermo, the French Consul at that port states that the prices of sulphur in Sicily for some years had increased to such an extent that the French purchasers were induced to send representatives thither for the purpose of examining and reporting upon the question. Last summer, on the contrary, the rates fell considerably. In certain districts the sulphur workings have reduced the miners' wages and strikes have resulted.

Towards the end of 1892 some disturbance was caused in the sulphur trade, as also in the export trade in other articles, because of the general sanitary condition and the obstacles raised by quarantine.

The export of sulphur from Sicily from the 1st January to the 31st October 1892 exceeded by 125,000 cantars (13 cantars = 1 ton) that for the corresponding period of 1891.

The countries which received the largest quantities were:—the United States, 67,928,628 kilos. (against 81,503,043 kilos. in 1891); France, 62,393,868 kilos. (against 46,382,288); Italy, 34,435,998 kilos. (against 43,903,903); England, 21,105,129 kilos. (against 20,523,620); and Russia, 11,418,587 kilos. (against 12,325,242 kilos.); the total quantity exported for the first 10 months of 1892 being 269,128,218 kilos. as compared with 259,076,941 kilos. in 1891.

It is noticeable that a large diminution is shown in the exports for America, those for other countries having increased to the extent of making up the difference.

Chinese Import of Galvanised Plates.

The Brussels *Bulletin du Musée Commercial* publishes the following information supplied by the Belgian Legation at Pekin with regard to the importation of galvanised plates into China.

The plates are beginning to be used even at Pekin as roofing.

The sheets are 2·140 metres long, 915 centimetres wide, and one millimetre thick; they obtain 5·6 kilos. The retail price is one tael per sheet at Tientsin, according to the rate of exchange.

The question is mooted of establishing at Tientsin an important iron railway station entirely after the European model, and a large quantity of plates will be required for this building, the plans specifying their employment for the roofs. With a desire to reduce its expenses as much as possible, the Chinese Government will certainly give preference to the lowest tenders. A large quantity of glass will also have to be supplied.

The German Brass Industry.

The French *Moniteur Officiel du Commerce*, in an article on the brass industry of Germany, states that there has existed for two years keen competition between the different brass factories; it commenced after the dissolution of the syndicate constituted by these factories a few years ago. For a certain time the large establishments were fed by the Government orders; but when these orders had been executed, the rivalry between them became much keener on the market, and at the present time almost all the establishments are working at a loss; this loss is estimated at six or eight marks per 100 kilos. There are in Germany about 25 works producing daily 200,000 kilos.; only admitting that half of them carry on at a loss, the result is very serious. The competition is all the keener as the large establishments try to destroy the small, some of which have already disappeared.

The Production of Wood-Pulp in Norway.

Compared with its predecessor, last year shows a slight decline in the production of wood-pulp, the figures being 210,000 tons for 1892 against 230,000 tons for 1891. The value of last year's production is estimated at about 420,000*l*. No manufactories for mechanical wood-pulp have been erected in Norway during 1892, and the number of such factories still remains at 58, of which about a dozen are connected with paper-mills. The Wood-Pulp Union has arranged that operations shall be suspended for a month during the year, and that last year's quotations of 36 kr. for wet and 75 kr. to 80 kr. for dry wood-pulp per ton fo. b. shall be maintained. A considerable quantity of this year's production has already been sold. The market for chemical wood-pulp improved during 1892, and prices were a little higher at its close than at the commencement. There are now in Norway 11 sulphite and four sulphate manufactories. Several of these are also connected with paper-mills. The exports during 1892 of chemical wood-pulp were about 20,000 tons dry, as compared with 17,500 tons in 1891; and about 8,500 tons wet, as compared with 9,500 tons in 1891.—*Industries.*

Tin in the United States.

The *Engineering and Mining Journal* states that the mines and mills of the Harney Peak Tin Mining Co. were closed down on the 2nd February, and that the real reason is the lack of tin in the ore. There is now not a tin mine in operation in the country.

PATENT LAW AMENDMENT COMMITTEE.

Extracts from the United States Patent Law.

Establishment of the Patent Office.

Sec. 475. There shall be in the Department of the Interior an office known as the Patent Office, where all records, books, models, drawings, specifications, and other papers and things pertaining to patents shall be safely kept and preserved.

Officers and Employés.

Sec. 476. There shall be in the Patent Office a Commissioner of Patents, one Assistant Commissioner, and three examiners-in-chief, who shall be appointed by the President, by and with the advice and consent of the Senate. All other officers, clerks, and employés authorised by law for the office shall be appointed by the Secretary of the Interior, upon the nomination of the Commissioner of Patents.

Salaries.

Sec. 477. The salaries of the officers mentioned in the preceding section shall be as follows:—

The Commissioner of Patents, four thousand five hundred dollars a year.

The Assistant Commissioner of Patents, three thousand dollars a year.

Three examiners-in-chief, three thousand dollars a year each.

Sec. 440. There shall be in the Department of the Interior—

* * * * *

In the Patent Office—

One chief clerk, at a salary of two thousand five hundred dollars a year.

One examiner in charge of interferences, at a salary of two thousand five hundred dollars a year.

One examiner in charge of trade marks, at a salary of two thousand five hundred dollars a year.

Twenty-four principal examiners, at a salary of two thousand five hundred dollars a year each.

Twenty-four first assistant examiners, at a salary of one thousand eight hundred dollars a year each.

Twenty-four second assistant examiners (two of whom may be women), at a salary of one thousand six hundred dollars a year each.

Twenty-four third assistant examiners, at a salary of one thousand four hundred dollars a year each.

One librarian, at a salary of two thousand dollars a year.

One machinist, at a salary of one thousand six hundred dollars a year.

Three skilled draughtsmen, at a salary of one thousand two hundred dollars a year each.

Thirty-five copyists of drawings, at a salary of one thousand dollars a year each.

One messenger and purchasing clerk, at a salary of one thousand dollars a year.

One skilled labourer, at a salary of one thousand two hundred dollars a year.

Eight attendants in the model-room, at a salary of one thousand dollars a year each.

Eight attendants in the model-room, at a salary of nine hundred dollars a year each.

One examiner of designs, two thousand four hundred dollars.

[Note.—The words in italics were added by the Act of June 15, 1880.]

Restrictions upon Officers and Employés.

Sec. 480. All officers and employés of the Patent Office shall be incapable, during the period for which they hold their appointments, to acquire or take, directly or indirectly, except by inheritance or bequest, any right or interest in any patent issued by the office.

Duties of Commissioner.

Sec. 481. The Commissioner of Patents, under the direction of the Secretary of the Interior, shall superintend or perform all duties respecting the granting and issuing of patents directed by law; and he shall have charge of all books, records, papers, models, machines, and other things belonging to the Patent Office.

Duties of Examiners-in-Chief.

Sec. 482. The examiners-in-chief shall be persons of competent legal knowledge and scientific ability, whose duty it shall be, on the written petition of the appellant, to revise and determine upon the validity of the adverse decisions of examiners upon applications for patents, and for reissues of patents, and in interference cases; and, when required by the Commissioner, they shall hear and report upon claims for extensions, and perform such other like duties as he may assign them.

Arrangement and Exhibition of Models, &c.

Sec. 484. The Commissioner of Patents shall cause to be classified and arranged in suitable cases, in the rooms and galleries provided for that purpose, models, specimens of composition, fabrics, manufactures, works of art, and designs, which have been or shall be deposited in the Patent Office; and the rooms and galleries shall be kept open during suitable hours for public inspection.

Disposals of Models on rejected Applications.

Sec. 485. The Commissioner of Patents may restore to the respective applicants such of the models belonging to rejected applications as he shall not think necessary to be preserved, or he may sell or otherwise dispose of them after the application has been finally rejected for one year, paying the proceeds into the Treasury, as other patent moneys are directed to be paid.

Printing Specifications and Drawings.

Sec. 490. The Commissioner of Patents is authorised to have printed, from time to time, for gratuitous distribution, not to exceed one hundred and fifty copies of the complete specifications and drawings of each patent hereafter issued, together with suitable indexes, one copy to be placed for free public inspection in each capital of every State and territory, one for the like purpose in the clerk's office of the district court of each judicial district of the United States, except when such offices are located in State or territorial capitals, and one in the Library of Congress, which copies shall be certified under the hand of the Commissioner and seal of the Patent Office, and shall not be taken from the depositories for any other purpose than to be used as evidence.

Contents and Duration.

Sec. 4884. Every patent shall contain a short title or description of the invention or discovery, correctly indicating its nature and design, and a grant to the patentee, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the invention or discovery throughout the United States and the territories thereof, referring to the specification for the particulars thereof. A copy of the specification and drawings shall be annexed to the patent and be a part thereof.

Drawings when requisite.

Sec. 4889. When the nature of the case admits of drawings, the applicant shall furnish one copy signed by the inventor or his attorney in fact, and attested by two witnesses, which shall be filed in the Patent Office; and a copy of the drawing, to be furnished by the Patent Office, shall be attached to the patent as a part of the specification.

Specimens of Ingredients, &c.

Sec. 4890. When the invention or discovery is of a composition of matter, the applicant, if required by the Commissioner, shall furnish specimens of ingredients and of the composition, sufficient in quantity for the purpose of experiment.

Examination and Issuing Patent.

Sec. 4893. On the filing of any such application and the payment of the fees required by law, the Commissioner of Patents shall cause an examination to be made of the alleged new invention or discovery; and if on such examination it shall appear that the claimant is justly entitled to a patent under the law, and that the same is sufficiently useful and important, the Commissioner shall issue a patent therefor.

Notice of Rejection of Claim for Patent to be given to Applicant.

Sec. 4903. Whenever, on examination, any claim for a patent is rejected, the Commissioner shall notify the applicant thereof, giving him briefly the reasons for such rejection, together with such information and references as may be useful in judging the propriety of renewing his application or of altering his specification; and if, after receiving such notice, the applicant persists in his claim for a patent, with or without altering his specifications, the Commissioner shall order a re-examination of the case.

Interferences.

Sec. 4904. Whenever an application is made for a patent which, in the opinion of the Commissioner, would interfere with any pending application, or with any unexpired patent, he shall give notice thereof to the applicants, or applicant and patentee, as the case may be, and shall direct the primary examiner to proceed to determine the question of priority of invention. And the Commissioner may issue a patent to the party who is adjudged the prior inventor, unless the adverse party appeals from the decision of the primary examiner, or of the board of examiners-in-chief, as the case may be, within such time, not less than twenty days, as the Commissioner shall prescribe.

Affidavits and Depositions.

Sec. 4905. The Commissioner of Patents may establish rules for taking affidavits and depositions required in cases pending in the Patent Office, and such affidavits and depositions may be taken before any officer authorised by law to take depositions to be used in the courts of the United States, or of the State where the officer resides.

Appeals from Primary Examiners to Examiners-in-Chief.

Sec. 4909. Every applicant for a patent, or for the reissue for a patent, any of the claims of which have been twice rejected, and every party to an interference, may appeal from the decision of the primary examiner, or of the examiner in charge of interferences in such case, or to the board of examiners-in-chief; having once paid the fee for such appeal.

From Examiners-in-Chief to Commissioner.

Sec. 4910. If such party is dissatisfied with the decision of the examiners-in-chief, he may, on payment of the fee prescribed, appeal to the Commissioner in person.

From the Commissioner to the Supreme Court, District of Columbia.

Sec. 4911. If such party, except a party to an interference, is dissatisfied with the decision of the Commissioner, he may appeal to the Supreme Court of the District of Columbia, sitting in banc.

Notice of such Appeal.

Sec. 4912. When an appeal is taken to the Supreme Court of the District of Columbia, the appellant shall give notice thereof to the Commissioner, and file in the Patent Office, within such time as the Commissioner shall appoint, his reasons of appeal, specifically set forth in writing.

Proceedings on Appeal to Supreme Court.

Sec. 4913. The court shall, before hearing such appeal, give notice to the Commissioner of the time and place of the hearing, and on receiving such notice the Commissioner shall give notice of such time and place, in such manner as the court may prescribe, to all parties who appear to be interested therein. The party appealing shall lay before the court certified copies of all the original papers and evidence in the case, and the Commissioner shall furnish the court with the grounds of his decision, fully set forth in writing, touching all the points involved by the reasons of appeal. And at the request of any party interested, or of the court, the Commissioner and the examiners may be examined under oath, in explanation of the principles of the thing for which a patent is demanded.

Determination of such Appeal and its Effect.

Sec. 4914. The court, on petition, shall hear and determine such appeal, and revise the decision appealed from in a summary way, on the evidence produced before the Commissioner, at such early and convenient time as the court may appoint; and the revision shall be confined to the points set forth in the reasons of appeal. After hearing the case the court shall return to the Commissioner a certificate of its proceedings and decisions, which shall be entered of record in the Patent Office, and shall govern the further proceedings in the case. But no opinion or decision of the court in any such case shall preclude any person interested from the right to contest the validity of such patent in any court wherein the same may be called in question.

Patents obtained by Bill in Equity.

Sec. 4915. Whenever a patent on application is refused, either by the Commissioner of Patents or by the Supreme Court of the District of Columbia upon appeal from the Commissioner, the applicant may have remedy by bill in equity; and the court having cognizance thereof, on notice to adverse parties and other due proceedings had, may adjudge that such applicant is entitled, according to law, to receive a patent for his invention, as specified in his claim, or for any part thereof, as the facts in the case may appear. And such adjudication, if it be in favour of the right of the applicant, shall authorise the Commissioner to issue such patent on the applicant filing in the Patent Office a copy of the adjudication, and otherwise complying with the requirements of law. In all cases, where there is no opposing party, a copy of the bill shall be served on the Commissioner; and all the expenses of the proceeding shall be paid by the applicant, whether the final decision is in his favour or not.—*Manchester Chamber of Commerce.*

BOARD OF TRADE RETURNS

SUMMARY OF IMPORTS.

—	Month ending 31st January	
	1892.	1893.
	£	£
Metals	1,822,503	1,550,125
Chemicals and dyestuffs	803,404	812,283
Oils	566,628	604,297
Raw materials for non-textile industries.	2,446,726	2,246,911
Total value of all imports	38,485,244	33,125,888

SUMMARY OF EXPORTS.

—	Month ending 31st January	
	1892.	1893.
	£	£
Metals (other than machinery)	2,551,466	2,632,783
Chemicals and medicines	707,184	728,274
Miscellaneous articles	2,321,560	2,162,905
Total value of all exports	19,146,704	18,026,019

IMPORTS OF OILS FOR MONTH ENDING 31ST JANUARY.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	.1893.
				£	£
Cocoa-nut	Cwt.	6,850	4,677	8,754	5,044
Olive	Tuns	1,510	1,344	57,427	48,245
Palm	Cwt.	87,773	98,777	101,730	120,219
Petroleum	Gall.	10,048,117	13.685,436	205,483	245,944
Seed	Tons	1,511	2,839	41,249	62,478
Train, &c.	Tuns	1,299	680	26,156	12,330
Turpentine	Cwt.	33,091	23,849	43,190	28,432
Other articles	Value £	..	..	82,639	81,605
Total value of oils		..	..	566,628	604,297

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST JANUARY.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Bark, Peruvian	Cwt.	6,897	5,237	18,292	11,999
Bristles	Lb.	170,486	189,964	20,350	23,689
Caoutchouc	Cwt.	32,556	23,170	398,788	267,518
Gum:—					
Arabic	„	5,305	5,969	15,374	17,829
Lac, &c.	„	10,824	6,998	47,985	27,602
Gutta-percha	„	2,284	2,546	30,924	21,802
Hides, raw:—					
Dry	„	28,761	24,276	73,056	61,650
Wet	„	41,622	32,814	86,803	72,631
Ivory	„	1,095	1,128	56,262	56,549
Manure:—					
Guano	Tons	1,456	7	10,685	40
Bones	„	7,056	4,279	36,266	17,662
Nitrate of soda.	„	2.631	1,787	23,682	16,025
Phosphate of lime	„	26,199	20,780	65,592	43,258
Paraffin	Cwt.	53,231	47,361	77,648	53,747
Linen rags	Tons	2,214	1,209	20,142	10,082
Esparto	„	19,170	23,362	91,857	107,535
Pulp of wood	„	13,475	9,781	66,686	60,590
Rosin	Cwt.	72,067	92,800	18,870	19,424
Tallow and stearin	„	85,118	139,925	106.980	186,330
Tar	Barrels	2,427	1,528	1,630	1,050
Wood:—					
Hewn	Loads	99,608	110,960	184,940	189,143
Sawn	„	95,491	60,498	205,135	129,629
Staves	„	3,672	4,734	26,110	35,833
Mahogany	Tons	3,164	5,191	30,715	47,260
Other articles	Value £	..	..	731,954	768,034
Total value		..	..	2,446,726	2,246,911

Besides the above, drugs to the value of 80,151*l*. were imported, as against 67,623*l*. in January 1892.

IMPORTS OF METALS FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Copper:—				
Ore............ Tons	6,200	5,389	38,821	36,093
Regulus .... „	9,189	10,404	228,572	289,176
Unwrought .... „	3,969	2,811	190,294	135,767
Iron:—				
Ore............ „	281,679	394,544	214,150	277,616
Bolt, bar, &c.... „	4,206	3,395	35,855	28,110
Steel, unwrought.. „	366	365	2,575	2,454
Lead, pig and sheet „	14,342	12,653	165,204	126,413
Pyrites .... „	56,028	59,708	98,758	109,026
Quicksilver .... Lb.	464,340	87,350	49,041	7,757
Silver ore......... „	..	..	322,365	192,966
Tin .... Cwt.	42,291	30,179	190,114	139,517
Zinc .... Tons	3,911	3,674	85,242	68,929
Other articles ...Value £	..	..	201,512	134,001
Total value of metals	..	..	1,822,503	1,550,125

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............. Cwt.	3,505	2,205	2,707	1,932
Bark (tanners, &c.) „	36,616	9,954	16,514	3,388
Brimstone .... „	60,563	30,204	18,783	7,067
Chemicals...... Value £	..	..	97,861	98,994
Cochineal .... Cwt.	580	577	3,420	3,416
Cutch and gambier Tons	1,346	1,479	31,057	32,211
Dyes:—				
Aniline .... Value £	..	..	13,959	12,166
Alizarine ..... „	..	..	18,694	13,736
Other .... „	..	..	1,187	741
Indigo .... Cwt.	21,596	21,945	443,224	481,267
Nitrate of potash . „	20,735	15,027	18,554	13,538
Valonia .... Tons	2,707	2,873	41,131	38,285
Other articles... Value £	..	..	91,313	105,542
Total value of chemicals	..	..	803,404	812,283

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	653,800	738,300	15,657	19,269
Military stores.. Value £	..	..	78,658	73,981
Candles.......... Lb.	1,379,900	1,459,600	26,793	26,196
Caoutchouc ..... Value £	..	..	111,459	92,333
Cement.......... Tons	25,626	22,974	46,507	41,269
Products of coal Value £	..	..	130,822	117,726
Earthenware ... „	..	..	121,760	142,298
Stoneware ...... „	..	..	11,239	11,414
Glass:—				
Plate........... Sq. Ft.	177,985	155,071	10,581	7,499
Flint........... Cwt.	6,914	6,235	17,242	15,499
Bottles......... „	59,941	57,245	28,347	26,554
Other kinds.... „	14,882	15,674	12,856	13,312
Leather:—				
Unwrought .... „	11,175	8,904	110,479	88,315
Wrought ..... Value £	..	..	25,053	20,132
Seed oil.......... Tons	5,461	5,795	111,943	114,890
Floorcloth ..... Sq. Yds.	1,975,400	1,462,400	85,997	60,775
Painters' materials Val. £	..	..	139,366	113,856
Paper .... Cwt.	74,866	69,340	132,235	116,029
Rags............. Tons	3,266	4,715	21,311	33,120
Soap............. Cwt.	47,946	45,189	46,695	46,192
Total value	..	..	2,321,560	2,162,905

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST JANUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	6,814	8,409	31,481	36,253
Copper:—				
Unwrought ..... „	43,895	50,606	107,239	128,761
Wrought........ „	27,237	21,344	84,036	64,368
Mixed metal .... „	22,841	24,130	59,506	58,424
Hardware ..... Value £	..	..	179,892	168,272
Implements....... „	..	..	99,565	94,140
Iron and steel..... Tons	196,678	197,616	1,736,404	1,632,738
Lead .... „	5,149	4,307	68,312	50,646
Plated wares... Value £	..	..	20,547	19,893
Telegraph wires, &c. „	..	..	46,246	271,502
Tin .... Cwt.	7,763	7,197	36,889	34,306
Zinc .... „	14,685	18,864	14,161	15,925
Other articles .. Value £	..	..	67,188	57,555
Total value	..	..	2,551,466	2,632,783

Exports of Drugs and Chemicals for Month ending 31st January.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	398,382	552,303	152,515	189,189
Bleaching materials „	85,320	106,848	33,066	44,439
Chemical manures. Tons	26,369	25,347	217,422	187,265
Medicines....... Value £	..	..	75,781	76,720
Other articles ... „	..	..	228,400	230,661
Total value	..	..	707,184	728,274

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

1297. C. Schmidt and E. Loh. Process and apparatus for purifying water. Complete Specification. January 20.

1467. E. Herz. Method of and apparatus for heating or evaporating liquids. Complete Specification. January 23.

1676. W. Webster. Improvements in apparatus for filtering and purifying water. January 25.

1708 E. B. Harlock. Improvements in apparatus or vessels for the continuous evaporation or concentration of liquids. January 25.

1780. H. J. E. Jensen. Improvements in and relating to filtering apparatus. January 26.

2340. E. G. Scott and F. W. Scott, jun. Improvements in apparatus for evaporating and cooling liquids. February 2.

2400. J. Parks. Improvements in or applicable to brine-evaporating pans. February 3.

2547. D. H. Lyon.—From D. Hanna, United States. An improved process of purifying water and apparatus therefor. Complete Specification. February 4.

2665. R. Dietrich. Improvements in regenerative furnaces. Complete Specification. February 7.

2985. D. Terrace. Improvements in retort-lid fastenings. Complete Specification. February 10.

3057. A. Shiels. Improvements in thermostats. February 11.

3129. A. C. Wells. An improved filter. February 11.

Complete Specifications Accepted.*

1892.

2895. F. M. Robertson, H. S. Fearon, and W. S. Miller. Improvements in the process of, and apparatus for, evaporating or drying. February 15.

4911. T. O. Easton, A. Watt, and J. Buchanan, jun. Apparatus for filtering saccharine or other liquids, and method of working the same. January 25.

5108. R. Fish and W. Smith. Apparatus for regulating liquid seals in gas-washers and the like. February 1.

5214. A. Desgoffe. Machinery for manufacturing fuel blocks and other articles from plastic material. February 1.

5239. J. A. Yeadon and W. Adgie. Apparatus for revivifying gas lime (sulphide of calcium) and other analogous materials. February 8.

5538. O. W. Ketchum. Improvements in gas-generating furnaces or gas producers. January 25.

6354. T. Thornley. Improvements in kilns or furnaces applicable for the drying and incineration of spent soda solutions. February 1.

6478. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Evaporating apparatus. February 8.

6700. C. D. Abel.—From E. Theisen, Germany. Improvements in surface-condensing and refrigerating apparatus. February 15.

19,149. H. W. Rappleye. Drying apparatus for brewers' grains and the like. February 1.

1893.

513. H. D. Fitzpatrick. — From F. A. Kleemann. Apparatus for heating and cooling fluids. February 15.

II.—FUEL, GAS, AND LIGHT.

Applications.

906. F. S. Cripps. A complete hydraulic main valve for gas, tar, and ammoniacal or other liquors. January 16.

919. L. Girerd. An artificial way of chemically producing the ozone. January 16.

1017. W. Young and R. Young. Improvements in the manufacture of and apparatus for producing water-gas and hydrogen. January 17.

1175. H. R. Stockman. Improvements in fuel. January 19.

1269. W. P. Gibbons and R. Masters. Certain improvements in the setting of gas retorts. Complete Specification. January 20.

1417. H. Coulthurst, J. Coulthurst, and A. Coulthurst. Improvements in apparatus to be used in the manufacture of gas retorts. January 23.

1432. A. R. Sennett. Improvements in apparatus for aspirating and propelling, humidifying or mixing air or other gases. January 23.

1433. A. R Sennett. Improvements in the combustion of fuel, and in the prevention of smoke, and in the apparatus therefor. January 23.

2155. C. A. Sahlström and E. Parr. A new and improved method for saponifying or mixing tars, oils, hydrocarbons, and similar materials, and for using the same for heating, lighting, and other purposes. January 31.

2161. L. B. Miller and M. W. Woods. Heating liquids by electricity. January 31.

2247. J. C. W. Stanley. Improvements in or relating to the manufacture or production of block fuel, gas, and other useful products from refuse materials. February 1.

2524. M. Cameron. An improved fuel. February 4.

2590. T. S. K. Hawxhurst. Solid illuminant. Complete Specification. February 6.

2685. A. L. Elfen. Improvements in or connected with the refining of petroleum and the like. February 7.

2716. J. Askins. Improvements relating to the manufacture of gas and to apparatus therefor. Complete Specification. February 7.

2791. F. Fanta. A new or improved process for the continuous production of water-gas. February 8.

2840. J. Turner. *See* Class XVIII. B.

Complete Specifications Accepted.

1892.

1958. W. Coultas, T. Siddell, and J. L. Smith. A novel or improved apparatus constituting a combined boiler and gas producer for the generation of steam and the production of gas, whether used in combination or for separate purposes. February 1.

4728. J. Moeller. Apparatus for making gas from oils, fatty substances, and other material. January 25.

4982. G. Angel. Manufacture of peat fuel. February 8.

6000. C. Hunt. Gas-washing apparatus. January 25.

6819. W. D. Scott-Moncrieff. Improvements in or relating to the treatment of fuel. February 15.

15,777. W. H. Laird. Hot-water or steam apparatus for heating purposes. February 15.

17,419. F. J, Collin. Coke furnaces. January 25.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Complete Specification Accepted.

1892.

5539. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Purifying anthracene and anthraquinone. February 8.

IV.—COLOURING MATTERS and DYES.

Applications.

957. O. Imray. — From the Society of Chemical Industry, Switzerland. Manufacture of blue colouring matters. January 16.

1280. J. Imray. — From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis and Dr. Chapius, France. Manufacture of mono-sulphonated anthracene acid by the direct sulphonation of anthracene. January 20.

1320. E. R. Wilson, E. Stewart, and R. Hunt. Improvements in the separation and purification of colouring matter from crude cotton-seed oil. January 21.

1851. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of azo colouring matters. January 27.

2316. A. E. Alexander.—From H. P. Wells, United States. Extracting dye matter from logwood. Complete Specification. February 2.

2370. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new sulpho acids of certain naphthalene derivatives, and of new colouring matters obtainable therefrom. February 2.

2614. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new azo dyes, and of a component for use in their manufacture. February 6.

2695. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of derivatives of hydroxyanthraquinones. February 7.

2984. C. D. Abel.—From The Actiengesellschaft für Anilin Fabrikation, Germany. Manufacture of a new amidonaphtholdisulpho acid. February 10.

Complete Specifications Accepted.

1892.

5112. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of new colouring matters. February 1.

5811. C. D. Abel.—From C. F. Boehringer, Sohne and Co. Manufacture of derivatives of amido-crotonic acid. February 15.

6252. Read, Holliday, and Sons, Lim., and L. G. Paul. Improvements in treating nitroso compounds for use in dyeing animal fibres. February 15.

6630. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of colouring matters. February 15.

24,081. J. Rohner. Production of new colouring matters, dyeing cotton without mordant. February 8.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

1380. H. C. Fellowes, W. R. Crozier, and H. Ferguson. Improvements in the preparation of the fibre of rhea and other grasses and fibrous vegetables. January 21.

2983. T. Mitchell. Improvements in or applicable to the manufacture of linoleum and like floorcloths. February 10.

2989. A. Törngren. Improvements in treating bast and wood for obtaining therefrom fibre suitable for being spun or woven. Complete Specification. February 10.

Complete Specifications Accepted.

1892.

1728. C. F. Dietrich and T. J. Palmer. Manufacture or production of floor coverings or like materials with coloured designs or patterns, and apparatus to be employed in the said manufacture. January 25.

1729. C. F. Dietrich and T. J. Palmer. Manufacture and production of materials suitable for use as floor coverings, or for other analogous purposes. January 25.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

955. J. A. J. F. Leclercq. An improved machine for dyeing ribbons direct from the combs. January 16.

977. J. M. Collins. Improvements in machines for dyeing and scouring yarn. January 17.

1172. J. D. Asquith. Improvements in washing and scouring machines for washing and scouring textile fabrics. January 19.

1220. E. Edwards. — From P. Jaeger, Germany. An improved process for dyeing wood. January 19.

1342. A. Schloesser and H. A. Mavor. Improvements in or relating to indigo-dyeing. January 21.

1623. J. Clapham, J. Picard, C. Villedieu, and W. W. L. Lishman. Improvements in bleaching and discolouration. January 25.

2009. L. Lang. Improvements in or relating to calico-printing. January 30.

2153. O. Ostersetzer. Improvements in printing and dyeing on fabrics. January 31.

2550. F. G. Stiel. Improvements relating to the dyeing of textile fabrics and other materials, and to apparatus therefor. February 4.

2555. F. W. Hayward. Improvements in colouring or staining and bronzing paper or other material, and apparatus therefor. February 6.

3066. S. Skuček and F. Jelen. Improvements in or relating to dyeing, and apparatus therefor. February 11.

Complete Specifications Accepted.

1892.

5197. R. H. Pickles. Improvements in aluminium, iron and chromium mordants. February 8.

6162. E. Hermite, E. J. Paterson, and C. F. Cooper. An improvement in the bleaching of textile and pulping materials in vacuo. February 8.

6304. T. Hoyle and Sons, Lim., and W. N. Neild. Improvements in dyeing cotton and other textile fabrics. January 25.

15,933. C. I. Edmondson. Printing designs or patterns in two or more colours upon textile fabrics. February 8.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

1099. J. Thornber and G. Rogerson. An improved system in the moulding and preparing white lump salt for domestic and other purposes. January 18.

1138. L. Tralls and E. Burmeister. A process for the utilisation of liquors containing sulphate of alumina or ferric sulphate. January 18.

1168. J. B. Petrie. Improvements in the production of sodium carbonate and sodium bicarbonate from metallic sodium or metallic sodium vapour, the said sodium or sodium vapour being obtained electrolitically or by other methods. January 19.

1214. E. K. Muspratt, A. Carey, and V. C. Driffield. Improvements in and apparatus for the manufacture of bleaching-powder. January 19.

1298. P. Buisine. Improvements in the manufacture of ferric chloride. Complete Specification. Filed January 20. Date applied for July 5, 1892, being date of application in France.

1396. E. Dyson. Improvements in retorts or apparatus for concentrating sulphuric acid. January 23.

1982. C. Dreyfus and H. Grimshaw. A new and improved method for the manufacture of basic per-salts of iron. January 30.

2148. J. Heibling. Improvements in the manufacture of potash, alum, and alumina. Complete Specification. January 31.

2274. Adrain van Berkel. Improvements in the extraction of carbonic acid from mineral carbonates, and in apparatus therefor. February 1.

2463. J. Marx. Improvements in and apparatus for the electrolysis of solutions of salts or compounds of the alkalis, more especially intended for the manufacture or production of alkalis and chlorine, and for bleaching. February 3.

2476. I. Levinstein. Improvements in apparatus used in the concentration of sulphuric acid. February 4.

2710. J. L. Kessler. Improvements in the manufacture and production of salts or compounds of alumine or aluminium, and in the apparatus employed therein. February 7.

2835. I. Levinstein. Improvements in the method of and in apparatus for recovering and concentrating waste and diluted sulphuric acid, and for separating and recovering other acids in mixture therewith. February 9.

Complete Specifications Accepted.

1892.

5225. A. Allhusen, G. E. Edgell, and W. Russell. Recovery of sulphur from the waste gases from Claus kilns or similar gases, and apparatus therefor. January 25.

5296. C. J. Bayer. Treatment of bauxite or similar minerals for the purpose of obtaining alkali-aluminates or alumina hydrate. January 25.

6931. H. H. Lake.—From J. H. C. Behnke and the Chemische Fabrik in Billwarder vorm. Hell and Staamer, Germany. Production of pure carbonic acid from the products of combustion of furnaces, kilns, and the like, and apparatus therefor. February 15.

22,817. E. Rotondi and C. M. Michela. A process for the manufacture of acetic acid. February 8.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

1289. P. Sievert. Improvements in the method of manufacturing glass bars, rods, or sticks. Complete Specification. January 20.

1774. C. D. Abel.—From Hector de Grousilliers, Germany. Improvements in transferring designs on to ceramic and other objects, and in the materials employed for that purpose. Complete Specification. January 26.

2033. F. Welz. Process or mode of making glass, having an orange-yellow colour when the light passes through it, and a greenish colour when the light falls upon it. Complete Specification. January 30.

2252. H. L. Doulton and W. P. Rix. Improved means for ornamenting pottery ware. February 1.

Complete Specifications Accepted.

1892.

5527. O. Imray. — From The Actiengesellschaft für Glasindustrie vormals F. Siemens. Manufacture of blown hollow glass with metal insertions. January 25.

18,178. J. Wade, W. Wade, and H. Wallace. Process of decorating tiles and other earthenware articles.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

1582. F. G. Montagne. Manufacture of artificial marbles. January 24.

1677. W. Webster. Improved manufacture of cement, and apparatus therefor. January 25.

2069. J. J. Green. An improved manufacture of sink stones and gullies from clay or other plastic material. January 31.

2335. J. F. Kleine. Improved construction of floors and ceilings. Complete Specification. February 2.

2374. F. W. S. Stokes. Improvements in apparatus connected with the continuous treatment of cement, lime, and the like materials, and in the lining of furnaces and kilns for burning such substances. February 3.

3106. W. Webster. Improvements in the manufacture of cement. Complete Specification. February 11.

Complete Specifications Accepted.

1892.

3079. C. R. Cowens. Calcination of limestone, ironstone, and the like substances. February 15.

11,226. G. C. Taylor. A fireproof composition or cement for boilers, flues, and furnaces. January 18.

21,105. P. J. Jackson. An improved system of street and floor paving. January 25.

X.—METALLURGY, MINING, Etc.

Applications.

1116. C. M. Pielsticker. Improvements in the extraction of gold and silver from ores. January 18.

1385. A. E. Haswell and A. G. Haswell. Improvements in and relating to the coating of metals. January 21.

1407. C. Allen, J. Clark, and G. W. Clark. Improvements in or relating to the production of aluminium. January 23.

1437. H. J. Phillips. A process for the elimination of sulphur from iron or steel. January 23.

1470. T. J. Tressider. Improvements in the manufacture of armour plates. January 23.

1795. S. Chatwood and S. R. Chatwood. Improvements in the manufacture of compound steel ingots and other articles. January 26.

1906. A. V. C. Fenby, J. B. Fenby, and G. Moore. Coating iron and steel with brass and other metallic alloys. January 28.

1959. C. Raleigh. Improved means applicable for use in extracting gold and silver from auriferous and argentiferous solutions. January 28.

2031. E. Jokl and E. Roudnitz. Improvements in and relating to the treatment of iron and steel to protect the same against rust. January 30.

2066. W. H. Greene and W. H. Wahl. Improved process of producing metallic alloys. Complete Specification. January 31.

2081. J. R. Wylde, N. Glendinning, and D. Watson. Improvements in obtaining silver and gold from their solutions. January 31.

2119. A. J. Boult.—From C. G. Richardson and A. B. English, Canada. Improvements in or relating to the treatment of metallic ores. Complete Specification. January 31.

2377. A. Allen, A. Bashforth, and H. Allen. A reheating furnace for steel and iron puddling and other purposes. February 3.

2433. H. C. Bull. Improvements in or connected with the smelting of iron ore in the production of pig iron. February 3.

2449. P. Willis.—From L. A. Allard, United States. A combined furnace for treating and reducing ores, and for refining the resulting metals. February 3.

2616. T. J. Tresidder. Improvements in apparatus for use in chilling armour plates. February 6.

2639. J. A. Mays. Process of and apparatus for separating metals and similar substances. February 7.

2724. C. Endruweit. Improvements in the method of producing thin films of metal and manufacturing metal-surfaced paper therewith. Complete Specification. February 7.

3096. A. Gilbertson. Improvements in machinery or apparatus for coating plates with tin, terne, or other metal. February 11.

3107. C. Vattier. Improved construction of converters for smelting copper ores. Complete Specification. February 11.

3111. C. Vattier. Process for roasting dust of copper and other ores. Complete Specification. February 11.

Complete Specifications Accepted.

1892.

2590. W. K. Greenway. Galvanising iron and steel. February 15.

4997. J. de Coppet. Treatment of minerals, mattes, speiss, and other substances containing nickel for the separation of copper, nickel, and cobalt. January 25.

5255. J. G. H. Batchelor and C. T. Batchelor. Improved means for the recovery of tin and iron from tin-plate scrap or other waste material from tinned goods. February 8.

5560. R. Heaton. A solder for aluminium. January 25.

6454. F. Ryland. An improvement or improvements in tinning cast-iron hollow-ware. January 25.

13,194. E. G. Brewer.—From A. A. Cowles, United States. Annealing furnaces. February 15.

20,151. H. H. Lake.—From R. W. F. Abbé. Process for treating oxidised or corroded lead, and apparatus therefor. January 25.

23,228. A. Longsdon.—From F. A. Krupp. A new or improved process and apparatus for or relating to the manufacture of armour plates. January 25.

23,476. R. Haddan. — From L. Oliven. Process or method of plating or coating aluminium with tin, zinc, or lead, or alloys thereof. February 1.

23,477. R. Haddan.—From L. Oliven. An improved process of soldering, applicable to the soldering of aluminium to aluminium or to other metals. January 25.

23,896. R. Pearce. Improvements in and relating to ore-roasting furnaces. February 1.

24,144. J. W. Sutton. Separation of gold from its chloride solution. February 8.

1893.

82. W. H. Greene and W. H. Wahl. Manufacture of manganese and manganese alloys free from carbon. February 15.

130. W. E. Koch. Furnaces for heating steel ingots. February 8.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

1168. J. B. Petrie. *See* Class VII.

1229. H. H. Lloyd. Improvements in secondary or storage batteries. Complete Specification. January 19.

1368. H. C. Gover. An appliance for escape of gas from battery cells. January 21.

1502. W. P. Thompson.—From E. Correns, Germany. Improved process and apparatus for the electrolytic production of porous finely-subdivided lead for use in secondary batteries. Complete Specification. January 24.

1615. N. S. Hill.—From I. Nicolariff, Russia. Improvements in electrical accumulators. January 25.

1661. E. Andreoli. Improvements in electrolytic apparatus. Complete Specification. January 25.

1778. The London Metallurgical Company, Lim., and S. O. Cowper-Coles. Improvements relating to the coating of articles with alloys by electro-deposition. January 26.

1948. H. Imray.—From La Société Anonyme pour le Travail Electrique des Metaux, France. An improvement in secondary voltaic batteries. January 28.

2134. G. Lentz. Improvements in porous vessels or pots and diaphragms for secondary and primary batteries. January 31.

2241. C. A. J. H. Schroeder and H. E. R. Schroeder. High-tension battery. February 1.

2267. C. T. J. Vautin. Improvements in the method of and apparatus for the electrolytical separation of the bases of salts, and of compounds of the same, from saline solutions. February 1.

2311. J. B. Hannay. A new or improved apparatus for the electrolysis of saline solutions. Complete Specification. February 2.

2320. R. Conedera. Electro-chemical cementation for separating copper from solutions by means of iron. February 2.

2329. J. C. Richardson. Improvements in the manufacture of white lead electrolytically. February 2.

2331. N. H. Edgerton. Improvements in secondary electric storage batteries or accumulators. February 2.

2361. F. Szymanski. An improved depolarising material for galvanic elements. Complete Specification. February 2.

2598. C. D. Abel.—From G. Lehnert, Germany. Processes for effecting the electro-deposition of metals upon aluminium. February 6.

2940. J. E. Richardson. Improvements in the electric dissociation or modification of gases, gaseous compounds, and products. February 10.

2946. R. J. Crowley and J. R. Grant. Improvements in or relating to galvanic batteries. February 10.

Complete Specifications Accepted.

1892.

6405. D. Urquhart and J. M. Small. Secondary voltaic batteries. February 8.

6467. E. Hermite and A. Dubosc. Manufacture of the alkaline carbonates or bicarbonates by the electrolytic decomposition of alkaline chlorides in the presence of gelatinous alumina or chloride or other salt of aluminium. February 15.

18,807. E. Andreoli. Electrodes for secondary batteries. February 8.

22,375. W. P. Thompson.—From C. L. Coffin. Improvements in the method of welding or working metals electrically. January 25.

22,987. P. M. Justice.—From W. W. Griscom. Secondary battery plates or elements and process of preparing same. January 25.

23,232. J. Y. Johnson.—From A. A. Michel. Secondary or storage batteries. February 1.

23,409. G. A. Washburn. Storage batteries. February 8.

23,919. T. Craney. Electrolytic apparatus. February 8.

1893.

140. G. W. Harris. Storage batteries, and electrodes therefor. February 15.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

1349. F. N. Turney. An improved process for treating and purifying sod and other oils, and apparatus therefor. January 21.

1612. H. C. H. Picard, C. Villedien, and W. W. L. Lishman. Improvements in bleaching and discolouring oils, fats, and greases. January 25.

1773. F. Walton. Improved process and apparatus for oxidising drying oils. January 26.

1845. A. F. St. George. Refining cocoa nut butter and other fats and oils, so as render them tasteless and odourless. January 27.

2896. N. Iseli. Improvements in or relating to the manufacture of alcohols, oils, greases, and other matter. February 9.

Complete Specifications Accepted.

1892.

3239. C. H. Ridsdale. Improvements in or appertaining to solid lubricants and bearings therefor. January 25.

18,086. E. Hill, F. W. J. Webb, A. W. Machonachie, and S. Roper. Improvements in cleaning and renovating compositions. January 25.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

978. E. H. Braidwood. An improved anti-fouling and anti-friction composition for ships' bottoms. January 17.

1113. S. J. Simpkin. Improvement in the manufacture of refined indigo. January 18.

2169. W. B. Abert and W. Scherer. Improvements in paints. Complete Specification. February 1.

2246. A. J. Boult. — From F. J. Honnay, Belgium. Improvements in or relating to the recovery of resinous or gummy substances. February 1.

2329. J. C. Richardson. *See* Class XI.

2626. M. Becker. Process for producing a fundamental mass from which varnish and similar coatings may be made. Complete Specification. February 6.

2705. H. C. Higginson. Improvements in and relating to the manufacture of whiting. Complete Specification. February 7.

2823. J. McDougall Smith. Improvement in the manufacture of varnishes, varnish paints, and the mixing of volatile spirits with other bodies. February 8.

2883. A. Macdonald. Improvements in the treatment of galena for the production of lead, lead sulphate, and lead oxide. February 9.

3034. A. M. Dumoulin. Improvements in varnishes. February 11.

3116. J. V. Walton. Improvements in apparatus employed in the manufacture of white lead. February 11.

Complete Specifications Accepted.

1892.

4169. E. C. Williams, P. E. Williams, and C. May. Improvements relating to bronze or other metallic paints. January 25.

6009. S. Z. de Ferranti and J. H. Noad. Production of white lead and chrome pigments. February 1.

12,728. P. Lehmann. Compounds suitable as protective coatings or paints for iron and steel. January 25.

19,539. J. F. Thompson and C. F. Baker. An improved colouring and burnishing composition for boots and shoes. February 8.

21,932. J. S. P. Stutley. An improved composition paint. January 25.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

1660. A. Sale and R. Hulett. A new process for removing grease or fat from all kinds of leather. January 25.

2172. E. Drew. An improved substitute for leather. Complete Specification. February 1.

2545. H. H. Lake.—From A. J. Strauss, France. Improvements relating to the treatment of hides and skins. February 4.

2837. A. W. Titford. Improvements in the manufacture or production of imitation vellum and leather. February 9.

Complete Specifications Accepted.

1892.

3105.. C. Cosinerie. Manufacture of a light-coloured albumen from blood. February 8.

4783. J. Pullman, W. R. Pullman, and A. Pullman. An improved process for treating skins and hides. February 1.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

1461. B. Dukes.—From W. A. G. Seyberlich, Germany. Improvements in the manufacture of grape sugar. January 23.

2597. Siemens Brothers and Co., Lim.—From Siemens and Halske, Germany. Process for bleaching raw starch, starch gum, and solutions thereof, by treatment with chlorine and ozone combined. February 6.

Complete Specifications Accepted.

1892.

5719. T. Drost. Manufacture of refined sugar from raw sugar. February 8.

21,217. W. P. Thompson.—From F. Soxhlet. Improvements in or relating to refining sugar. January 25.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

1235. F. W. Golby.—From J. B. Thierry, France. A process for disinfecting the waters of distillation, and for separating the empyreumatic products of spirits of wine before rectification. January 20.

1591. A. Werner. Improvements in the treatment of beer and other liquids, and in apparatus for the same. Complete Specification. January 24.

1887. F. M. Polsky. Improvements in the manufacture of yeast. January 27.

2201. W. S. Squire. Improvements in the treatment of distillers' spent wash. February 1.

2484. J. Gregor. Improvements in and relating to malt kilns. Complete Specification. February 4.

2579. J. T. Gough. Improvements in the apparatus fer the making and drying of malt. February 6.

3077. J. Heron. *See* Class XVIII.—A.

Complete Specification Accepted.

1892.

3798. W. L. Wise.—From A. Antheaume. Manufacture of beer. February 1.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

1954. C. A. Sahlström. Improvements in the preservation of alimentary and other substances, and apparatus therefor. January 28.

2152. A. Bay. Process and apparatus for oxidising or seasoning newly-ground flour and the like. Complete Specification. January 31.

2675. The Nutriment Company and C. P. Eyre. Milk coagulating ferment. Complete Specification. February 7.

2683. W. P. Thompson.—From B. G. Hudnut, United States. New or improved corn product, and process of manufacturing the same. February 7.

3077. J. Heron. Improvements in preserving yeast for transport. February 11.

B.—Sanitary Chemistry.

1675. W. Webster. Process for treating the effluent from electrolytically or chemically purified sewage for neutralising its alkalinity, and for the production of bye-products therefrom. January 25.

2840. J. Turner. Improvements in the purification and utilisation of sewage, and in gas-producers. February 9.

C.—Disinfectants.

1213. W. J. Menzies. Improvements in the treatment of manganates for the production of permanganates suitable for use for disinfecting or other purposes, and in apparatus therefor. Jannary 19.

1313. A. Blackie and E. J. Mills. Improvements in compounds applicable for dipping animals, preserving skins, and for destroying germs, parasites, and weeds. January 21.

1738. M. Rees. An improved disinfecting fluid. January 26.

1742. E. O. Storr. "Storr's fluid." A medical compound for disinfecting purposes. January 26.

2564. A. Blackie. Improvements in compounds applicable for dipping animals, preserving skins, and for destroying germs, parasites, and weeds. February 6.

2694. J. Vigerie. A method of and apparatus for preserving meat, cereals, and other animal or organic substances, destroying parasites and vermin, extinguishing fires, and disinfecting leather, fabrics, and the like. February 7.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

2421. J. F. Boesen. Manufacture of meat extract. February 8.

4948. H. J. Allison.—From J. Miner. Process of making food compounds. February 15.

21,488. W. Paterson. Process for manufacture of bread and the like with extract of malt. January 25.

B.—Sanitary Chemistry.

1892.

2560. H. Lockwood. Method of purifying sewage by means of lime in conjunction with a salt of iron. February 8.

6731. H. Grimshaw. A new and improved method for the purification of sewage and waste water from manufacturing processes. February 1.

C.—Disinfectants.

1892.

20,785. S. Pitt.—From Schloesing Bros. An improved insectiside and anticryptogamic composition. January 25.

XIX.—PAPER, PASTEBOARD, Etc.

Application.

2724. C. Endruweit. Improvements in the method of producing thin films of metal and manufacturing metal-surfaced paper therewith. Complete Specification. February 7.

Complete Specification Accepted.

1892.

21,795. E. N. Cummings. Toilet and wrapping paper. January 25.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

Applications.

1626. A. E. Broome and J. Walsh. Improvements in the manufacture of Epsom salts. January 25.

1678. O. Imray.—From A. Vozarik, Germany. Manufacture of guanidine nitrate. January 25.

2884. W. Webster and T. Moore. A manufacture of pharmaceutic preparations for use more particularly in case of anæmia and for weak throats. February 9.

2951. J. Morris. Means for using certain chemicals, drugs, and perfumes for therapeutic, disinfecting, antiseptic, and perfuming purposes. February 10.

Complete Specifications Accepted.

1892.

19,878. H. Thoms. Process for obtaining *p*-phenetolcarbamide. February 8.

21,938. F. Krafft and A. Roos. A new process of preparing methyl-ether, ethyl-ether, and their homologues by the action of alcohols on benzenesulphonic acid and other sulphonic acids or their esters. February 15.

XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

Applications.

963. E. Hooker. Improved means for colouring and tinting photographic prints. January 16.

2202. J. E. A. Gwynne. Improvements in photographic printing by electric light, and in apparatus therefor. February 1.

Complete Specification Accepted.

1892.

6543. J. S. Fairfax.—From F. Crane. Manufacture of pyroxyline solutions and compounds for photographic or other films or coatings, and for solid or massive articles. February 15.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

1893.

1868. W. Hartig, jun. Improvements in the manufacture of Ligrin gunpowder. January 27.

2704. C. M. Bowman. Improvements in and relating to matches and the manufacture thereof. Complete Specification. February 7.

Complete Specifications Accepted.

1892.

6448. C. O. Loundholm and J. Sayers. Manufacture of explosives. February 1.

23,377. O. Imray.—From J. Storer. Manufacture of explosives. February 1.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

2542. A. N. Nahm. Improvements in and apparatus for ascertaining the percentage of fat in milk and other like liquids. February 4.

Complete Specification Accepted.

1892.

23,398. C. Weitenkampf. A new or improved process for separating solid or fluid substances dissolved in alcohol, ether, or chloroform, without evaporation of the solvent. February 8.

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Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL
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The Annual General Meeting will be held in Liverpool on the 12th, 13th, and 14th July next. Full particulars will appear in a subsequent issue.

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Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer *5s.* apiece for copies of the Society's Journal for January 1883 in saleable condition.

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Mensching, Dr. Chas., 43, George Street, Cheetham Hill, Manchester, chemist.

Shallcross, T. H., Delamere Street, Fairfield, near Manchester, manufacturing chemist.

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Campbell, And., Journals to 14, Thirlestane Road, Edinburgh (until August 15th).

Clark, Durand G., Journals to 44, St. John's Wood Park, N.W.

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CHANGES OF ADDRESS REQUIRED.

Brown, Jas. T., l/o 27, Petworth Street, Albert Road, S.W.

Deaths.

Anderson, John, of the Alkaline Reduction Syndicate, Hebburn-on-Tyne; at Gourock, N.B. March 9th.

Foster, F., of Niagara Works, Eagle Wharf Road, London, N. March 4th.

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SESSION 1892-93.

Monday, April 10th:—
- Mr. E. A. Cowper. "The Application of Hot Blast Stoves to Chemical Industries."
- Mr. R. Bowman. "The Manufacture of Alkali and other Products as carried on in Russia."
- Mr. Ernest A. Smith. "The Presence and Estimation of Gold and Silver in Antimony and Bismuth."
- Election of Officers and Five Members of Local Committee.

Monday, May 1st.—Dr. P. Dvorkovitch. "The Gasification of Coal and Liquid Hydrocarbons."

Monday, June 5th:—
- Mr. H. G. Watel. "The Movement of Air as Applied to Chemical Industries."
- Messrs. Cross and Bevan.

Meeting held Monday, February 6th, 1893.

MR. WM. THORP IN THE CHAIR.

THE MANUFACTURE OF NITRIC ACID.

BY OSCAR GUTTMANN, ASSOC. M. INST. C.E.

In order to avoid misunderstanding it may be stated at once, that the manufacture of nitric acid, as it is practised on a large scale, alone will be dealt with and all reference to the various other processes, by which nitric acid results either directly or indirectly will be omitted in this paper.

The usual way of manufacturing is by distilling a mixture of nitrate of soda and sulphuric acid., At ordinary temperature the reaction takes place according to the following equation:—

$$\underset{85}{NaNO_3} + \underset{98}{H_2SO_4} = \underset{63}{HNO_3} + \underset{120,}{NaHSO_4},$$

or 1 part of pure nitrate of soda and 1·153 parts of sulphuric monohydrate yield 0·741 part of nitric acid monohydrate. There is not sufficient heat produced to enable this reaction to go on by itself, and therefore artificial heat has to be applied. Should the mixture get locally overheated, as it is likely to occur on the walls of the still, then a different reaction takes place:—

$$\underset{170}{2\ NaNO_3} + \underset{98}{H_2SO_4} = \underset{126}{2\ HNO_3} + \underset{142.}{Na_2SO_4}$$

It appears from this, as if the most advantageous proportions would be 0·576 parts of sulphuric acid to 1 part of sodium nitrate. But if such proportions were used, the temperature would remain nearly constant, at about 125° C., until about half the nitric acid had distilled off. The acid sulphate thereby formed would have to act on the nitrate, which remained undecomposed, and this would have to take place at such a high temperature, that a great part of the nitric acid would be decomposed into hyponitric acid. At the same time neutral sulphate of soda would remain in the still as a hard cake, and the iron would be attacked excessively.

In practice, as a rule, about equal weights of nitrate and sulphuric acid monohydrate are taken, and in the case where the bisulphate is run off automatically, even an excess of about 8 per cent. of sulphuric acid monohydrate is employed. This means, that for each cwt. of nitrate of soda either 1·083 parts of sulphuric acid of 1·840 sp. gr., or 1·327 parts of 1·710 sp. gr., or 1·656 parts of 1·530 sp. gr. should be used. Frequently these proportions are changed for reasons, which will be considered further on. Sometimes only 1·333 of acid of 1·563 sp. gr. are used, instead of the 1·575 parts corresponding to the above proportions. With these proportions sufficiently pure acid for most purposes can be obtained, although it will always contain some hyponitric acid. It will be readily seen that the acid will contain much more hyponitric acid, when a high concentration is required, or when the charge is worked off quickly, because in both cases stronger heating is necessary.

The time required for the distillation varies a good deal both on account of the quantity of nitrate treated in the still and the sulphuric acid employed. In many cases as much as 36 hours are required, the general average being about 24 hours. With my own special system the time required is reduced to about 10 or 12 hours, by far the shortest of any system with which I am acquainted.

The yield of nitric acid is good in almost all factories. It depends in the first place of the complete decomposition of the charge, which may be readily checked by examining the bisulphate, and from the more or less complete condensation of the nitric acid gases. As a rule about 95 per cent. of the theoretical yield is obtained, but with very good means of condensation 99 per cent. and over can be reached.

The consumption of coal cannot be easily compared, as in the first instance so much depends upon its quality. It is usually about $\frac{1}{2}$ lb. of best coal for 1 lb. of nitrate, or $1\frac{1}{2}$ lb. for every lb. of nitric acid monohydrate produced, but with good systems it has been reduced to 0·2 lb. and 0·3 lb. respectively. An American chemist, Mr. Hart, affirms that he has reduced it to about 0·15 lb. for each lb. of monohydrate, but I am at a loss to understand it, as it would mean, that with 1 cwt. of coal he could during 13 hours maintain sufficient fire to distil a charge of 10 cwt. of nitrate.

The degree of purity is a very important consideration with nitric acid. The most common impurities are hyponitric acid, chlorine and sulphates. The hyponitric acid as just mentioned is chiefly due to overheating and consequent decomposition, but there is also another source. It is well known, that even the best nitrate of soda contains some sodium chloride, and an average good sample will have between 0·3 and 0·7 per cent. of it. This with the sulphuric acid will cause the formation of hydrochloric acid, and this in turn will decompose the nitric acid formed into nitrous acid and chlorine

$$HNO_3 + HCl = NO_2 + Cl + H_2O.$$

Therefore every 1 per cent. of sodium chloride causes a loss of 1·453 per cent. of pure nitrate of soda, and forms 1·573 per cent. of hyponitric acid, and 0·607 per cent. of chlorine. In the usual condensing apparatus the nitric vapours come into continual contact with the condensed acid, and therefore the chlorine is to a large extent absorbed. Sulphates will only be contained in the acid when, from improper construction, the contents of the still boil over and reach the condensers, or when at the end of the distillation such a high temperature is allowed to occur, that the free sulphuric acid in the bisulphate distils over. As the nitre cake at the end of the operation is a thick mass, which strongly retains the nitric fumes, the danger of distilling over some sulphuric acid is larger, the more complete the yields aimed at.

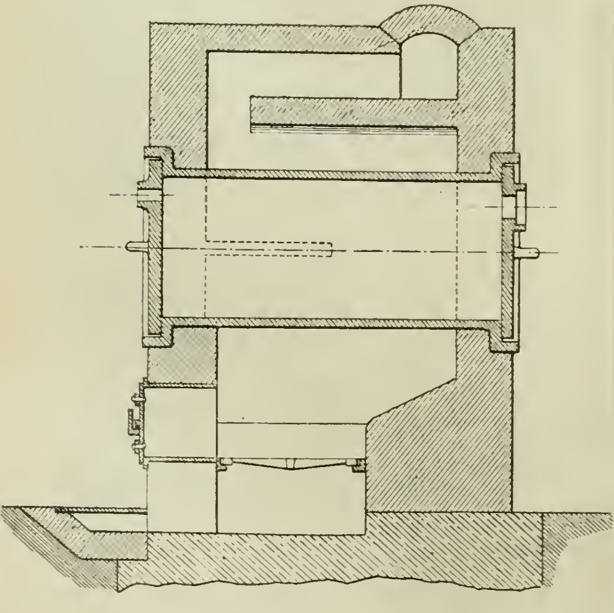
It is very easy to get any required strength of acid. If only the strongest acid, of 95 and more per cent. monohydrate, is required, then the nitrate must be as dry as possible, and the sulphuric acid of the maximum obtainable strength, 96 to 97 per cent. monohydrate. In America they even go so far as to fuse the nitrate, in order to get it quite free from moisture, but as a rule it is sufficient to dry it by the waste gases passing to the flue and to reduce thereby the moisture to about ½ per cent. For ordinary commercial acid of 1·420 sp. gr. the nitrate need not be dried and ordinary chamber acid can be used. With good systems of distillation and condensation sulphuric acid of 1·530 sp. gr. is sufficient to get the average strength of the nitric acid up to 1·380 sp. gr.

On the other hand it is not so easy to get rid of the impurities. To eliminate the sulphates nothing but re-distillation can be done. The hyponitric acid and the chlorine can be driven off by the process known as "bleaching," that is to say, heating the acid in a water bath and driving compressed air through it. It generally takes about 2 days, and is a very slow process indeed. Much easier is it done by driving *hot* compressed air through, but the bleaching of the manufactured acid necessarily reduces its strength and causes a certain loss.

There is only one metal, which is perfectly suitable for the construction of stills for nitric acid, and that is cast iron, as it is well known, that nearly all other metals are rapidly attacked by nitric acid, and those materials, which are more resistant against it, do not stand the heat. Almost every engineer has a special mixture of cast iron of his own for this purpose, but as a rule good hematite iron with a reasonable quantity of white pig iron is the best. Scrap iron should not be an ingredient of the mixture, as it is apt to lead to the inclusion of slag in the castings, in which case they would be rapidly eaten through. A good mixture of iron is an important factor in the life of a still. I have seen retorts eaten away in less than 3 years, and others working for over 10 years without any apparent wear. Some parts of a still will wear more rapidly than others, the covers of retorts or the ends of a cylinder are the most subject to it. This is due to the condensation of nitric fumes on them, especially at the beginning and end of the operation, when the acid is weak.

Attempts at diminishing the wear and tear of the stills, and facilitating the removal of the nitre cake, have given rise to a large number of different designs of stills. The diagrams show a variety of representative types of such stills.

Fig. 1.



There is above all the time-honoured cylinder, Fig. 1. You find it sometimes by itself, sometimes set with a companion into the same furnace. It generally consists of a cast-iron cylinder, about 2 ft. to 2 ft. 6 in. diameter, 5 to 6 ft. long, and between 1½ and 2 in. thick. Very rarely the cylinder is closed on one end, usually both ends are removable. Sometimes the ends are of flagstone instead of cast iron. These ends have sockets on their upper part, which serve on the one side for the introduction of the sulphuric acid, and on the other side for carrying away the nitric fumes. In order to introduce the nitrate and to remove the nitre cake, one of the ends has to be removed, and in fixing it again the rim is luted with clay. The cylinder is a very good form of still, because it allows the fire to play all round, and thus avoids condensation of acid on the top, and the consequent wear. But on the other hand the ends are necessarily exposed to the cooling action of the air, and therefore the wear of them is rather great. The removal and fixing of the lids, the charging of the nitrate, and the breaking up of the cake are very tedious operations. For ordinary commercial acid they are largely used, but on account of the constant cooling of the ends it is impossible to produce in them the strongest acid, now required, and only a small part of the total yield can be got as ordinary strong acid. Sometimes the upper half of the cylinder is lined with bricks. To do this, there is either a rim cast on the inside, as in Fig. 2, or the cylinder is cast to a special shape, to allow the bricks to be set back, as in Fig. 3, or the cylinder is cast in two halves, which are bolted together, as in Fig. 4. If the rim is cast on inside, it is subject to great wear. If the cylinder consists of two halves, it is difficult to keep it tight. Altogether with cylinders the brick lining is unnecessary, as the whole of the circumference is surrounded by fire, and with a proper position of the outlet for the gases no condensation is likely to occur. With the brick lining on the contrary, even if the bricks are perfectly acid proof, the mortar in the joints will gradually be eaten away. Once there is the smallest leakage, the gases will get between the lining and the shell, the iron will be then more readily attacked, and the brick lining apt to fall in.

Fig. 2.

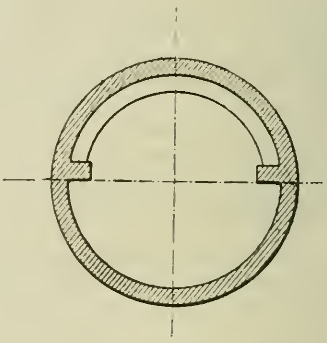
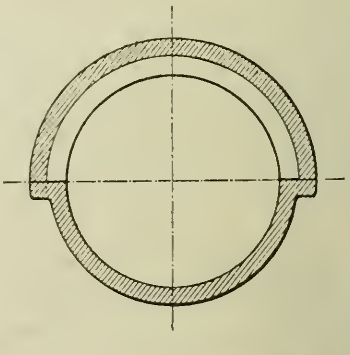


Fig. 3.



Another form of still, which was formerly often used, is trough shaped (Fig. 5*a* and *b*). In this case the charging is done from the top, and there is an outlet at the bottom for the bisulphate.

Fig. 4.

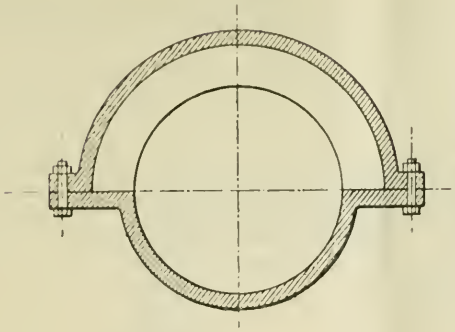
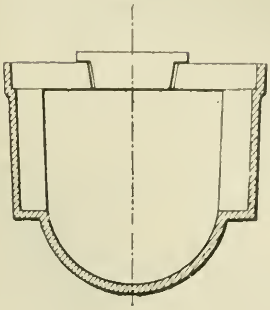


Fig. 5a.



The great manual labour required by the cylinders and their comparatively uneconomical work has led to the construction of pots and retorts. One form, which is still in use in some places, is a simple iron pot, with a rim on the top, into which fits a flagstone as cover. The fume pipe enters a hole in the centre of the flagstone. Pots of this description last a very long time, as the cover is not attacked, but they are quite impracticable for large works, as the stone cover has to be removed for each charging, and the bisulphate to be ladled out, or, when hard, broken up in the pot itself.

Another form of pot, where the whole is surrounded by fire is shown in Fig. 6. Here there is a small cover for charging, and a larger one on the top of the flue. The gas outlet is on the side, as with a laboratory retort, and therefore the cover is more readily attacked, and the acid is likely to contain some sulphates. No provision is made to run off the bisulphate, and unless proper precautions are taken, nitrate is likely to be spilt into the flue when charging. The main flue is a double one provided with a damper in order to divert the smoke under the condensers to prevent their cracking.

Fig. 5b.

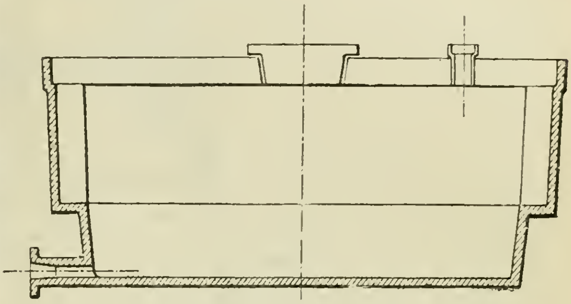
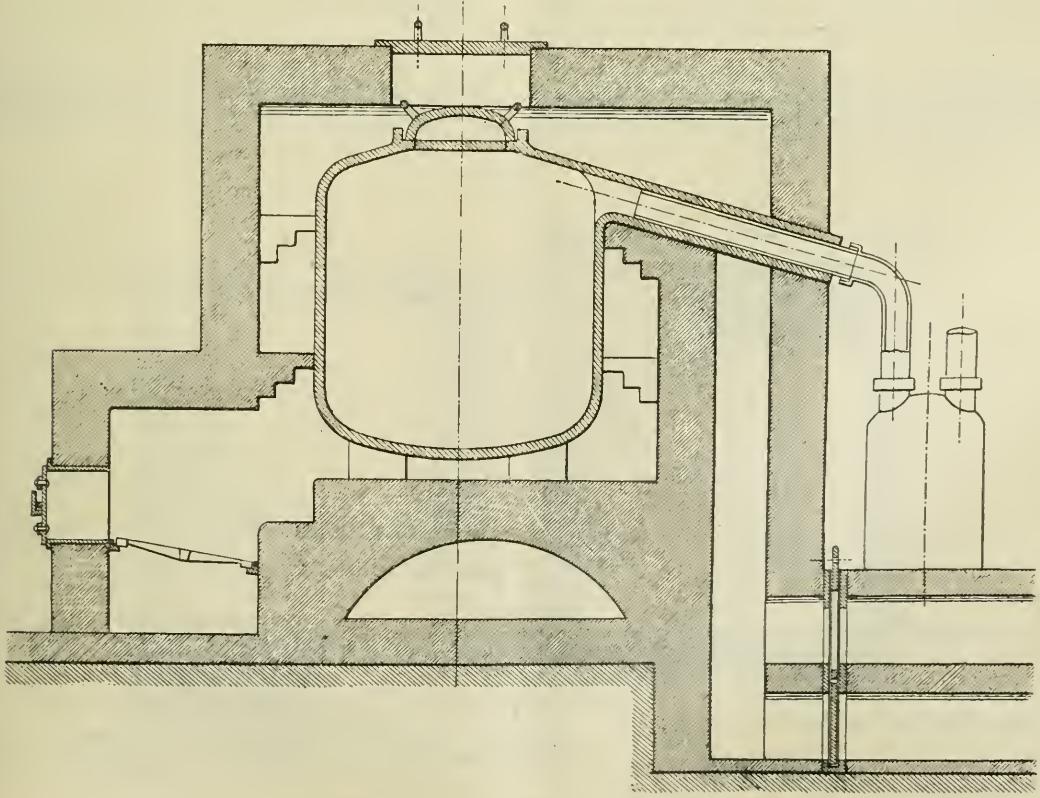


Fig. 6.



A better pot, which in fact is a good retort for small quantities, is shown in Fig. 7. It has a wide socket closed with a cast-iron or stone cover for charging the nitrate, and a small hole in the cover to run the sulphuric acid on the top of the nitrate. Another socket, placed near the centre, carries away the gases, and the earthenware pipe going to the condensers projects a little through the socket, so as to prevent the acid condensed in this pipe coming into contact with the metal of the retort. The bisulphate is discharged through the socket at the bottom. The whole retort stands in the fire, consequently it lasts for a very long time, and requires but little fuel. Fig. 7*a* shows a similar retort which is in use at a large French factory, where it is giving very good results.

Fig. 7.

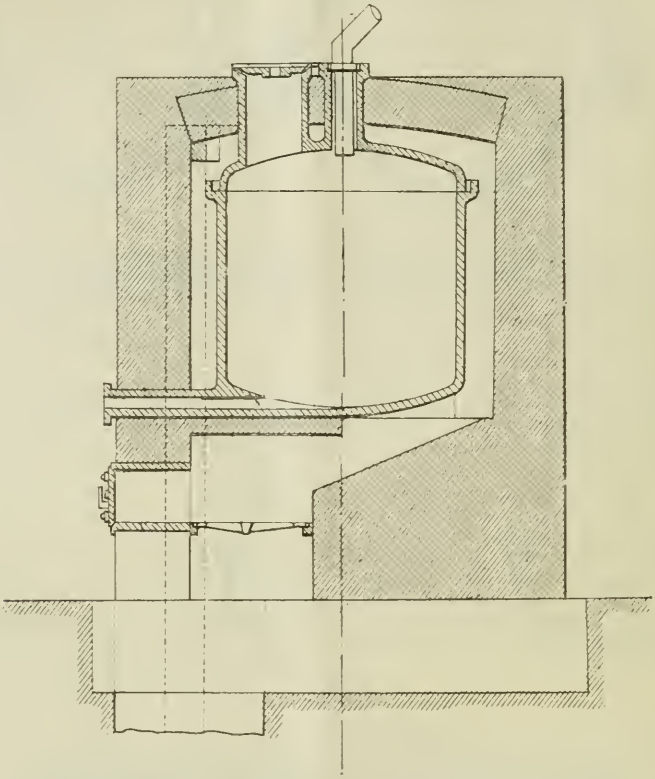
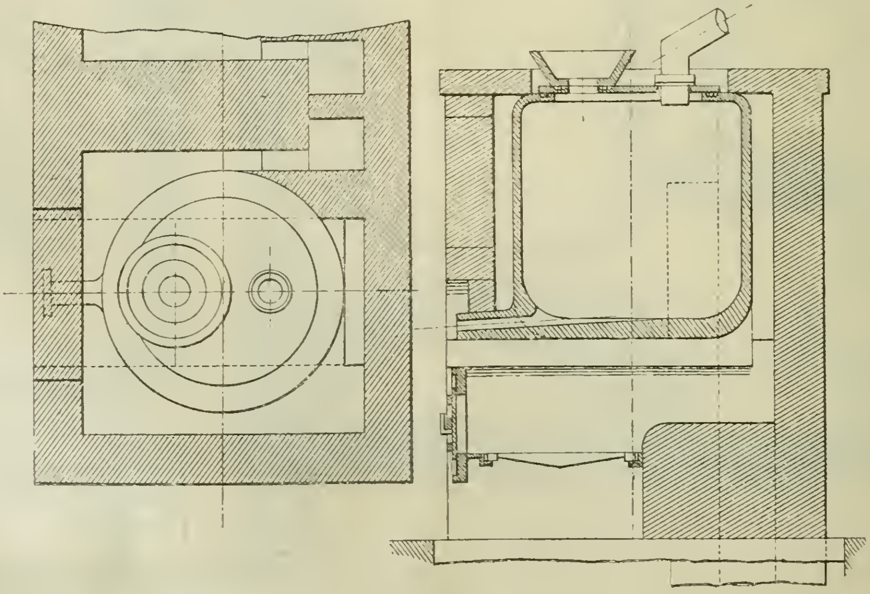
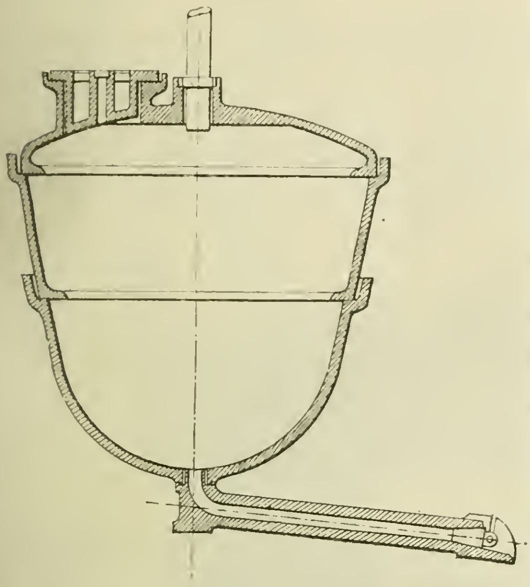


Fig. 7*a*.



In larger works it is preferable to have retorts of greater capacity, as the labour of stoking, charging, and discharging remains very much the same, and the condensers also are as a rule capable of doing more work. The latter consideration forms a limit to the size of the retort, and therefore 12 to 14 cwt. of nitrate is about the maximum charge. The upper half of the retort must always remain empty in order to allow for the considerable frothing of the mass whilst distilling, and naturally this part is more subject to wear than the bottom. It would be impracticable to cast retorts of so large capacity in one piece, and a retort of this size, weighing many tons, is difficult to manipulate, when setting in the brickwork. For this reason such retorts are cast in several parts, and Fig. 8 shows a form used by me in many factories I have designed, and which has given general satisfaction. It will be seen that the retort rests on a small base, which is connected with the bisulphate discharge pipe, and is supported on the sides. There is a hemispherical lower shell, which holds the mixture of nitrate and sulphuric acid, an upper ring to allow for frothing, and a cast-iron cover with the usual charging hole and fume pipe. The various parts are put together by means of rust jointing, and no trouble is experienced if this is properly done. The brick setting has to be arranged in such a way that the whole of the retort is surrounded by fire. It will also be seen that both the upper ring and the cover have internal flanges, which prevent the frothing mass from rising up to the cover, and the lips round the sockets cause any acid condensing to fall back into the shell, instead of running along the metal.

Fig. 8.



It was formerly usual to have these covers arched in with bricks, especially where for the manufacture of strong nitric acid a wrought-iron cover was slipped over the retort to dry the nitrate upon by the heat radiated from the cover. This of course caused a good deal of condensation on the covers, and they only lasted a short time, but the brick lining was only a small improvement, and it was difficult to set it properly, so as to stand for any length of time.

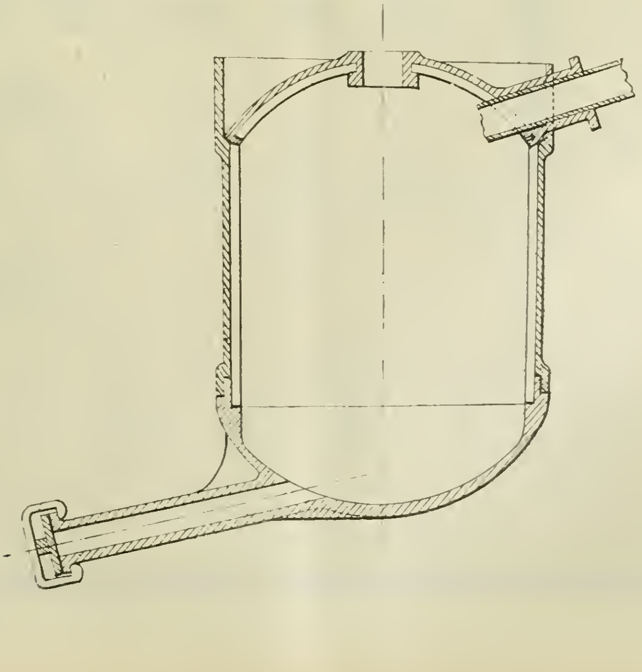
A similar retort, but of rectangular shape instead of circular, is in use at a continental factory. This form makes the brickwork setting cheaper, but it is not so easy to cast, and the corners will probably get blocked up with cake. Another retort, designed by Mr. Walter F. Reid, which is used in an English factory, is shown in Fig. 9. It has the peculiarity that the whole of the vertical part and the cover are lined with tiles.

The gases issuing from the still are a mixture of nitrous acid, chlorine, sulphuric acid, steam, and nitric acid. Nitrous acid and chlorine do not condense, but they are more or less absorbed by the liquid nitric acid. The boiling point of nitric acid being 86° C., chlorine and nitrous acid if absorbed in the nitric acid, will distil off at this temperature. It is therefore essential that the condensed acid should be either maintained at a temperature of about 80°, or that the condensation should take place so rapidly, and the acid be carried away so quickly that the impurities have no time to condense or to be absorbed.

There is very little room for variety in the construction of stills, but the condensation of nitric acid offers a much wider field.

From time immemorial the well-known earthenware pots or receivers have served for this purpose. They are simply Woolfs bottles, with or without a tap at the bottom, and

Fig. 9.



connected to each other by means of special bends. Before good mastic was available, these bends had conical ends, which were ground into funnel-shaped sockets on the receivers (*see* Fig. 10). Later on the sockets had the usual form (Fig. 11), and the bends were luted in by a mastic or putty made of asbestos and silicate of soda, sometimes with the addition of a little barium sulphate, to harden it. Care has to be taken that the sodium silicate is diluted with

Fig. 10.

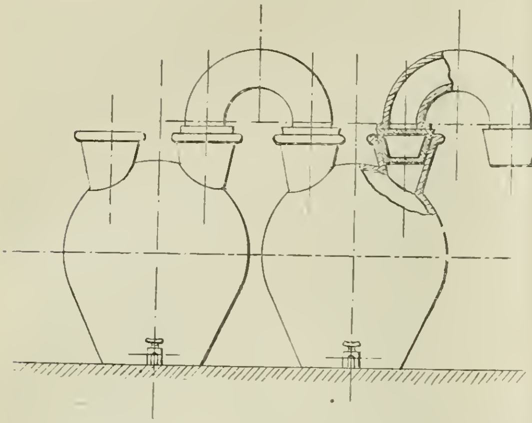


Fig. 11.

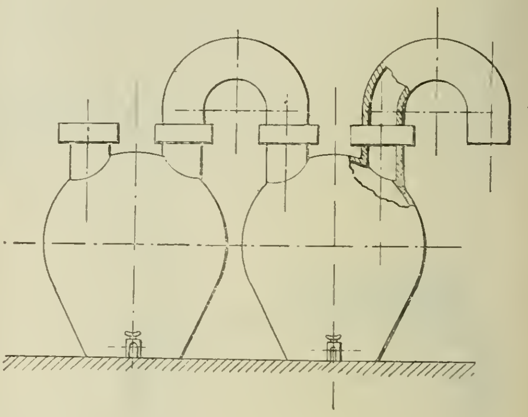
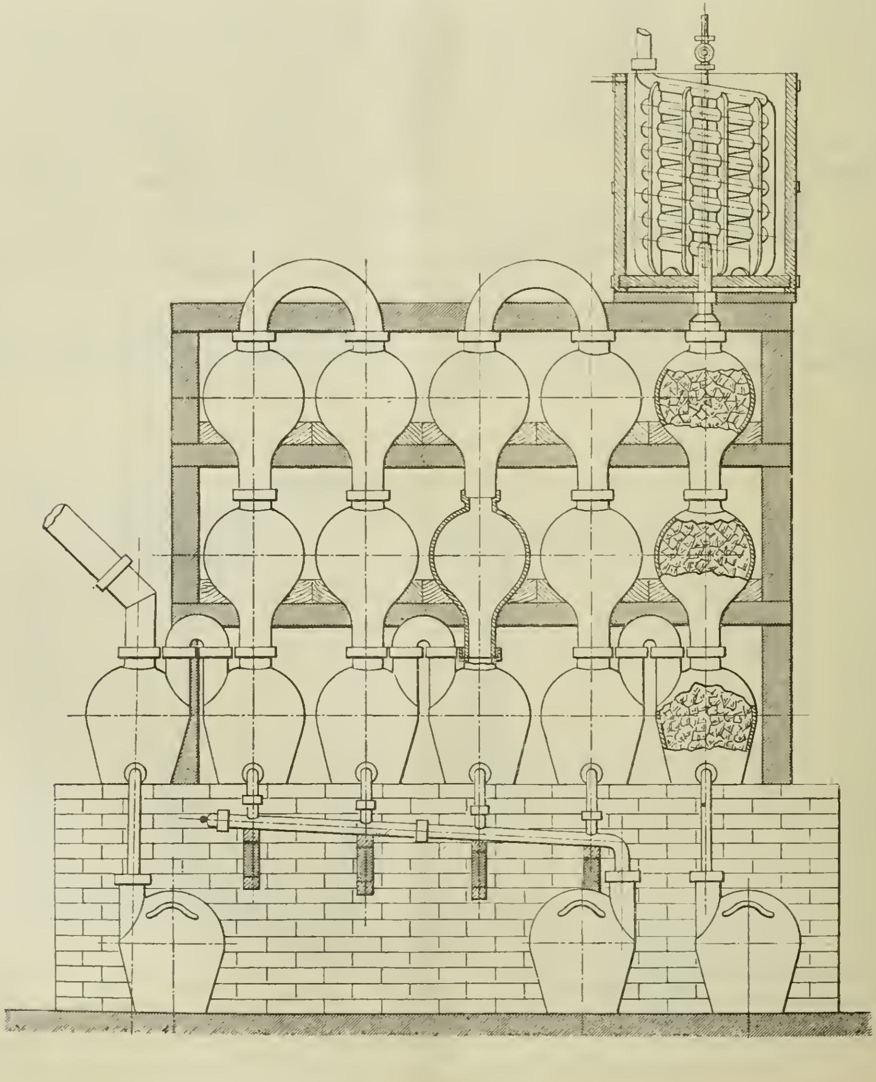


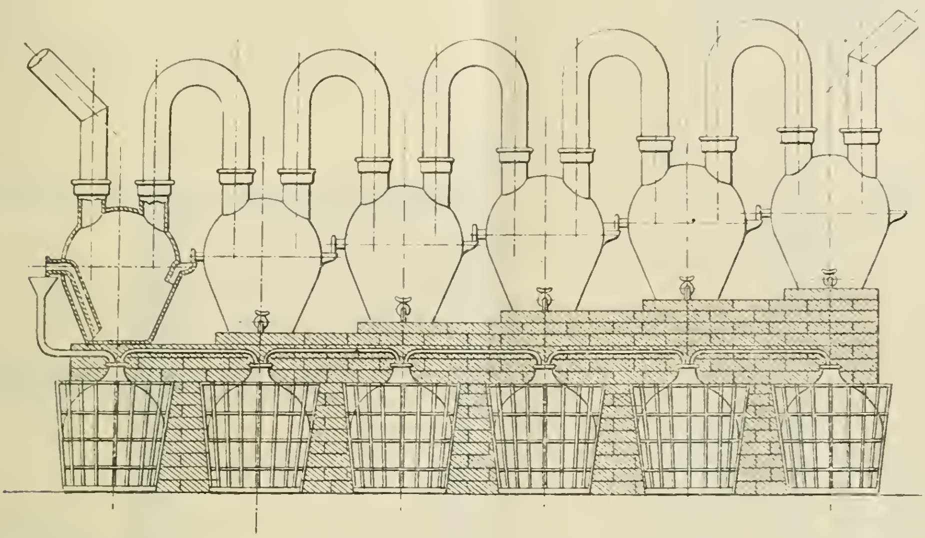
Fig. 12.



about 20 parts of water, or else the mastic absorbs moisture, and by its swelling cracks the sockets. There is a good deal of manual labour connected with these receivers, as they have to be emptied from time to time, and as condensers they are by no means perfect. A simple consideration will show that it is only the outer surface of the pot which effects condensation, and therefore the whole of the inner core is useless. At the same time these receivers are nearly always partly full of warm acid, which consequently largely reduces the available condensing surface, and affords constant contact for gases, so that any impurities are readily absorbed by the liquid. It is also natural that each receiver yields a different strength of acid. For a retort of 10 cwts. of nitrate there were always at least a dozen of receivers required.

A better condenser was that of *Plisson and Devers* (Fig. 12), which may still be found in some old works. It consisted of a number of pots fitted one in the top of the other. The first acid ran into an independent receiver, and thence into a separate carboy. The lowest receivers were connected at the bottom by means of an overflow pipe, so that the acid could only reach a certain level, and was drawn off from the last receiver. In a similar way the condensation is sometimes effected by means of receivers arranged in steps (Fig. 13).

Fig. 13.



Marchal made a good improvement on the Plisson and Devers system, which is shown in Fig. 14. There is only one range of receivers, but each of them has a conical bottom with a trap, and these bottoms fit into a main discharge pipe. By these means the receivers were always empty, and the whole of the acid obtained is of the same strength. In order to further increase the condensation, a short pipe was interposed between the receiver and the bend.

In many factories earthenware worms are used to partly replace the large number of receivers. Such worms, when placed in a tub of water, are a very effective means for cooling, especially when they have a corrugated section, such as the sample shown on the table. They have on the other hand great drawbacks. Unless they are made from very good material, they are liable to crack with the difference in temperature between the cooling water and the hot gases. And also it is, with the rough usage they get in a factory, very easy to knock off either the inlet or the outlet piece. But the greatest objection is in the fact, that the gases enter them at the top, and unless the gases are entirely condensed in the worm (which as a matter of fact they never are), there will be either a stoppage of the draught, and consequently slower distillation, or a certain pressure on the worm to enable a mixture of liquid and gas to pass through. In either case all the impurities will be absorbed by the acid, and all the water will be condensed, so that a weaker acid will be the result.

In this connection I may mention a process patented to the *Chemische Fabrik Griessheim*. They put the collecting vessel between the retort and the condenser, which is on the Liebig's principle, or a worm, where the gases enter at the bottom. Compressed air is blown into the collecting vessel, and this bleaches the acid, whilst the nitrous acid and chlorine pass through the condenser.

Another system is that of *Valentiner* in which a vacuum is formed behind the condenser, and the temperature of distillation thereby reduced.

In order to get a largely increased cooling surface, and to do away with the receivers, which by reason of their shape are unequally strained in different places, which makes them liable to break, I have devised a system of condensation by means of long earthenware pipes. This has only been possible by using the excellent material supplied by Rohrmann, such as you see here.

Originally each pair of pipes was connected at the bottom by means of a trapped bend, (Fig. 15), and the outlet of this bend went into a main discharge-pipe. The many joint necessitated a good deal of attention and lead to dripping of acid. I then devised the "chamber-pipe," this is a pipe with a number of sockets for the insertion of the vertical condensing-pipes. and a division between each two sockets, so as to allow the gases to pass from one pipe into the other, whereas the acid runs constantly off by means of small bends connecting one chamber with the other. A section of one of these pipes is exhibited here, and the whole arrangement of the condensing battery, &c. can be seen in *Fig* 16. This condensing battery works very well, as the condensation is rapid whilst at the same time the steam and chlorine have a perfectly free passage to the tower without coming into contact with the acid. The distillation can be carried on very quickly, the usual time being only 12 or 14 hours. These pipes stand any reasonable variations of temperature, in fact the cylindrical form is the most favourable one for resisting such stresses as are thus set up, and only gross ill-usage will cause breakage.

Although the acid made in this condensing batteries is quite free from chlorine and sulphates, and contains comparatively little hyponitric acid, yet with very strong acid, and fairly quick distillation the hyponitric acid is rarely less than 2 per cent. This is more than is desirable, because now a days manufacturers of dynamite, smokeless powder, &c., require acid, which whilst having the maximum possible strength contains as little hyponitric acid as possible. Subsequent bleaching would weaken the acid again, and therefore very slow distillation would have to be

Fig. 14.

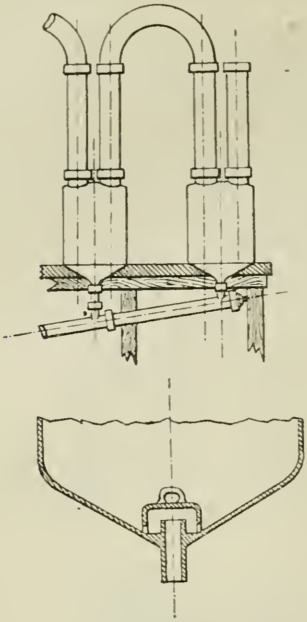


Fig. 15.

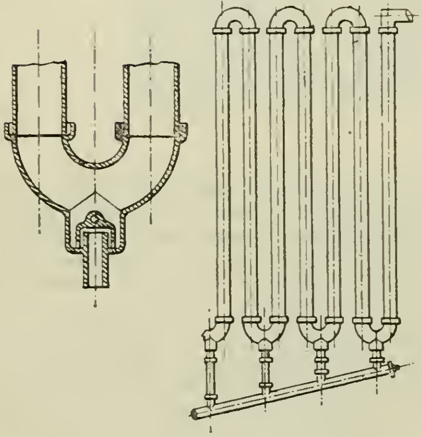


Fig. 16.

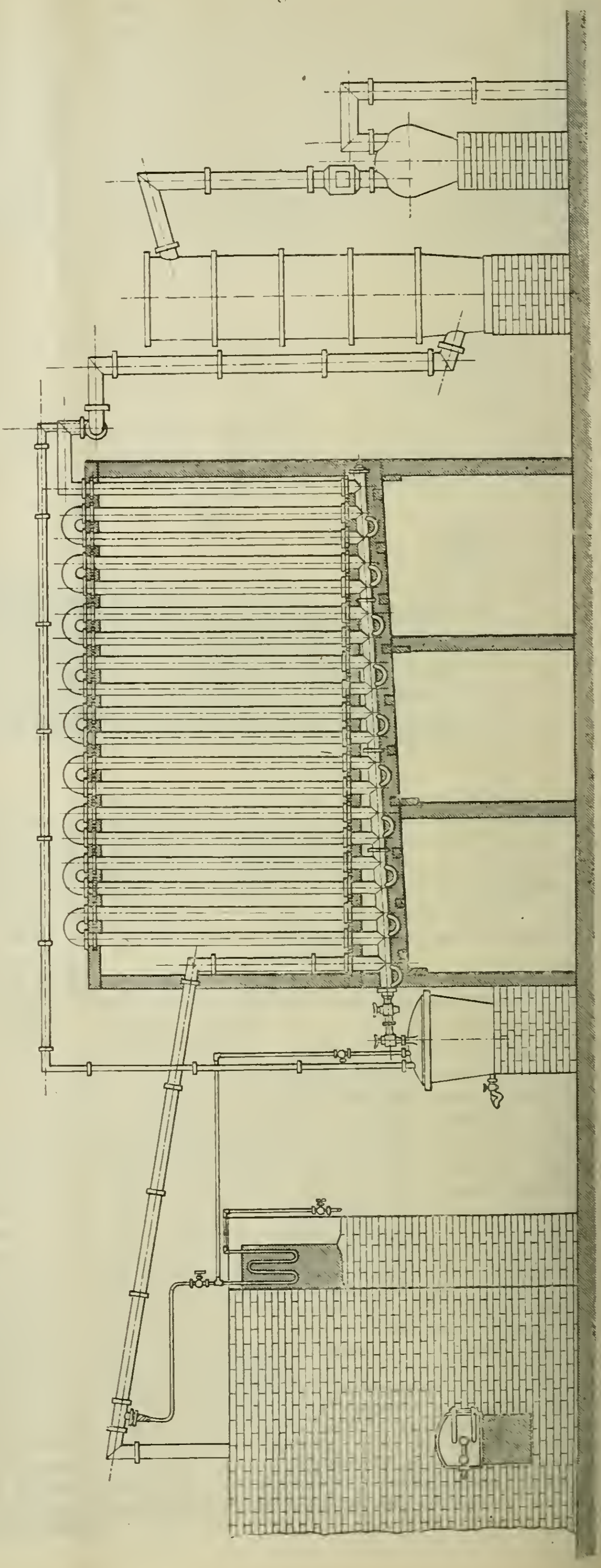
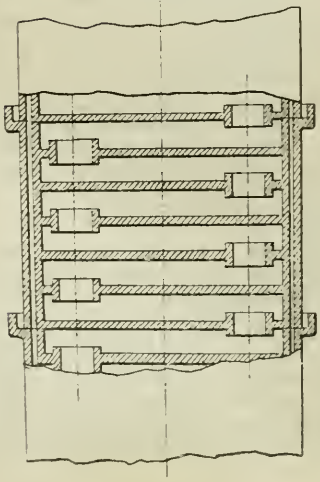
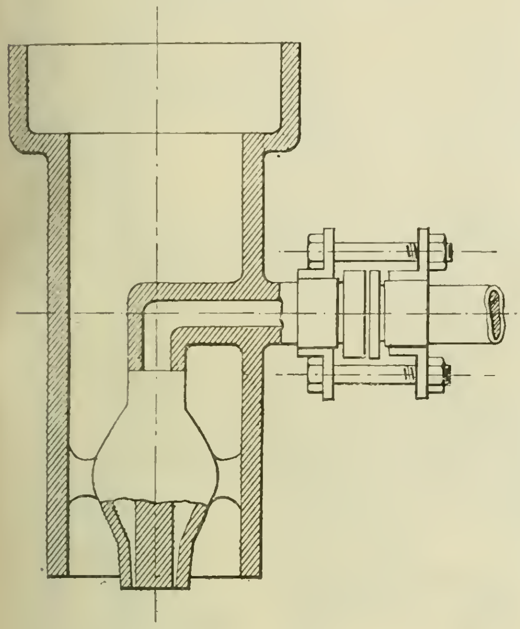


Fig. 20.



resorted to, which could only give a small proportion of strong acid. It is well known, that in order to convert nitrous acid into nitric acid the presence of air and water are necessary. The reaction $3\,NO_2 + H_2O = 2HNO_3 + NO$ takes place, and the nitric oxide is by the air constantly oxydised and again transformed by the water. Now, even the strongest nitric acid, which is made on a large scale, contains about 4 per cent. of water, which is ample for a much larger quantity of nitrous acid. If, therefore, hot air is blown into the gaseous mixture, before any of it has commenced to condense, the nitrous acid should be transformed into nitric acid. This consideration led me to employ an earthenware injector (Fig. 17) on the top of the retort, and it has been a complete success. A small coil of gas pipes is placed into the flue of the retort, and compressed air goes through it to the injector. This simultaneously causes a reduction of pressure in the retort, thereby reducing the temperature of distillation, and transforms the nitrous acid into nitric acid. The expansion of the compressed air also assists in cooling the gases after leaving the injector, and the air carries the impurities away from the condensers. This injector enables one to produce nitric acid of 96 per cent. monohydrate, with under $\frac{3}{4}$ per cent. hyponitric acid, and also to make nitric acid of 1·420 sp. gr., which is free from every impurity except a slight trace of iron. With other condensing systems there is at best but 80 per cent. of the total yield obtained as strong acid, with my system the whole of the yield contains 96 per cent. of monohydrate. In distilling with waste acid from the manufacture of nitroglycerin, which contains a great quantity of organic compounds, the nitric acid produced without the injector has as much as 16 per cent. hyponitric acid, whereas with the injector it is reduced to below 1 per cent., which shows conclusively its good work.

Fig. 17.



With the necessary modifications this battery is admirably adapted for such operations as the denitration of waste acids, the manufacture of arsenic acid, &c., where a prolongated contact with air and steam is required.

Finding Mr. Rohrmann's pipes to be of such excellent quality made me bolder, and I have recently devised a water-cooled condenser (Fig. 18) on the same principle as the battery just described. It has enabled me to reduce the number of pipes from 20 to 5, and yet to get about 5 per cent. more strong acid out of it. In fact this condenser yields now 97 to 98 per cent. of the total possible quantity of acid at a strength of 96 per cent. monohydrate with about 1 per cent. of hyponitric acid only, and the remaining 2 or 3 per cent. go to the tower. The cost of this condenser, including injector, collector, &c., is only half of the large battery, viz., about 45*l.* per retort of 12 cwt. nitrate. A plant erected to this system takes now only about a quarter of the floor space, which is required with others for the same quantity of production, and a charge is easily made every day from each retort, as against one in 48 hours with other systems. The coal consumption is only $1\frac{1}{3}$ cwt. per charge, or about 0·175 lb. of coal per lb. of nitric acid.

It is a matter of course, that no system of condensation is perfect, and that the stronger the acid the more fumes will ultimately escape it. As the nitric fumes are in most cases a nuisance to the neighbourhood, and as in this country the Alkali Act provides, that the gases escaping should not contain more than a minimum of free acid, special contrivances have to be resorted to, which are commonly known as towers. In the Plisson and Devers system, the last column of receivers was filled with pumice stones, on to which water trickled, and the uppermost receiver was connected with a cooling worm.

A more effective way was the use of coke towers (Fig. 19), these had a Segner's wheel on the top to distribute the water. They are still largely used, but sometimes they choke, and sometimes the acid finds a straight and short path through the coke, and so minimises the action of the tower. A coke tower to serve six retorts of 10 cwt. each must be 48 ft. high and 3 ft. diameter, which means a costly structure to contain it.

Since then attempts have been made to construct towers similar to the column apparatus in the distillation of alcohol. Such a tower is shown in Fig. 20. It consists of a number of saucers with a hole in one corner through which a small pipe is fixed. The acid always stands as high as the pipe, thus presenting a large surface for absorption. The liquid falls on to a plain part of the next saucer, the pipe being wide enough to allow the gases to pass through from below.

By far the best is the plate tower designed by Professor Lunge and made by Rohrmann, which is now used for a large variety of purposes. It is shown in Fig. 21. You see there is the usual bottom vessel with a number of cylinders placed on the top of each other, but instead of being filled with coke, it contains a large number of thin earthenware plates, each of which has 1,200 small perforations, each perforation having a small rim so as to cause the liquid to reach a certain height before falling through. The enlarged section of a plate is shown in Fig. 22. Each plate rests on a thin earthenware ring. Both plate and ring will probably strike you as clever pieces of workmanship, considering that they are both 26 in. in diameter and only $\frac{3}{8}$ in. thick. The plates are so placed, that a hole in one corresponds to a plain part in the next, so that the liquid dropping down is scattered into small drops, and consequently the whole of the tower is filled with a cloud of minute drops, which offer a very large surface for absorption.

The tower as it is designed here, is only 10 feet high without the base, and has the same absorbing power as the coke tower 48 feet in height mentioned before, but whereas the coke tower yields at best an acid of 1·260 sp. gr., the acid from the Lunge-Rohrmann tower marks 1·380. This is due to the fact, that with a coke tower every drop of water falling through the distributing cover on the top runs without stoppage to the bottom, whereas in the Lunge-Rohrmann tower it only causes a drop from each plate to fall on to the lower one, and ultimately one from the last plate to fall into the bottom vessel. With the coke tower it is therefore necessary to have a fair stream of water running down to prevent escape of gas, whereas with the Lunge-Rohrmann tower the water can be admitted even drop by drop, and therefore does not block the draught.

The proper working of a nitric acid plant can easily be regulated by a sight glass, which is placed into a pipe just before the gases pass into the chimney. They should only show the faintest yellow tinge here.

Having thus given a broad outline of the manufacture of nitric acid, I have only a few more words to say as to the quality of the acid. With the invention of smokeless

Fig. 18.

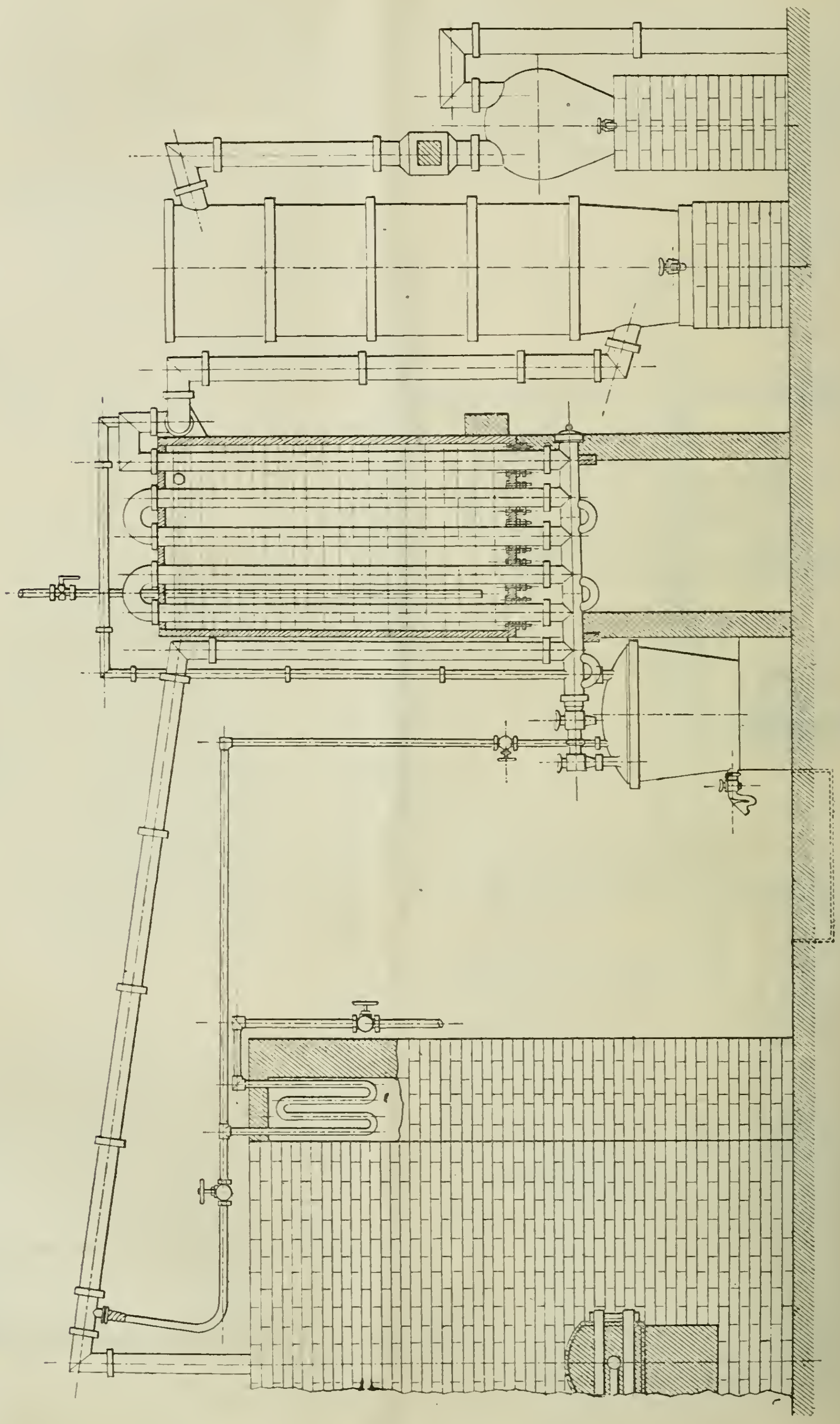


Fig. 19.

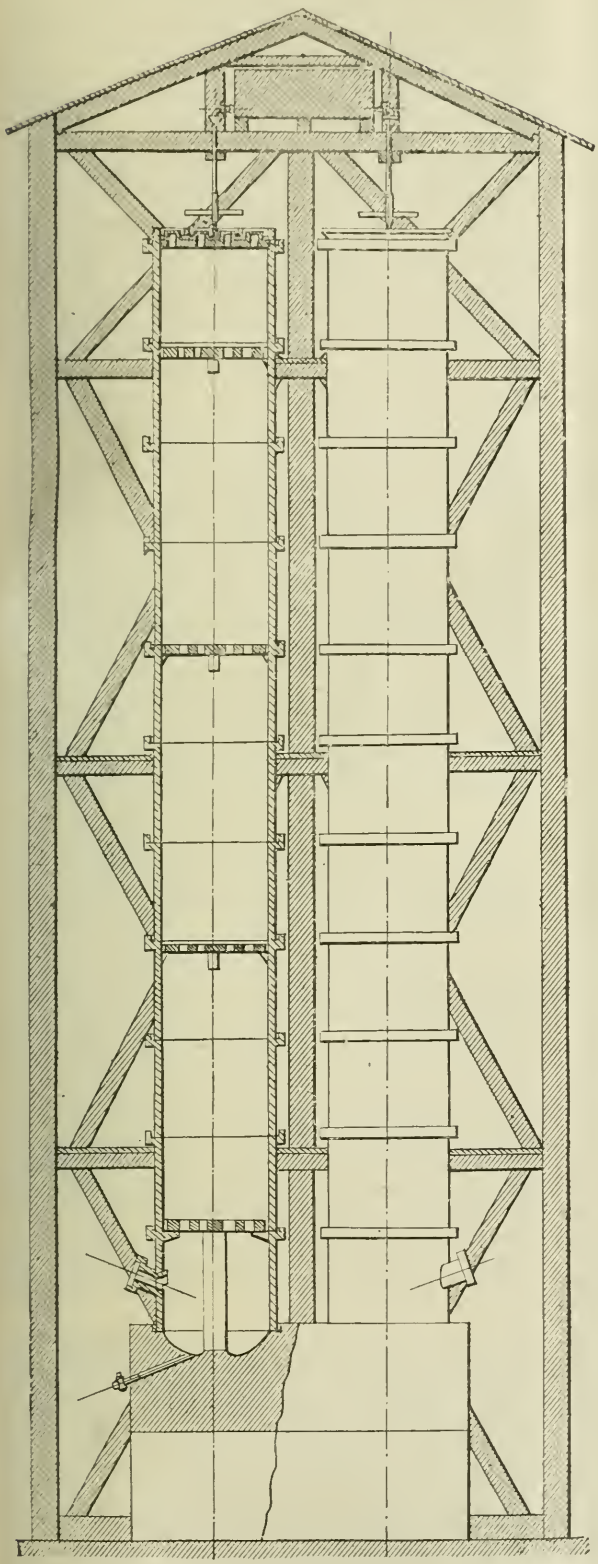


Fig. 21.

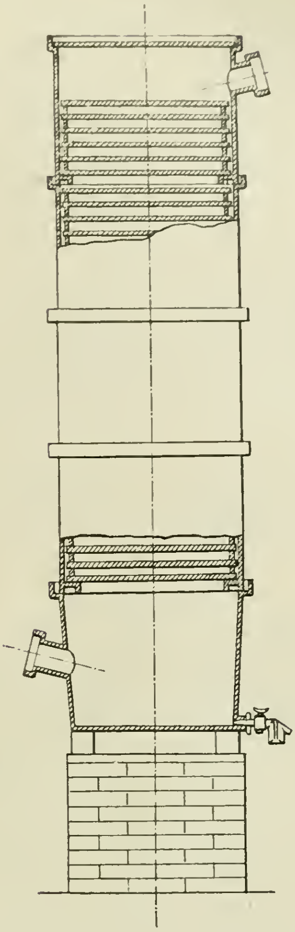
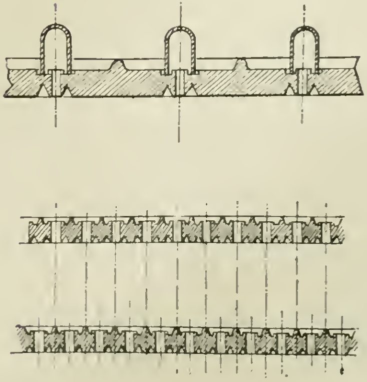


Fig 22.



powder the manufacture of nitric acid has received a fresh impetus, but at the same time the requirements as to strength and purity have increased, and this manufacture like so many others has now to be carried on in a more scientific manner than hitherto. Professor Lunge and Mr. Rey have shown, that with nitric acid the same peculiarity takes place as with sulphuric acid, viz., that in the highest concentration the specific gravity does not increase in proportion to the percentage of pure nitric acid. At the same time Lunge and Marchlewski have determined exactly, which was in a qualitative way well known, that the hyponitric acid contained in the nitric acid considerably increases its specific gravity. It will therefore no longer do to sell nitric acid 1·500 sp. gr. as the strongest acid, since it only contains 94·09 per cent. of pure acid, when free from hyponitric acid, and if at the same specific gravity it contains 1 per cent. of hyponitric acid, then the percentage of pure nitric acid will be only 92·60, or nearly 1½ per cent. less. This means considerably more than appears at first sight because such strong nitric acid is used principally for the nitration of glycerin, cotton, &c., and the hyponitric acid is not only without effect, but even lowers the yield, and gives inferior nitro compounds, which may considerably impair the quality of the product.

It is therefore no longer customary to buy either sulphuric and nitric acid of high concentration by the specific gravity, but by the percentage of pure monohydrate contained and this certainly places the whole manufacture on a higher level. December 26th, 1892.

Discussion.

Mr. Reid said the method Mr. Guttmann described of condensing nitric acid appeared very simple, and one only wondered that it had not occurred to anyone before. Possibly the real reason was that which lay on the table before them, for he feared that such plant could not be produced in England. He had never been able to get chemical plant in England of the same quality as some of the foreign goods, and he spoke with large experience of this particular plant. Not long since he had to design a plant on a very large scale for nitric acid to produce four or five tons a day, and the allowances that the manufacturers had to make on account of defective plant were, he felt convinced, sufficient to secure to them the services of the best men in Germany to superintend the manufacture. English manufacturers had good material, but he did not know of any firm who could turn out goods like those before them, and they did not seem to care about taking the trouble to work out a new thing as had been so well done in the apparatus exhibited. If English manufacturers were more enterprising a great deal of money would not go abroad that now did. He felt it all the more in this particular industry because he had applied to manufacturers in all parts of the country, and had been obliged, much to his regret, to go abroad for things which could have been easily made at home. Mr. Guttmann remarked that the time of working off the retorts, 10 or 12 hours, was rather short, but in his own experience it was the usual time. He generally expected a retort to be worked off in that time. One of those on the walls was his design. In connection with condensing he must say that the old system had given him satisfaction on the whole, but he thought that the new form might be more economical for any one putting up new plant. But he should like to ask Mr. Guttmann as to the probable loss by breakage in the carriage of these things. He had always found it considerable in England, but when it came from abroad and had to be transhipped and moved about it would probably be more. He had used goods of this description, and knew they stood differences of temperature as well as any other kind he had met with. With regard to the introduction of air he had tried himself, some years ago, blowing air through a pipe passed through the opening in the top of the retort into the retort itself, and by that means facilitating the exit of the gases. He tried that on a set of retorts for months, and found that practically there was no advantage. He did not say that was the same method Mr. Guttmann was using, because the temperature in the retort was no doubt much higher than at the spot where Mr. Guttmann applied the air, but he could not find any gain in the result sufficient to warrant an alteration of the whole of the retort. One very simple way of admitting air, which he found effectual, and did not cost anything, was this. There was generally a stopper to each condenser, and if, even when the retort was in full work, one took out the stopper at about the third or fourth condenser, provided there were a proper draught into the chimney, instead of the gases coming out, enough air was drawn in to materially increase the yield of nitric acid so far as the yield could be increased. With these retorts, or retorts very similar to them, and with ordinary condensers the yield was very satisfactory. It approached so closely to the theoretical that he did not see much room for improvement in that direction. But there was room for improvement in the consumption of fuel. As had been pointed out, there were such differences in the statements with regard to the consumption of fuel that it was clear there must be enormous variations in the quantity actually used. The application of fuel in these two species of retorts was quite different. In the one it was applied to the bottom, and in the other a considerable amount must be expended in heating the sides as well, because a retort must be enclosed in hot gases to prevent condensation on the iron, which would otherwise be eaten through in less than a week. He should like to ask Mr. Guttmann if he had not had that experience with the Lunge towers of which he had heard from many others, that there was a great chance of the plates cracking if there was a quick alteration of temperature as there would be, for instance, if cold water got into them. Of course one could not get inside a chamber like that to replace them, and if one could they were rather expensive things. He should advise anyone never to put up a coke tower, for his experience was that the nitric acid acted upon it, and if the coke diminished in weight there must be loss of nitric acid.

Mr. Hamilton asked Mr. Guttmann how he made the joints, also the proportion of breakages. It seemed to him that this ware was very delicate, and it would be interesting to know how he managed to carry the whole weight of these pipes, and especially the connecting pipe at the bottom.

Mr. Tyrer said he had had a great deal of experience of pot-stills, which had lasted 20 years, to which the only cover had been an excellent quality of York paving stone, and there had been exceeding few renewals of the covers, which were in halves. So much for quality. Secondly, the lining of the upper part of any cylinder was certainly less necessary, and particularly in a pot. He distinguished between pots and cylinders. If the nitric-acid still or generator were pot-shaped, there was no very great difficulty in so adjusting the flues that the upper part of the pot should be comparatively hot. A doubt had been expressed by Mr. Reid, whether a pipe like the one on the table could be made by any English earthenware manufacturer. He said unhesitatingly from his experience, yes, a piece of earthenware for chemical use in every respect equal to any specimen on the table would be produced on request, and within a reasonable time by at least three well-known London makers. He said so from personal experience, and with a desire to protest against the mischievous idea that all that was good came from abroad.

Mr. Reid said such a statement never came from him. He should be very pleased if Mr. Tyrer would inform him who could make such a pipe.

Mr. Tyrer said he was not there for the purpose of advertising any firm ; there were but a few in London, and some in the provinces. Mr. Reid could give a trial order to any of them, and he would undertake to say that so far as two at least were concerned the pipes would if required be equal in beauty of appearance, in stability, and in care of manufacture, in a word, in every way equal to the specimens on the table. With regard to the general process, he thought that each nitric acid manufacturer found that the conditions under which his manufacture was conducted were slightly different from those of other manufacturers. The variations in the conditions were so small sometimes that they were overlooked by the unscientific manufacturer.

One of the reasons for the success of a scientific manufacturer as against an unscientific one, was that the former observed minute conditions and followed them up, and as nearly as possible had the same conditions when trying to produce the same results. With regard to the manufacture of nitric acid there was an advantage undoubtedly in the neat and compact apparatus now shown; but he had not heard proof from figures that the old fashioned receivers, if properly attended to, did not yield as good results, notwithstanding the scientific principles and the very great care exhibited in the details of its construction. He was not disposed to be prejudiced against new ideas, but when one had laid down a plant, and found it answer and did difficult work, he required convincing before he saw his way to replace an old-established method by anything so new, and in some respects so admirable, as this apparatus. Much had been said about the proportion of strong acid produced at once by this new battery, but he had yet to learn that equal strengths and quantities could not be turned out by existing methods. He knew positively this was so at least at one works in London. But what he chiefly had to protest against was the idea that England could not produce a piece of apparatus like that exhibited by Mr. Guttmann.

Mr. **Crowder** asked if he correctly understood that one plate constituted the only plate in the section of Lunge's tower. He did not quite understand about the measurements, and what space it would occupy. If that was the section as shown on the table, and it was only 13 ft. high, and if it would do all the condensation of a 40 ft. or 50 ft. coke tower it would be very advantageous, for surely the expense of putting up such an apparatus must be infinitely less than erecting a coke tower with all the lead and appliances. In connection with the manufacture of nitric acid he might say that they did not make it for the purpose of selling, but used it in their Glover towers. They had put up pots like the diagram figured 7, but only the bottom part, the cover came on to that, and a short pipe went immediately into the flue. When used in that way they found that there was no destruction of the pipe, but if it were carried up 3 or 4 ft., in the course of a fortnight condensation took place, and the whole thing was burnt out. Finally, what he wished particularly to know was the capacity of such a tower as compared to one of 40 or 50 ft. high.

Mr. **Reid** said he did not say England could not produce, he simply said he had been unable in England to find anyone who could. He had tried all the London manufacturers, and they all failed.

Mr. **Napier Sutton** said he understood from Mr. Guttmann that the long pipe on the table had been in constant use for two years, but he should like to ask whether it was at the commencement of the plant, where it would be subjected to considerable variations of temperature, or at the end where it would be cooler.

The **Chairman** said Mr. Reid was probably right in saying that the gist of the paper lay on the table. Whatever opinion might be formed as to the relative merits of different earthenware makers all would agree that this particular apparatus was exceedingly beautiful, neat, and workmanlike in appearance. He should be very sorry to think that English makers could not produce goods as well as anyone else; but most manufacturers were rather afraid of earthenware, and adopted it only where there was no other resource.

Mr. **Guttmann** in reply said he would deal with the long list of questions put as briefly as possible. Mr. Reid said that English manufacturers could not make such goods, and he had been a little contradicted by several speakers; but he must say that, like Mr. Reid, he had also tried and failed. He had used English pottery for the last 20 years, and had always used that of a well-known manufacturer. These pots he had always used where great resistance to heat was required, especially for the first receivers in hydrochloric acid plants, but they would not resist great changes of temperature. If one looked at an English pot, of the ordinary run of pots, the thickness was about 1 inch, whilst this ware was within ⅜ths. Again, the material was porous, like biscuit, and if used for nitric acid plant acid fumes would ooze out, and acid trickle down. Of course there were other makers who might make better pots. This brought him to the question of Mr. Tyrer, whether the old plant did not do just as well as the new plant, and whether he could prove it by figures. He believed he had shown in his paper figures enough to convince Mr. Tyrer that there was a considerable difference between the two systems, inasmuch as when making strong acid, one might get up to 98 per cent. of the total possible yield in the form of an acid of between 95 and 96 per cent. monohydrate; whereas whatever one did with the old plant it did not give more than 70 or 80 per cent. of acid, which never had more than 94 per cent. of monohydrate, and then 20 or 30 per cent. of acid of all strengths. He never claimed, and never said that this new system gave a greater yield; he said at the outset that nearly every plant gave a satisfactory yield, and that the average was 95 per cent. If one came to that it was cutting very close, but it was the quality that was important. Instead of getting the acid in 48 or 36 hours' work, and having to bleach it afterwards another 48 hours to get it pure, here one got it all of the same strength; no weak acid; white, pure. That was a very great advantage. Then Mr. Reid said that he found that 10 or 12 hours for distillation was the usual time. He would not exaggerate, but he believed he knew the work of nearly 50 nitric acid factories, and there was not a single one amongst them where the time of distillation had been below 24 hours. He had seen such factories, which, by dint of over-heating, had gone to 18, but only to the detriment of the retorts. He had not seen Mr. Reid's plant and could not say what he was doing. It was quite possible for any man with any retort or any cylinder to bring the time of distillation down to 10 or 12 hours. It was only a question of firing, but the question was how long would the retort last. A question had been put as to the amount of breakages and probable loss from that cause and transit, and so on, and one gentleman had alluded to these pipes as being extremely delicate. He was glad to say that they were not delicate in the least. The pipes on the table had only been cut in two, in order to be able to show a clean section of them, otherwise the whole pipe was in one piece. He had erected some 20 factories of that kind, and had never had a single long pipe broken, either in working or in transit. He had had one or two chamber pipes broken, and that came about by their not having been allowed sufficient time for drying during manufacture. Then when they were burnt they developed very minute cracks which could not be seen, and when they were worked of course the cracks enlarged; otherwise everything stood very well. The one on the table was the fourth out of the row, but he could assure them he had not yet had a single pipe broken. The handling of the pipe was very easy, and it was very easily supported. The chamber pipe was fixed and tied by means of iron clamps and simply rested on two trusses. The long pipes were fixed with mastic on the bottom of the tube, they were left quite loose on iron clamps so as to give room for expansion. This was important else they would crack. The other battery, which for convenience he called a water battery, had a different joint, and a very good one. There was a wooden box straight through which the pipe was supposed to go. It was apt to leak where the joint came, and to prevent that the hole was drilled large enough for the pipes to slip easily, and an india-rubber ring ½ in. thick was put over the pipes and secured by an iron flange, which was screwed to the box by bolts. There was never the slightest dropping, it kept absolutely tight. Mr. Reid also mentioned that 10 years ago he tried to put in air at the top of the retort by blowing in compressed air. He said it was not quite the same thing. In fact it was an entirely different thing. Air blown into the top of a retort was stopping the draught instead of increasing it, and stopping the distillation. Here there was an injector which at the same time increased the draught of the still. It reduced the temperature of distillation, but on the other hand it blew, not cold air, but hot air, about 80° C., into the hot mixture, so that no cooling took place. In fact it converted hyponitric acid into nitric acid. When the air expanded it produced cooling, and thus increased the cooling power of the battery, so that there was a triple or quadruple action going on which was very different to simply blowing air into the top of the retort. Again he said there was another easy system in taking out the third stopper in the condenser and admitting air there. That was a very old dodge; every manufacturer knew that, and in fact every receiver was fitted with a stopper for that purpose. In former times they used to pour water in so as to have a stock of water in this place to absorb the acid, but in five cases out of ten there would not be sufficient draught to prevent the nitric acid going out, and it would cause bad fumes. He did not see what the air would do. Mr. Reid said it would increase the yield of acid, but he failed to see how. Mr. Reid asked him if the plates in Lunge's towers cracked. That was rather difficult to answer because one could not see through the tower, but there it stood and it acted. He had had some working for the last three or four years, and they were constantly acting wonderfully well, and he had never heard nor had one of his workmen heard a plate crack. But even if one did crack they would still hold on the rings, and would be just as effective as they were before. Mr. Crowder inquired as to the number of plates in the tower. The tower contained as many plates as one liked, but of course there must be a considerable number to effectually condense because it was the distribution of acid in fine spray which caused it. The ordinary tower which he usually took for between four and six stills of 12 cwt. each contained 36 plates, and the acid dropped from one to the other. The sulphuric acid tower which he thought Mr. Crowder had really been referring to had 16 rows of plates, each row consisting of 6, making 96 square plates; they were put, not on rings, but on earthenware bearers, and the whole thing was lined by lead, not by a pottery tube. This was a different thing altogether, though the principle was the same. Mr. Crowder said he found when he put his pipe on the level of the bottom, that he could put a rod in, which was very handy. No doubt he was right, and this was the most convenient way of putting it. There was one retort illustrated, which had it on the level, the French one; but sometimes a convenience in one way involved a little inconvenience on the other hand, and in this particular retort that outlet pipe formed at the same time a base for the whole retort which weighed 4 tons. Without that, one did not get the bottom portion surrounded by fire, and it was apt to be ruined. There one had that disadvantage, and with the other one there was no bisulphate at the bottom. In getting some left at the bottom one might start the action a little more rapidly, but whether that made much difference, considering that the time of distillation had been so shortened, he doubted. When Mr. Tyrer said that he wanted to keep the top of the cylinder cool, he thought he must have made a slight mistake in speaking, because he thought the hotter one kept it the better for the iron.

Mr. Tyrer said what he referred to was the very top of the pot which had the stone paving.

Mr. Guttmann said if one had York paving at the top that required a lower heat altogether, because that was very apt to crack.

Mr. Tyrer said it had stood 20 years.

Mr. Guttmann said he had seen some which lasted quite that time, and some which did not. He believed he had now answered all the questions which had been put, but he should be very glad to give any further information to any gentleman who desired it who would call at his office.

Meeting held Monday, March 6th, 1893.

MR. WM. THORP IN THE CHAIR.

The Chairman said that the Council of the Society, having resolved to form a committee to deal with the whole question of patent law revision, had requested the London Section to appoint in open meeting three members to serve upon it. The members already appointed by the Council, were the President, Sir Henry Roscoe, Mr. Ludwig Mond, and Mr. E. Rider Cook. The Committee of the Section had met that evening and selected six names, viz.: Messrs. Newlands, Guttmann, B. Redwood, Friswell, Hutchinson, and Salamon. It would be open to any member to nominate any others, and then a ballot would be taken for the election of three names out of those suggested.

A ballot was then taken and Messrs. B. E. R. Newlands, Boverton Redwood, and C. C. Hutchinson were elected to serve.

NOTES ON A CONVENIENT FORM OF EXPERIMENTAL APPARATUS FOR FILTRATION AND OTHER DETERMINATIONS.

BY CHRISTOPHER CLARKE HUTCHINSON, ASSOC. R.C.S.I., F.I.C., F.C.S., ETC., CHEMICAL ENGINEER.

The separation of liquid from solid matter by means of filtration occupies an important place in the chemical and other industries. Not only is it taken advantage of where the separation or the recovery of either the soluble or insoluble constituents of the material dealt with is the primary object, but it is frequently employed as a substantive process, either to render a substance into a form convenient for handling, or to effect an entire change in its physical condition. In many instances it is employed as the operative agent for the economical disposal of waste material; notably in dealing with the noxious and filthy precipitate produced in processes of purification of contaminated waters prior to their discharge into the watercourses provided in Nature's scheme of arterial drainage. In fact, there is no other operation more largely taken advantage of or more widely applied, technically, than that of filtration in one or other of its varied forms.

It is not intended to enlarge the scope of the present paper to the extent that would be necessary to deal with the many variations in process or apparatus to meet the conditions required to be fulfilled in successfully coping with the multifarious phenomena presented. It is intended merely to indicate the broad lines which have been generally found to be the most practicable, and more particularly to describe a useful form of apparatus, recently developed by my firm, which may be advantageously employed in investigating the extent of apparatus requisite to be used on the technical scale, or the conditions to be regarded which are necessary to success.

The rapidity with which a liquid is separated from a solid, during filtration, depends primarily upon the force with which it is urged through the filtering medium, and the resistance which the medium opposes to the flow. With many substances, an increase of the force urging filtration results in an increase of the quantity of liquid filtered during a given time. Hence means are generally adopted, in technical operations, to force the liquid portion of the substance dealt with through the filtering medium. The increased flow under the circumstances above alluded to is by no means an universal rule, and cases frequently occur in which an increase of pressure, particularly when it is suddenly or rapidly applied, actually diminishes the rate of filtration. It may be broadly stated that for every substance there is a particular rate of flow, and hence a corresponding pressure, beyond which no increased useful effect results commensurate with the increased force applied. A little consideration will show why this is so. Coincident with an increased rate of flow, there is an increased resistance at the point of filtration, because the real filtering medium is not the particular fabric or surface upon which the solid matter is retained, but the aggregated solid matter itself, built up or deposited upon this surface. Hence, the more rapid the flow, the more the solid matter deposited; the thicker the filtering-bed becomes in a given time, and the closer the particles deposited are driven together under the greater force, and thus, being more firmly compacted, offer a greater resistance to the passage of liquid. From this it will be at once apparent that there must be a limit not only to the rate of deposition to secure the most favourable permeable condition of the substance deposited, but also a maximum thickness of deposit, beyond which, when reached, useful filtration practically ceases. This is of course more strongly marked in some cases than in others. In some crystalline precipitates filtration can be usefully continued through deposits of considerable thickness, even as far as 12 in. or 15 in., and within this limit increase of pressure is mostly accompanied with increased rate of flow. On the other hand, with many bodies of a flocculent character, or where colloid, slimy, or gummy substances are present, the thickness limiting the useful rate of filtration is soon reached. Very often such deposits do not exceed the thickness of a sheet of ordinary paper, and any increased pressure seriously retards the rate of filtration, and ultimately so closes the pores of the deposit that filtration entirely ceases.

In the pressure filters commonly known as "filter-presses," the points above alluded to are those which are of the greatest importance to determine. This form of apparatus is so well known as to need little if any description. Briefly described, a filter-press is an apparatus consisting of a number of sieves or filtering chambers having internal spaces for the deposition of the solid matter in layers or cakes, all held rigidly together so as to resist the pressure found most suitable for urging the filtration. As the filtration takes place on both of the surfaces which form the filtering faces of the chambers the deposit is built up gradually, at the same time, and at the same rate, on both sides of the chambers. The layers so formed gradually approach each other, finally meeting in the centre of the space provided for the deposit. When this occurs no further space for the introduction of fresh material is left, and the double thickness of deposit compacted into a "cake," of a greater or less degree of hardness according to the pressure finally applied and other conditions, must be removed. From the foregoing it will at once be recognised that one of the most important conditions to determine, in the adaptation of a filter-press to its work, is the maximum thickness of chamber which can be employed. This will be exactly twice the thickness of the deposit which limits the useful rate of filtration. Such a dimension varies very widely, not only with different substances, but even with bodies or precipitates of identical composition. In the latter case the difference consists in difference of physical condition, depending largely upon the mode or method of production, and time and temperature, as well as the state of dilution of the medium in which precipitation is effected, play an all-important part, in addition to the nature and physical condition of the menstrum in which the solid is suspended. This factor, as well as the method of forcing the substance into the apparatus at the most effective rate at which the operation can be conducted, and the size of the apparatus to be employed for dealing with a given quantity of material, cannot be determined in any other manner than by direct experiment.

There are likewise other conditions in technical operations to which due regard must be paid, and many of them are as important as those first mentioned. For instance, regard must be paid to the condition or state of aggregation of the "cake" when it is discharged from the filter-press; this is a point which depends not alone upon the ultimate use of the solid residue, but likewise upon the facility with which it leaves the chamber. For example, if the cake is not compacted sufficiently hard to separate from or leave the filtering surface easily, a considerable loss of time and labour in the cleansing, or actual renewal, of the surface may result. Where the deposit is of such a character, and so excessively thin, that no cake can be built up, of course easy renewal of the primary filtering medium is an important consideration, and the most suitable substance for renewal, as well as the mode of the operation, must again be determined by experiment. There is again another important consideration. Where the soluble constituents of a substance are the primary object, especially where they may be valuable, or where it may be desired to change the appearance or physical appearance of the solid matter, it is frequently found desirable, on economical and other grounds, to accomplish either the displacement of the soluble portions left in the solid cake by lixiviation in the same apparatus, or to effect the treatment of the solid, which may be desired, without removal from the filtering chambers. This, again, is a matter purely for experimental determination, as are also conditions of temperature most suitable both for the primary simple filtration, and the subsequent operation of lixiviation or other treatment, and the extent to which such operations can be usefully extended.

The general conditions have now been broadly outlined, so that not only may their importance be noted, but that some indication may be given of the ground which an experimental apparatus should be able to cover. The saving of both material and labour from the use of such determinations in technical operations can be easily imagined, and it is believed that the piece of apparatus about to be described will render this comparatively difficult task somewhat easy of solution.

Perhaps, however, before going further, it would be useful to classify the different aspects under which the process of mechanical filtration presents itself. Such processes may broadly be split up into the following divisions:—

A. *Simple separation* of the solid material from the liquid with which it is mixed, for the recovery of the one or the other, without regard to complete separation of the whole of the soluble constituents.

B. *Complete separation* of the soluble from the insoluble portions of the substance, as far as can be practically accomplished, by systematic lixiviation in the same apparatus of the solid recovered; or the treatment of such solid matter to effect a change in its physical condition by means of liquids forced through it.

C. *Simple or complete separation* as described in A and B, accompanied by the condition that the filtered liquid, or the liquid used for subsequent treatment, shall not pass unnecessarily through the air and so evaporate or become contaminated.

D. *Partial separation* where the solid matter is very finely divided, or when slimy and gummy, or where colloid bodies may be present, so as to retard filtration and produce a cake not sufficiently thick or compacted to leave the primary filtering surface easily or cleanly.

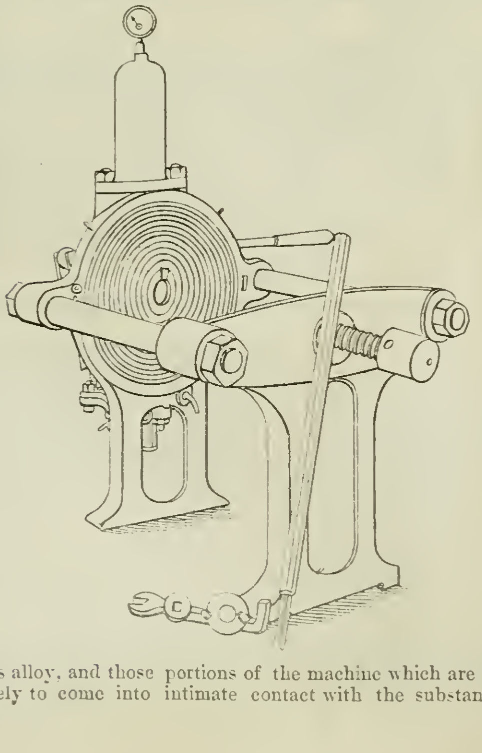
Closely allied in mode of operation to that of mechanical filtration is the process of separation of colloid from crystalloid bodies, not infrequently used with considerable success in some technical operations, and to which therefore a laboratory apparatus should be readily adaptable. It will therefore suffice for present purposes to classify with the types of filtration before given:—

E. *Dialysis*, or the separation of colloid from crystalloid bodies in solution.

Apart from the structural provisions requisite to be made in order to enable an apparatus to fulfil all the conditions noticed, it is perfectly obvious that judicious selection of structural material is desirable, so as to afford a practical margin of resistance to the action of the various substances experimented upon. Where mineral or vegetable acids are present to any extent, the use of iron, and in some instances copper, or certain alloys of copper, is most undesirable in all parts coming into intimate contact with the substance. With alkalis, on the other hand, although iron can be used with advantages most alloys of copper are inadmissible. In both cases, although certain alloys of lead and antimony, or even tin, give fairly good results, their softness and want of strength, as well as their weight, render their use most undesirable. This is particularly the case as far as the filtering diaphragms are concerned, for not only have these to be handled frequently and easily without any great risk of damage, but if corrosive action of any kind does occur, the favourable conditions of the large surface exposed to the action of the liquid in close contact, and its continual renewal, soon causes their destruction, or at all events an undesirable contamination of the products of filtration.

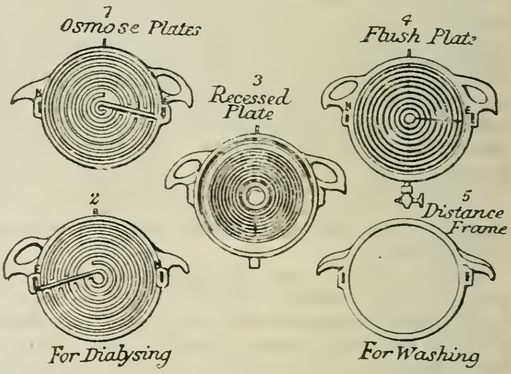
The material which instinctively occurs to the mind first is glass, but the difficulties of forming such diaphragms are not only material, but considerations of cost and friability largely discount the advantages it otherwise presents. A perusal also of the results of experiments recently published in this Journal, shows somewhat startlingly the fact that the solubility of glass even in water, more especially in the presence of alkalis, is greater than is generally supposed.

After careful experiment, the most favourable material for the construction of the parts subject to action appears to us to be the form of camphorated nitrated cotton known as "celluloid" or "xylonite," and in the machine shown this has been employed wherever practicable; in fact, the diaphragms throughout are constructed of this substance. The conditions of lightness, strength, and rigidity, and the high power of resistance to corrosive action, are thus all fairly secured. The process of moulding and the time occupied in preparation, as well as the production of expensive dies, have, after careful trial, been overcome; and such diaphragms can now be produced in almost any quantity, and even of considerable size at a comparatively low cost. In those portions of the apparatus, *e.g.* the end plates, the distributing valves and force pump, which are necessarily of a somewhat complicated character, and where considerable strength is requisite, metal is indispensable, and in this case no material seems to be more suitable than the bronze made from pure copper and aluminium containing 10 per cent. of the latter metal. Not only is its resisting power to corrosive action considerably higher than the copper alloys in common use, but immeasurably so in the case of some vegetable acids, *e.g.* lactic, citric, and tartaric acids; whilst its strength and durability, as well as the case of its manipulation by tools, is fully equal to that of "mild steel." When the initial difficulties of founding this alloy have been solved, articles of the most complicated character can be readily produced, the surfaces of which are susceptible of a high degree of polish, and the brilliant appearance is not readily destroyed by ordinary contact with the atmosphere, as in the case of most bronzes. In the machine shown all the portions above mentioned are constructed in this alloy, and those portions of the machine which are not likely to come into intimate contact with the substances experimented upon are, for the sake of lightness and strength, constructed throughout of steel.



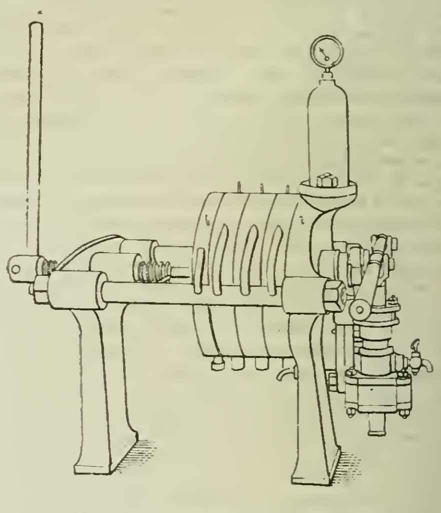
A few words of explanation will suffice to show the structural arrangements made to meet the conditions of the different types of experiment before mentioned.

The framework of the apparatus closely resembles that of an ordinary filter-press. Fixed to the head of the machine there is a small hydraulic pump for forcing in the material under pressure, a pressure chamber with a Bourdon gauge to register the pressure, and the rotary valve, which serves to direct the flow of the material experimented upon, or the solvents or other liquids used in the experiment, through the different passages to the interior of the chamber.



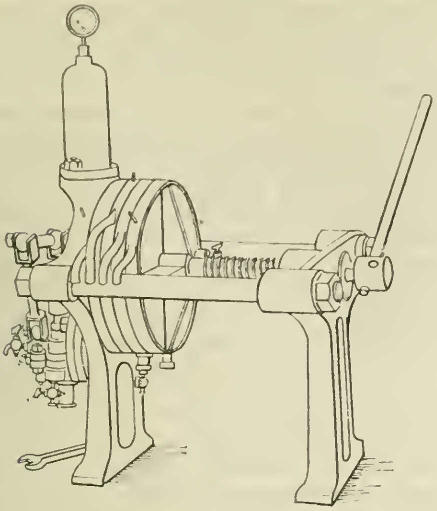
Experimental Chambers for all Types, A, B, C, D, E.

In experiments coming under type A the "recessed plates" are used, covered on both sides with a suitable filtering cloth. The depressions formed by the projecting rims of the plates, when in contact screwed up in the framework, form the chambers or cake spaces. The chambers are thus fed through the centre, the material entering them directly from the pump through the centre of the head, so that substances which are likely to form obstructions can easily enter the cake spaces without clogging or binding. The liquid expressed during filtration emerges through the small outlet at the bottom of each filtering surface, and can be caught in any suitable vessel.

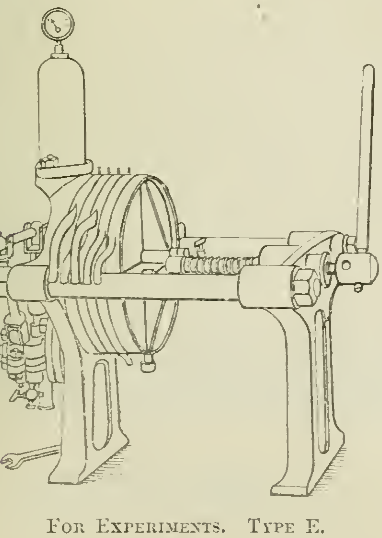


For Experiments, Type A.

In experiments coming under types B and D chambers formed by the "flush plates" and "distance frames" are used; in the former instance, B, to ensure the formation of a cake of fairly equal permeability, and so secure equal distribution of the lixiviating water, hence systematic displacement of the solid constituents of the cake; and in the latter case, D, to facilitate the removal of the filtering medium with its adhering deposit for further examination. These chambers can also be used when the filtration is accomplished through filter-paper, which can be readily applied to the flat filtering surfaces of the "flush plate." The *modus operandi* in experiments of this type is as follows:—The diaphragms, covered either with cloth or strong filter-paper, or even both in combination with each other, are screwed up in the frame, with the "distance frames" inserted between them. The distributing valve is set "to fill" and the operation of simple filtration effected in the usual way. The excess of material left in the pressure chamber is then run out through the waste cocks, and the distributing valve set "to wash." The outlet cocks on the head and follower, and the alternate plates similarly marked, are left open, whilst the remainder have their outlets closed. The lixiviating liquid is then forced in by the pump, and entering the chambers at the opposite side to that at which they are filled, arrives at the surface of the cakes next the filtering surfaces instead of the interior of the chambers, and is thus constrained to pass entirely through the body of the deposit in the chamber before it can emerge from the outlet cocks on the diaphragms which are not closed. Hence, it displaces before it the soluble constituents left in the cake from the simple filtration.



For Experiments, Types B, C, D.



For Experiments. Type E.

In the case of experiments coming under type C the alternate "flush plates," marked thus ●, only are employed, with the "distance frames" interposed; the outlet cocks of these chambers are closed, the distributing valve set "to fill," and the single outlet cock on the opposite side to the filling side opened, from which, in a single stream, the whole of the filtrate emerges, and can be conveyed through a tube to any desired receptacle.

In experiments on dialysis under type E the pump on the head of the apparatus is not employed, the distributing valve is set "to shut off," and the chambers, covered with suitable parchment septums, are screwed tightly in the frame in the order marked on them and shown thus—

● ●
● ● ● ●
● ●

A vessel placed above the level of the machine so that its contents can gravitate freely into the dialysing chambers, is connected to the horizontal cock at one end of the machine, whilst the other liquid, similarly placed, is connected to the other horizontal cock at the opposite end of the apparatus. The two liquids therefore run through the dialysing chambers in opposite directions, and each emerges through a cock at the end remote from that at which it entered. In their passage over the surfaces of their respective plates they are separated from each other by the parchment dialysing septum, and being compelled to follow the convoluted or helical channels formed on the surfaces of the chambers, flow first from the circumference of the plate towards the centre, and then, after passing through the centre opening, the direction of the flow is reversed from the centre towards the circumference. In this way they travel along a path of considerable length on opposite sides of each septum, but flowing in opposite directions, in thin streams, and hence under the conditions most favourable to dialysis. By multiplying the number of chambers, or by passing each liquid over and over again through the same chambers, the operation can be carried to a considerable extent. It may be mentioned that apparatus of this construction and of considerable size are now employed with apparently considerable success in separating the "meat salts" from the colloid substances which the brine employed in curing meat takes up.

The standard thickness of the cakes produced in the various filtering chambers is 0·75 in., but this can be readily increased to any desired extent by the further interposition of one or more of the "distance frames" as may be found necessary.

The following are the principal dimensions of the apparatus, which it may be useful to note:—The external diameter of the chambers 9 in., producing cakes 8 in. diameter. Filtering surface on each complete chamber 0·75 sq. ft. or 4 chambers = 3 sq. ft. Cubic contents of each chamber of standard depth 0·02 cub. ft. = one-fiftieth of a cubic foot. Length of travel on each dialysing plate 103 in., or, in a battery of four plates, the liquids travel side by side in a stream 0·35 in. wide, and 0·03 in. in depth, along a path 26 ft. in length.

In conclusion, an apparatus such as described offers facilities for obtaining exact results comparable to those yielded in large technical operations, and cannot but be found of value in every technical laboratory or works.

Discussion.

The Chairman said they were much obliged to Mr. Hutchinson for exhibiting this apparatus, which was so well arranged to perform all its various functions with efficiency, and it would be very useful for the many experimental operations which were now required to be on a larger scale than the ordinary laboratory appliances could cope with.

Mr. Thos. Tyrer asked whether Mr. Hutchinson had any data as to the results of dialysis on a practical scale, as such would be very useful.

Mr. De Mosenthal asked if it had been found that owing to the evaporation of the camphor the celluloid discs became spongy, and whether in that case certain acids, such as acetic acid, would not attack them. He would also like to know how long they would last when in such a condition. With certain kinds of celluloid this evaporation of camphor went on incessantly, until the matter really changed in its physical properties. Another question was whether Mr. Hutchinson did not find that aluminium bronze was affected by chlorine compounds, and particularly by hydrochloric acid.

Mr. O. Hamilton also asked if the effect of acetic acid had been tried on the alloy. Mr. Hutchinson had referred to several acids, but he had not mentioned acetic acid or acetate of ammonia. He was pleased to hear that Mr. Hutchinson had found that the chief difficulty with the alloys was the casting. He had also worked out a special alloy made on a very large scale indeed, and found that the chief difficulty was in the mixing. A great many alloys had been condemned as very inefficient simply because they had not been cast properly. He had made several from a known composition, and found that by taking special precautions in the casting they could be used with perfect safety for most things, but acetic acid and acetate of ammonia were the worst things to deal with. Where there were traces of copper and iron they were very injurious.

Mr. T. S. Davis said that with regard to acetic acid, he wished to know if Mr. Hutchinson had tried a solution of about 5 per cent. or 6 per cent. mono-hydrated acetic acid, and if such would affect the alloy. It would be readily understood that he made special reference to the filtration of ordinary vinegar, because one had to deal here with a gelatinous compound extracted from the malt in connexion with this dilute acetic acid, which was rather difficult to separate, in fact so much so that there were very few metallic substances it would not act upon. In order to obtain vinegar in a bright condition it was usual to resort to subsidence alone, but this process occupied two or three months, and if a filter could be used it would very much facilitate the commercial production of the article in a bright condition.

Mr. E. J. Bevan asked if the xylonite was of the ordinary composition. It seemed to him that it was considerably heavier than ordinary xylonite, and he should like to hear something about the composition of it.

Mr. C. C. Hutchinson said, in reply to Mr. Tyrer, that he had not given any data in his paper relative to the dialysis of different materials, and he thought that it was perfectly obvious that unless very large portion of the columns of the Journal could be devoted to this purpose, it would be useless to make such an attempt. However, he would be very glad to give Mr. Tyrer information on any particular form of dialysis in which he was interested.

The next question that had been asked was whether the celluloid diaphragms became spongy by the evaporation of the camphor, which was an ingredient of this substance. Diaphragms of this material, even of large size, such as those exhibited, had been used with great success for some three or four years. No sponginess of the kind had ever been observed, and the diaphragms were in just as good a condition as when they had been originally made. This of course was due to the care bestowed upon their preparation, and it might be parenthetically mentioned that a very considerable period of stoving was necessary, as well as a very high pressure, under which the diaphragms were moulded, in order to secure such a result, and this material had not been brought under the notice of the members without being subjected to very stringent and rigorous tests.

Some apparatus of this kind had been employed in the filtration and treatment of vinegar for upwards of two years, and no corrosion or sponginess had yet been observed.

With regard to the effect of hydrochloric acid or chlorine upon the aluminium bronze, of course if these substances were in a concentrated form the aluminium bronze would be attacked, because the hydrochloric acid would dissolve out the aluminium; but with solutions which had to be dealt with in everyday practice, in which hydrochloric acid was not in a high state of concentration, this alloy would resist the action of such acid better than any other copper alloy with which he was acquainted. A solution of chlorine had not nearly the same vigorous action on this or other alloys of copper that hydrochloric acid had.

With regard to acetic acid and acetate of ammonia, aluminium bronze had a far higher resisting power than any form of bronze with which he was acquainted, and it was perfectly certain that there was a great field for its use in apparatus and plant, not only filter-presses, but cocks, valves, and pipes in which such liquids had to be dealt with.

With regard to casting the alloy, the member making the inquiry appeared to him to have had some experience in the matter. It was necessary to exercise the greatest care and precaution in making such alloys in order to secure a good result, and for want of experience and care, as well as patience, negative results were often obtained when there was not the slightest reason why success should not have resulted. It was a fallacy to suppose that by simply taking two or more metals and melting them together in the usual way in one operation that a uniform alloy could be obtained. It was nothing of the kind. Not only was the purity of the materials an absolute necessity, but it appeared to be necessary to repeat the operation of alloying or melting more than once or twice, in order, as it seemed, to bring the molecular structure of the metals more closely into intimate contact. This was more particularly so in the case of some alloys than of others. For instance, with the aluminium bronze shown, the operation of re-melting had been carried out some six or eight times, and unless this was done a very considerable amount of segregation was the result, and an alloy of very variable composition was obtained. It was one of the peculiar properties of aluminium bronze that, however many times it was melted, the actual ultimate composition did not seem to vary. The aluminium remained present in just the same quantity in the sixth or eighth melting as at the beginning. If it were melted only once or twice, and a bar then cast were fractured, segregation could be easily seen even without the aid of a lens, and it was only after repeated meltings that this appearance vanished and a true alloy appeared to be obtained.

The strength increased very considerably, as a matter of course, with each melting; that is to say, with the actual formation of the true alloy.

With regard to the filtration of vinegar, that was a very interesting subject, but there was no difficulty in securing an ordinary bronze, such as an alloy of copper and tin, which was practically resistant to acetic acid, if the precautions which had been pointed out as to the absolute purity of each metal and the conditions of re-melting were secured.

It was doubtful, however, if filtration of any sort would effect very much in the case of vinegar, unless it were followed by another treatment. In brightening vinegar, the substance which was removed was an excessively fine growth, and no filtering medium which had hitherto been used had been fine enough to keep back the whole of the small portions of this vegetable growth, or the spores which would give rise to a fresh growth. Consequently no matter how bright vinegar might be filtered, the cloudy appearance again soon became manifest because a fresh growth arose. If the vinegar maker wished to brighten his vinegar quickly, he would have to look in another direction. He had before suggested that it should first be filtered and then "pasteurised," so as to entirely destroy the spores of the plant, and this, it might be mentioned, had been used with considerable success, at his suggestion, in dealing with a material where the same thing occurred.

In reply to Mr. Bevan's question: — Yes; this was ordinary celluloid, but it was prepared in a special way which he did not feel he was at liberty to describe. The experiments had been attended with a considerable amount of cost; but he could tell Mr. Bevan one thing, and that was that it had been compressed under a pressure of about 4 tons to the inch.

COMPOSITION OF THE PETROLEUM-LIKE BITUMEN OF JAPANESE COAL.

BY WATSON SMITH AND J. C. CHORLEY.

In the first description I gave of that remarkable coal from the Miike mines in Japan, and more particularly of the character of the bituminous matter disseminated through it (this Journal, 1891, 975—980), I referred (*loc. cit.* page 979 and 753) to Zaloziecki's theory of the formation of petroleum (which this bitumen so greatly resembles) from animal remains exclusively, and ventured to point to the greater probability of such a source being rather contributory than exclusive. Zaloziecki has detected small quantities of pyridine and similar bases in crude petroleum, and points to the fact as confirmatory of his view. The small quantity of such bases present, however, rather indicates—if it indicates anything in that direction—that the animal remains form but a contributory source. In my last investigation, already referred to, not having sufficient of the bitumen at command, I failed to detect any bases, though I did find small quantities of phenols. By taking for extraction, in the present investigation, a much larger quantity of the Miike coal, viz., 5,000 grms., I have been able to obtain very distinct evidence of the presence both of phenols and of nitrogen bases, specimens of which I have now pleasure in showing. The odour of each is distinctive enough, as you will perceive.

The coal extracted chiefly consisted of that from the Miike mines, but some portions of it appeared to consist of other varieties, yielding much less bitumen.

About 5,000 grms. were extracted with benzene, which had been dried well with calcium chloride, and redistilled, only that portion coming over below 95° C. being accepted. 252 grms. of bitumen were obtained after distilling off the benzene, and then passing dry air through the mass kept at 100° C. This was now distilled, and the fractions were collected as follows:—

——	° C.	Grms.	Per Cent.
I.	100—150	15·0	6·0
II.	100—200	7·5	3·0
III.	100—240	3·0	1·2
IV.	100—280	9·0	3·6
V.	100—300	9·5	3·8
VI.	300 and over	14·5	5·8
VII.	..	22·5	9·0
VIII.	..	40·0	16·0
IX.	..	10·0	4·0
		131·0	

The residual pitch weighed 119 grms.

I. and II. were mixed together and the mixture marked A.

III., IV., and V. were mixed together and the mixture marked B.

VI., VII., VIII., and IX. were mixed together and the mixture marked C.

The specific gravities of these oils, A, B, and C, were now determined.

Specific gravity of A = 0·858.
" " B = 0·910.
" " C = 0·978.

Each portion named respectively A, B, and C, was now treated by Helbing and Passmore's method (this Journal, 1892, 848) for the separation of the phenols and bases, my desire being especially to ascertain if nitrogen bases really are present.

Phenols:—

A. Yielded only traces of phenols.
B. Yielded rather more of phenols.
C. Yielded about 1 grm. of the crude phenols.

Nitrogen bases.—In A and B no appreciable amount of bases was discovered.

In C there was a distinct, though small quantity, which I now show; the smell resembling pyridine and quinoline, is quite plain and sufficiently characteristic.

Aromatic Hydrocarbons.—There is no doubt that amongst the hydrocarbon oils, and especially the fraction distilling at 150° C., there is a small quantity of aromatic hydrocarbon present, for I obtained a nitro product smelling like nitrotoluene or nitroxylene, and sinking in water in oily drops. A small portion of the hydrocarbon also absorbed bromine directly, without evolution of HBr.

Now since this Miike coal is an advanced bituminous lignite, we have in the presence of so much of the bitumen, or, shall I say, petroleum, in it, an interesting indication of something like the degrees of temperature which arise and exist during that remarkable process of conversion of vegetable (along with some animal) matters into the fossil condition of coal, termed by the geologist, the "mouldering process." Of course this heat of the mouldering process is also accompanied with great pressure, but it suffices for first of all drying the mass, and then for submitting it to a very slow and gradual destructive distillation, lasting through ages, such that at all events a portion, if at length (as in the older fossil of the secondary formations) a very minute portion of the liquid and solid products remain behind in the mass of the coal produced. This is, I think, the first distinct evidence we have of this fact, for here I can place before you such substances as paraffin, higher phenols probably containing pseudocumenol, &c., naphthas, containing paraffins, with unsaturated hydrocarbons and small quantities of hydrocarbons of the benzene series, and nitrogenbases.

My experiments, resulting in the isolation, or identification, of such individual substances as I have named, now show me also that these coal resins are not, as I first thought, the resins of trees and plants of a former vegetation on the earth, but merely the tarry or bituminised remains of these along with other matters. Clearly the heats of the mouldering process are too great to have allowed any original resins, fats, or distinct organic matters to remain unaltered, undecomposed. All have suffered a kind of gentle destructive distillation, extending over immense periods, and the question naturally arises: What has become of the vast quantities of oils, naphthas, and gas, represented thus by so many of our coalfields of the secondary geological period, the coal of which, however bituminous, seldom contains 1 per cent. of this bitumen? This Miike coal, containing nearly 10 per cent. of the bitumen, forms an interesting exception, and at the same time helps us to a solution of this bitumen question, though it be indeed, as would appear, a tertiary coal or lignite.

I cannot but point, in my reply to such a question, to the vast collections of gas and oils stored up in the Caucasus, Baku, Pennsylvania, and elsewhere. Those oils are very similar to those which I have distilled from this Japanese coal-bitumen, and both contain small quantities of aromatic hydrocarbons, small quantities of phenols and of nitrogen bases. The hydrocarbons also agree in odour, in fluorescence, composition, and general character, the differences as to precise character of the bulk of hydrocarbons of the fatty series, present respectively in American and Russian petroleums not affecting my argument, since such differences will probably be functions of subsidiary matters, such as temperatures, proportions of certain of the matters undergoing the "mouldering" decomposition, &c.

Discussion.

Mr. Hamilton said anyone comparing Japanese coal with English would be almost compelled to agree with Mr. Watson Smith's argument, because Japanese coals had lost the beautiful sparkling lustre characteristic of many coals in England or on the Continent. These coals possessed a certain brown, dead appearance like the mass obtained in a filtering press at extreme pressure; they had lost their brightness and got this dense appearance, which was probably obtained by subjecting ordinary coal to very great pressure and heat.

Mr. Cresswell said he should think that the reverse of the process Mr. Hamilton suggested was the case; that the Japanese coal had not been subjected to anything like so great pressure as English coal. The fact that all the resinous and bituminous matter had been removed from coal pointed rather to greater pressure than less. Lignite, or that form of coal which was very prevalent in Italy, was always regarded as being produced under less pressure than English coal, and that had a very similar appearance to the Japanese coal. Then came the question of the petroleum formations; they must always expect to find them in newer formations than the coal measures. Although there was reason to believe that the coal measures underlay the major part of this country, still no quantity of petroleum had been discovered anywhere in the United Kingdom, with the exception of such petroleums or bodies of a similar nature as were found in the Scotch shales. The Salt Union had been engaged in boring a long time for petroleum somewhere in Cheshire, and, so far as he had heard, had not met with the slightest success. At any rate, the idea that the bituminous coals of England, which were brighter and more like jet, should have been subjected to less pressure than the coals of Japan, seemed to require a little further explanation before it could be accepted.

Mr. Sutherland said there were some interesting papers in their own journal a little while ago by Mr. Steuart, of Broxburn, on the discovery of petroleum shales in Scotland. No doubt it was thought at one time that this petroleum had been produced by fires in mines, but the characteristic odour of petroleum was very different from anything which would have been produced in that way, and Mr. Stewart had no hesitation in saying that that was petroleum. He should like to ask if Mr. Smith had given the specific gravity of any of the higher fractions, and if he had determined the paraffins in any way by taking the bromine absorption.

Mr. MacEwan said he had seen petroleum obtained in England very much resembling the higher fraction that Mr. Smith had obtained. He believed the locality was somewhere in the extreme north of England, and the characteristics were undoubtedly those of crude petroleum. It was used by a London firm in the manufacture of a purified petroleum jelly.

Mr. Watson Smith, in reply to Mr. Hamilton's remark, said there was little doubt that this Miike coal was a lignite. The amount of lime in the ash was enough to show that, for that was a good index of the character of shale and general substratum, indicating that it was cretaceous. The coal was thus a tertiary product and accordingly contained a large quantity of lime in its ash. Another indication was the brown dust on the surface. It easily pulverised and gave off this brown dust. It was of lower specific gravity than ordinary bituminous coal. Our coals in England were of the secondary formation; that is to say, the true coal measures. He did not think we had any lignites like this in England. It was a mistake to suppose that petroleum had not been found in England; the fact was that the petroleum industry was started with English petroleum at Alfreton, in Derbyshire. The late Dr. Jas. Young and Mr. Binney, of Manchester, started the business there, but later on it was found that the Scottish cannels afforded on distillation at low temperatures a more lucrative produce; then the Bog-head cannel was taken up. There was a celebrated lawsuit fought over it, the question being was Bog-head a true cannel or merely a bitumen. A single fossil in the Boghead mineral would have given Mr. Young immediate victory. W. Boyd Dawkins has recently found in an exact counterpart of this Scottish Boghead (now extinct) in Australia, a distinct fossil or two. With regard to the remark Mr. Sutherland made, he might say he intended to make a further examination of this bitumen when he had extracted a much larger quantity of the crude substance from about 2 cwt. of Miike coal which he had just received. He intended to investigate the more precise nature of the hydrocarbons present in it. This Japanese lignite was actually used—all that could be supplied—by the North German Lloyd steamers on their return journeys, and it was rather remarkable that lignite should turn out to be so excellent a steam-raising coal. He understood that these steamers were often recognised at sea by the other steamers from the intense black smoke which they put forth when just freshly firing up, and there was no wonder at it. The effect of putting a fresh lot of this stuff on a fire would be something equivalent to taking a quantity of crude petroleum residue, throwing it on the coal, mixing slightly, and then firing up with that.

ADJOURNED DISCUSSION ON MR. WARINGTON'S PAPER ON "THE DETECTION AND ESTIMATION OF LEAD IN CITRIC AND TARTARIC ACIDS."

The Chairman said he understood Mr. Warington wished to make a few remarks before the discussion took place.

Mr. Warington drew attention to a few figures he had put on the board showing the amount of lead he had found in certain effervescing powders. He had received the following letter from Dr. Attfield as a contribution to the discussion:—

"The statements in the British Pharmacopœia respecting citric and tartaric acids, that an aqueous solution is not altered by sulphuretted hydrogen, means, obviously, that the compilers do not recognise the presence of lead, tin, or copper in either acid. There is no reservation as to the strength of the aqueous solution or as to the reagent being dissolved or in bubbles, notwithstanding any slender foundation in the book for any such forced interpretations."

* * * * *

"But why attempt to set numerical bounds to bagatelles? Where are the lines to be drawn? Why even at one per million?"

He did not exactly understand what Dr. Attfield meant, because the Pharmacopœia had clearly set a limit to the amount of lead in tartaric acid and citric acid by saying that they must not be affected by hydrogen sulphide. He wished especially to point out that this test fixed a different limit for tartaric as compared with citric acid, that it passed an amount of lead in tartaric acid which it would not pass in the case of citric acid, and that, therefore, it would be far more scientific to have a fixed numerical standard.

Mr. E. J. Bevan said he should like to say a few words chiefly from the point of view of the estimation of lead in such substances as lemonade. It was perfectly clear from the paper, and he had verified it himself during the last few days, that an estimation by the colorimetric method of the amount of lead by a comparison with the known quantity of lead in distilled water was fallacious. In some cases he believed analysts had reported that things were contaminated with a certain amount of lead, whereas in reality they had only about one-fourth the quantity. He had made some determinations of the amount of lead necessary in water to bring the colour up to the same tint as the same amount of lead in solution of citric acid, and he found, under the conditions under which he worked, about four times as much lead could be put into the water before the colour arrived at the same tint as in the case of citric acid. As this method was one very largely used, he was afraid that in many cases the amount of lead had been largely over-estimated. There was a point of view from which one might look at the presence of small quantities of lead as decidedly injurious. If lead were present even in such small quantities as to have no serious effect in itself, what was there to prevent the maker some day being a little more careless and putting in a larger quantity? Therefore it was quite right that the authorities should see that the manufacturers did not allow even small quantities to be present. With regard to the colorimetric estimation of lead, he would point out also that even the presence of sugar increased the reaction very considerably. If you took two vessels each containing the same quantity of lead and water, and one containing a considerable quantity of sugar, and added sulphuretted hydrogen water to each of them in the same proportion and under exactly the same conditions, the one containing sugar would be nearly twice as dark as the other. He was going to make a large number of experiments on both citric and tartaric acids with sugar and various other substances, and hoped to bring forward the results on some other day.

Dr. C. R. Alder Wright said the chief conclusion to be drawn from Mr. Warington's research appeared to him to be a matter already pretty well known to most physicists at any rate, viz., that through differences in the condition of molecular aggregation a given precipitate thrown down in the presence of other substances was apt to vary considerably in appearance. In consequence, the colorimetric method was open to such wide sources of error as to be in many cases utterly untrustworthy. Even in so simple a matter and where the conditions varied so little as the determination of "albuminoid" ammonia by the ordinary method of Nesslerising (Wanklyn's test), most people found that unless they worked exactly by a certain routine, the results were apt to vary within tolerably wide limits. More especially, the presence of a small quantity of manganese compounds spirted over with the distillate caused a very considerable variation in the depth of tint produced by a given quantity of ammonia. When one came to consider the mode of production of a minute quantity of a coloured precipitate—that is to say, solid matter in an extremely finely divided state—disseminated in a liquid, it was obvious that the presence of comparatively large quantities of other matters might, and in most cases probably would, affect the condition of molecular aggregation. For example, in the presence of a given quantity of citric acid or sugar, or this, that, or the other body, the particles of sulphide of lead might be aggregates averaging twice, three times, or four times as many molecules as the molecular aggregates produced under other conditions; it might be that in the presence of other bodies still larger aggregates were developed; or the opposite might hold, the aggregates being larger in the absence of other matters in solution. There was a large bulk of evidence tending to show that in many cases different molecular aggregates were produced under different conditions as regards the presence of other substances; the result of which would be that the degree of opacity or the effect on a beam of light passing through or reflected from the liquid in which the precipitate was suspended, must of necessity vary with these conditions. It almost came from first principles that you could not possibly expect to get the same tint produced when there were other substances present in the solution, that you would get when they were absent. It was practically almost certain that the depth of colour would necessarily differ with the nature and quantity of other things present. Another conclusion to be drawn was, that there appeared to be rather a tendency to use rough and ready methods of analysis instead of accurate ones in the case of the tests made by professional analysts in such cases; which perhaps might be explained by fees being charged for the work to be done, too low to permit of much time and skill being employed.

Mr. H. R. Smith (Teschemacher & Smith) said he should confine himself to the question of the actual "detection and determination of lead in tartaric and citric acids." He did not quite understand why Mr. Warington had given such a preference to a method which would generally be admitted to be a troublesome test and liable to vary, from the difficulty of judging the perfect similarity of colour between two solutions. He thought that a much more exact method would be the incineration of tartaric or citric acid, and in the resulting ash the determination of lead could be made to such a degree of accuracy that even 0·0001 per cent. in the original acid could be found. To most chemists this would seem to be the more satisfactory method.

Referring to the standard of the Pharmacopœia, he admitted it was rather a rough one, but still it was a somewhat curious fact that many chemists had come to the same conclusion as Mr. Warington—that applying that test carefully to a dilute solution any point exceeding 0·001 per cent. was distinctly shown by sulphuretted hydrogen gas. Mr. Warington at the close of his paper suggested that samples should all be tried by the "ammonium sulphydrate test," but if that method were employed any insoluble lead would also be shown as in the "incineration test," although anyhow it would be difficult, and perhaps inadvisable, to attempt to separate these. The total lead in the sample should be shown, although the insoluble lead may not be so injurious as the soluble. The limit Mr. Warington suggested, viz., not exceeding 0·0005 per cent. lead, would mean a manufactured acid of extraordinary and most satisfactory purity in this respect. He was rather surprised that such could be made, as it seemed that sulphide of lead was soluble in a solution of tartaric acid—1 in 10. Mr. Warington had not stated whether, before ultimately crystallising the acid, he had removed the lead in a more dilute solution than 1 in 10; if not, one would expect to have as much as 0·005 per cent. in the purified crystals. He thought the suggested limit, 0·0005 per cent., was an extremely, and probably quite an unnecessarily low point to fix for the maximum total lead.

Mr. E. J. Millard asked what would be the cost of this absolutely lead-free tartaric acid. Mr. Warington was probably aware that for some time one of the chemical makers had offered tartaric acid absolutely lead free, but at a price practically prohibitive, viz., six or seven times its market value. If this acid were produced at a price of say 10 per cent. or 20 per cent. above the market price, it would be accepted very freely indeed by all the wholesale trade, but the attitude taken up by the manufacturers had hardly been satisfactory. At first they were anxious to state that the Pharmacopœia test was indefinite, which was true; and also that it was too delicate, which Mr. Warrington had shown to be the reverse. With regard to Dr. Attfield's letter, he took it that he meant to infer that the tests for lead in tartaric acid would be revised, and probably the basis would be, not sulphuretted hydrogen, but ammonium sulphide. The curious point Mr. Warington referred to was the probable presence of arsenic or tin in glycerin. Mr. Siebold some years ago showed that arsenic was very frequently present to the extent of 1 part in 4,000 of commercial glycerin, but he also showed that the glycerin obtained by the steam-distillation method, such as was employed by Price's and several other firms, was absolutely free from any trace of arsenic. He was confident that if an acid could be produced absolutely lead free at a moderate cost, it would be in a great measure owing to the researches of Mr. Warington.

Mr. J. C. Umney said he should like to add a word from the distributor's point of view. From what he gathered from Dr. Attfield's letter, until this standard in the Pharmacopœia was revised a difficulty would arise naturally as to the application of this test. Apart from Mr. Warington's paper it appeared to be very important that some standard should be fixed. Of course it could not be fixed authoritatively, but some standard should be made which might be taken as a basis. The standard proposed by the Chemical Section of the London Chamber of Commerce consisted in the addition to a certain amount of solution of tartaric and citric acid, or making up to a certain volume with a solution of sulphuretted hydrogen, fixing a different standard for tartaric acid to that for citric acid; but until this was actually cleared up the same difficulty would arise. If tartaric acid were not obtainable absolutely lead free he believed at the present time it was possible to obtain it for not ½*d.* a lb. above the usual price which did not contain more than seven or eight parts per million of lead.

Mr. Thomas Tyrer, after referring to the great inconvenience, and even hardship, which had arisen from want of both uniformity of methods of analysis and definiteness as to standards of purity, said that analysts should agree upon the procedure and abhor the deplorable looseness of the British Pharmacopœia. Mr. Hodgkin (of Hopkin and Williams) had said at the Pharmaceutical Conference in Edinburgh last year, that the way to get good chemicals was to pay a proper price for them; but he thought there was a better way—eliminating bad chemicals—viz., by adopting rigid tests for them, when prices would soon be determined, The present standards for these acids according to the tests of, and applied according to, the British Pharmacopœia, were too low. He confirmed Mr. Warington's experiments and results, and with regard to the glycerol test wished to remark that he had experienced no difficulty in obtaining glycerin free from impurities indicated by H_2S. Further, he was inclined to agree with the criticisms of the colorimetric test until this suggestion of the addition of glycerol which—due probably to the causes indicated by Dr. Wright—assimilated the physical conditions of the solutions. He regretted the absence of the late President of the Society of Public Analysts, Mr. Otto Hehner, who, if not away from London on business, would have offered instructive observations from his extensive experience, and fully corroborative of the looseness prevailing on this matter. He (Mr. Tyrer) had seen some results of analyses, chiefly of aërated waters, lemonade, &c., and while the total metals precipitable by H_2S in no case were seriously large, yet of these totals an average of one-third only was referable to lead. As to the lead reported by Dr. W. R. Smith in the Woolwich case as 0·0026 per cent. in the tartaric acid in question, and stated to be a "poisonous" quantity, was not the correct word "innocuous"?

Mr. Warington: "Poisonous quantity" was the expression used in the "Chemist and Druggist," and I have no other authority.

Mr. Tyrer, continuing, said if the report was inaccurate it should be corrected, for Dr. Thomas Stevenson, F.R.S., whose reputation as a toxicologist none would dispute, was present in court was prepared to say that such a quantity of lead was innocuous. Nevertheless the public had every right to be protected, and he trusted that as the result of Mr. Warington's careful researches a definite method and standard would be determined upon, and, knowing what he did of the manufacturers, whom he was glad to see very fully represented in the room, he was quite sure they would be equal to the call of precision and purity.

Mr. Warington said he had been extremely interested with Mr. Bevan's remarks. The determination of lead in a substance like lemonade must be a matter of considerable difficulty; the amount was probably too small to be determined without previous concentration of the lemonade. If Mr. Bevan were to proceed a little further with his experiments, he would probably find that there was a strength of ammonium tartrate or citrate at which the lead colour was at its maximum. Then one must take care that there was both in the lemonade to be examined, and in the solution which was to be compared with it, that maximum amount of citrate present. By working in that direction one would be able to make a determination without any great error. We should probably find when we got near that maximum amount that small differences in the amount of ammonium citrate or tartrate did not matter much. He was very pleased that Dr. Wright had attacked the very difficult question why you got these very deep colours with lead in solutions to which ammonium tartrate or citrate had been added. Dr. Wright must admit that at all events the method which had been proposed for the determination of lead in tartaric and citric acid was free from any of the objections he had urged, because you could not have two solutions more similar than the solutions of tartaric or citric acid which were compared in this method. You could not say you had in one solution a quantity of unknown matter which was not present in the other. You had as near equality as it was possible to obtain in any chemical experiment, and might therefore sufficiently rely on the tint produced as really representing the lead present. Mr. Smith had suggested that it would be better to incinerate the acid. Now the incineration of a great mass of organic matter, in order to get a very small amount of inorganic matter present in it, was not a very safe process. You were sure to have some loss. Moreover, tartaric and citric acid were most difficult substances to incinerate. They boiled up to an enormous extent, and unless the chemist had a good muffle, and a great store of patience, he would find that incinerating these acids was a work of great trouble and annoyance. There was a very good question asked, and a very thoughtful one: how could you get tartaric acid free from lead when there was a certain proportion of lead which, when added to tartaric acid, you could not precipitate with hydrogen sulphide? You could get tartaric acid free from lead, because when a considerable amount of lead was present it all came down with hydrogen sulphide, if the solution were not too strong. It was this action of masses that the chemist continually met with when he began to make any intimate study of any chemical reaction. It was also said that the standard proposed of five per million was too low. It was not really so low as the Pharmacopœia standard for citric acid. It was, indeed, an attempt to bring up the standard for citric acid to what was the Pharmacopœia standard for tartaric acid. Then as to the question, could this pure acid be supplied without any increased cost? Of course there was an increased cost in the purification, but it was very small, and at the present time he believed that the London makers, who were supplying pure tartaric acid free from lead, were doing so without any increased charge at all; and therefore there was no excuse whatever if people continued to use tartaric acid containing lead. With regard to Dr. Smith's statement as to 0·0026 parts of lead per million being a poisonous quantity, it should be taken in connection with another statement of Dr. Smith, which all would agree with, that lead was a cumulative poison. That was the point which he principally dealt with; and he seemed to have thought it did not matter how infinitesimal the amount of lead taken into the system was, as it would go on slowly accumulating, and at last produce some disastrous result. He was afraid that he had carried that point a little too far. He could not but think that there was some means of discharging small quantities of lead from the human system; and if you did not exceed in the intake the amount of lead which naturally occurred in the output, there would be no serious risk in the matter. But of course when you came to take effervescing powders of which people took nearly an ounce at a time, and were recommended by the traders who supplied them to take this frequently during the day, you might take without much difficulty considerable amounts of lead, seeing that an effervescing powder would contain about 40 per cent. of tartaric acid, and the lead in that acid might run up, as they saw the other evening, to something like 190 parts per million. If lead therefore was a cumulative poison you would very soon have an amount which might be inconvenient.

Dr. Alder Wright said he should like to answer Mr. Warington's question with regard to an illustration of the fact that foreign bodies affected the molecular aggregation of a suspended precipitate. If you add ferric chloride to a highly dilute solution of ferrocyanide of potassium in the absence of saline matter to any considerable extent in the water, the precipitate was in such a fine state of division that it would pass through any filter that ever was made; but a comparatively small amount of a large number of ordinary salts would alter the character of the particles to such an extent that they could be filtered out through ordinary Swedish filter-paper. That was only one out of a large number of well-known instances where the presence of foreign matters altered the molecular aggregation of a precipitate. "Faraday's ruby gold," and many analogous finely-divided metals suspended in fluids which became coloured thereby, were analogous cases: the tints of the fluids varying according to the nature of the liquid and the substances dissolved therein. With reference to another point Mr. Warington touched upon in his concluding words, he should like to mention a case of lead poisoning in St. Mary's Hospital a few years ago. The patient was a cab-washer who washed the cabs plying at the Great Western Railway station, so that his duty took him out at the times when most other people were in bed, his work commencing at about 1 o'clock in the morning. Accordingly, when the neighbouring public-house opened first thing in the morning, he was ready for a meal. This man's *penchant* was for a beverage which he was informed was called "dog's nose," a compound of gin and porter. By-and-bye this man showed very decided symptoms of lead poisoning, and was brought into the hospital as a patient. The question arose, how had the lead got into him? and finally the suggestion was made that it had been derived from the liquids which he drank, which had mostly stood all night in the pipes of this public-house. A variety of samples of these liquids were drawn from the pipes, after standing therein all night, and were tested by him (Dr. Alder Wright), and he had also examined the pipes themselves, and found that the metal, instead of being pure block tin, was a compound containing a considerable amount of lead and other impurities. The result was that the gin which had stood in the pipes for six or eight hours contained a very appreciable amount of lead, and the malt liquors still larger amounts; so that even a few hours' standing in contact with metal containing lead caused a considerable amount to be dissolved. He might add that in this case the lead was determined by the incineration process.

ON A NEW SAFETY THERMO-REGULATOR FOR BACTERIOLOGICAL WORK.

BY DR. J. WILLIAM JAMES, F.C.S.

Probably the best-known thermo-regulator is that of Reichert; it has, however, this objection, that after a few days or weeks of use, depending upon the purity of the gas supply, the upper surface of the mercury becomes coated with a black powder (sulphide of mercury) which before long impairs the delicacy of the regulator, necessitating taking a portion of the apparatus to pieces for cleaning and subsequent resetting. This also applies to all regulators with oblique tubes, or where the gas comes into direct contact with the mercury. Another objection common, I believe, to all modifications which have emanated from Reichert's, is, that should the micro-burner by any chance become extinguished, the escape of gas as the incubator cools down is so much as to become a source of considerable danger. The only thermo-regulator in which the use of a float has been advocated, is that of Kreusler (Chem. Zeit. 8, 1321, September 1884, Ber. xvii.; Ref. 515), and this certainly overcomes the blackening of the mercury. A few words will make its construction clear. Between two ends of glass tubing which nearly touch, and fitting inside the main tube, is a glass float with a bulb at each end. When the centre or largest circumference of the upper bulb is opposite the space between the two tubes, the amount of gas passing through is at its minimum; and when the top of the bulb is about level with the space, then the gas supply is at its maximum. But I have not found such an arrangement to work satisfactorily: you either get too large or too small a micro-flame according to the distance between the ends of the glass tubes, and as the instrument should be made entirely of glass the necessary distance is by no means easy of adjustment.

Further, if the bulb of the float be not perfectly round, too much gas passes round it even at the minimum point, and should the incubator have got overheated, the micro-flame would not be small enough to bring it quickly back to its right temperature; then again, if the two ends of the glass tubing be so near each other as to permit of a very small flame being obtained at a minimum, the size of the flame at a maximum is insufficient for cold weather. The ball of the float must fit the tube accurately or the delicacy is insufficient for bacteriological research, and to get a bulb perfectly round and fitting the tube accurately is by no means an easy matter.

Repeated failures to obtain anything like good results by expending a reasonable amount of time, with Kreusler's modification, led me ultimately to the safety thermo-regulator now described.

The principle of this thermo-regulator is the same as that proposed by Reichert, depending upon the expansion or contraction of the mercury in C, which portion of the instrument goes inside the incubator. It is convenient to have this large enough to hold about 12 cc. of mercury—size 8 cm. long and 1·5 cm. diameter.

The tube B leading from the large mercury chamber is 4 mm. internal diameter and 50 mm. long, and in it the bulb of the float rests upon the mercury. This bulb should fit the tube well and permit of no lateral movement; the delicacy of the regulator is interfered with if the bulb be made too small. The upper end of the float, itself 40 mm. long, consists of a cone 4 mm. at its largest diameter, which is slightly ground into the opening, 2 mm. diameter, at the bottom of the gas-supply tube D; this effectually prevents any tendency to stick, and the accuracy obtained by grinding adds to the delicacy of the regulator.

The action of the cone in increasing or diminishing the aperture of the gas-supply tube is so sensitive that constant opening of the door of the incubator has no material effect on the temperature, and if the door be not opened the temperature remains within ± ·1° C.

The arrangement for shutting off the gas supply is very simple, merely being a glass bulb with a stem which is dropped into the gas-supply tube D; the stem of the bulb is placed inside the cone, and acts as a guide when the regulator is adjusted. This bulb is ground in on its side of D.

When the regulator is in work the bulb is slightly pushed upwards, but should the micro-burner become extinguished the mercury descends as the incubator cools down, and in a short time the orifice of the delivery tube D will be completely closed by the bulb. The contact line of the cone is shown by grinding in; the top of the cone is cut off and ground down until 1 mm., or rather less, above the line, which requires a contraction of only 1 mm. in the mercury column before the bulb closes the opening.

The tube A is 8 mm. internal diameter and 50 mm. long, and into this the gas-supply tube D accurately fits, its upper end being slightly enlarged. When covered with rubber tubing securely wired round A, the tube D is sure of being kept in the same position.

As will be seen from the sketch, there is a minute hole in the body of the cone. Usually there is sufficient space between the bulb and where it rests upon the cone for a very small quantity of gas to pass; should this, however, not prove to be the case when the regulator is set up and tested, a small knotch must be made in the top of the cone. In this way the micro-flame cannot be extinguished should the incubator by any chance get overheated. The door of an incubator must never be left open longer than is necessary to take out or replace vessels; neglect of this will produce a larger micro-flame, which quickly overheats the surrounding water. When the door is again closed the regulator is immediately brought to its minimum flame, and were no provision made to prevent the gas being entirely shut off, the flame in this case would be extinguished.

The regulator is set up as follows:—

Mercury is poured in until just above the joint of the adjusting screw, which is screwed out as far as possible, care being taken that no air bubbles remain between the mercury and the glass.

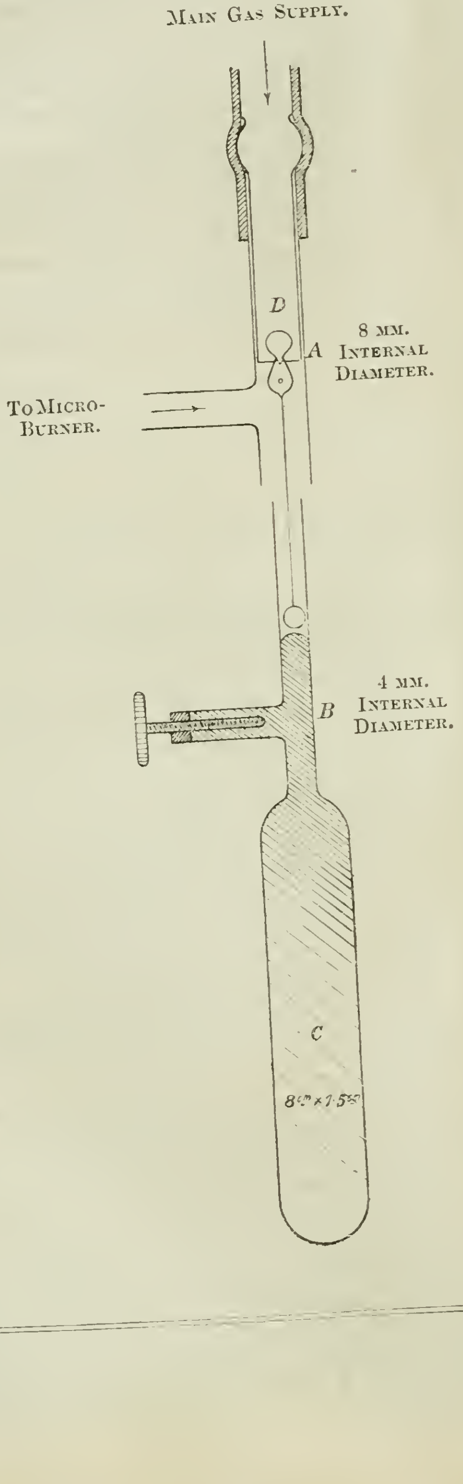
The float is now dropped carefully down the side of the tube, and the gas-supply tube with its bulb inside put in position. After fixing the rubber tubing from the gas supply, the regulator is put in its place in the incubator, which is heated gradually until within 5° of the wished-for temperature, or filled with water at the desired degree.

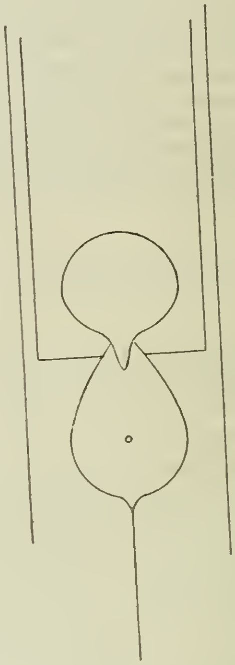
The mercury is next screwed up (pushing the float upwards, the cone of which must be manipulated into the opening in D) and the micro-burner lighted, the flame being kept at its maximum by slightly screwing out the regulating screw as the temperature rises. When the thermometer indicates the right temperature, turn the screw inwards until the flame just begins to get smaller. After this a slight adjustment of the screw in or out will be found sufficient.

elicacy can be obtained in two ways: either by reasing the diameter of B, in which the float rests, or by ing the cone of the glass float spherical, with a segment und off. With a 4 mm. tube all the necessary delicacy btained, and the float is preferably made conical, as in sketch.

As regards the temperature at which the gas is shut off, t of course depends upon the amount of drop given to bulb; the more the cone is ground down the less the l, and the less number of degrees the incubator would ve to cool before the gas was shut off. With a 4 mm. tube it is a simple matter to make the float so that with a fall of 5° the gas is shut off.

The screw for setting the regulator for any desired degree can be easily made with an ordinary 3-inch screw, vaselined, screwing into a piece of cork at the end of the tube, which will be found quite as accurate and convenient as a micrometer screw cemented in. Although this thermo-regulator is very easily constructed by anyone accustomed to ordinary glass-blowing, I may mention that it is admirably made by Geissler's successor, F. Müller, of Bonn.





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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

April 5th :—
Election of Officers, &c. for the Session 1893—94.
J. W. Kynaston. "Suggestions as to the Treatment of the Waste Gases of the Chance-Claus Sulphur Recovery Process."

May 3rd :—Geo. Tatè, Ph.D. "The Relation of Bacteriology to Industries."

Meeting held Wednesday, March 1st, 1893.

MR. HENRY BRUNNER IN THE CHAIR.

COKE-TOWERS AND SIMILAR APPARATUS.

BY FERDINAND HURTER, PH.D.

In two previous papers (this Journal, Vol. IV., 639, and Vol. VI., 707), I have brought before this section the results of some investigations partly theoretical, partly experimental, made to compare the efficiency of various modes of treating liquids with gases.

In the first paper I divided the apparatus usually employed into three classes, according to the mode of producing the contact surface, viz.:—

(1.) The gas, divided into small bubbles passes through a column of the liquid.

(2.) The liquid, divided into fine drops, falls through a column of gas.

(3.) Solids with extensive surfaces and interstices are covered with the liquid, the gas passing through the interstices.

In the two previous papers I only dealt with apparatus of the first description, and I shewed that for a given expenditure of mechanical work, the maximum effect was obtained when the gas is forced through a column of liquid, and allowed to issue at atmospheric pressure from the surface. I showed the properties of so-called distributors for the gas, and proved that the velocity of gas bubbles in a column of liquid was uniform and about one foot per second.

I also pointed out that this mode of treating a liquid with a gas, while applicable to finely divided solids in suspension, had one drawback, it does not permit us to apply in a perfect manner the principal of contrary flow of liquid and gas.

To-night I intend to bring this subject to a close by discussing on similar lines that almost universal apparatus the coke tower, as the representative of the apparatus of Class 3.

My work would however be very incomplete, if I omitted all mention of apparatus of class 2, in which a liquid is treated by a gas, by sub-dividing the liquid into drops (or spray), which descend through a column of gas; and as this mode of dealing with the problem of liquids and gases seems to have particular fascination for inventors, I shall pay a little more attention to it than is consistent with the title of my paper.

The method of causing a liquid divided into fine drops or spray to pass through a gas has been tried for various processes, but it has never been very successful. I shall not be far wrong in saying, that generally it has proved a failure. There are of course always cases, where from exceptional circumstances this method is the only one applicable, but whenever there is a choice of methods, the sub-division of the liquid into drops has been abandoned, and for good reasons, which I proceed to show.

Foremost among the causes which contribute to the failure of this mode of treating a liquid with a gas, is the relatively large bulk of the gas as compared with the bulk of the liquid with which it has to be treated. In nearly all technical processes, without exception, the volume of the liquid at disposal is but a small fraction of the volume of the gas with which the liquid has to be treated.

The following table does not profess to be accurate in any sense, but is intended to convey some idea of the relative amounts of liquid and gas which have to be brought into intimate contact in various processes.

The table gives the number of cubic feet or cubic meters of the gas, which must be treated with a single cubic foot or cubic meter of the liquid. The column headed V. gives the number of volumes of the gas which has to act upon one volume of the liquid in question.

TABLE I.

Process.	Apparatus.	Conditions.	V.
Manufacture of sulphuric acid.	Glover tower.	Chamber acid only treated	4,000
		Chamber acid and Gay-Lussac acid.	2—3,000
	Gay Lussac tower.	According to quantity of sulphuric acid used.	4,000—8,000
Condensation of hydrochloric acid.	Gossage's coke-tower.	Pan-gas only used, containing 33 per cent. HCl, condensed to liquid acid of 30° Tw.	600 to 800
	„	Muffle furnace gases, about 16 per cent. of HCl, condensed to acid of 30° Tw.	1,000 to 1,300
		Open furnace: about 10 per cent. HCl acid condensed to 20° Tw.	1,500
Recovery of MnO_2 Weldon.	Gas bubbling through oxidising column.	From practical work	100 to 200
Ammonia soda.	Solway tower.	Carbonating ammoniacal brine	300 to 400
Sulphur recovery (Chance).	Series of Chance's carbonators.	Carbonating calcium sulphide..	1,000
Coal-gas manufacture.	Scrubbers, &c.	Absorbing ammonia, &c.	800 to 1,000

The table is meant to impress the fact that in all technical processes the bulk of the gas is at least 100 times, more often 1,000 times the bulk of the liquid. Once this fact is clearly grasped it is easy to understand why the method of sub-dividing the liquid into drops is inferior to the method of sub-dividing the gas into bubbles.

Take the most favourable case, that of the Weldon process. Assume that the bulk of the gas is only 100 times that of the liquid. On the one hand subdivide the 1 cubic foot of liquid into drops, on the other subdivide the 100 cubic feet of gas into bubbles of equal size as the drops, and you see at once that 100 times the contact surface is created by the latter proceeding than by the former. If we had to subdivide the liquid so that the same contact surface should be produced, the drops would have to be one-tenth the diameter of the gas bubbles.

To me this consideration alone is sufficient to show the superiority of the process of subdividing the gas generally over the method of drops. But it might not be sufficient to others, and I therefore recall to you a fact dealt with in my previous papers. The effectiveness of any process of absorption depends in some way upon the number of molecules of the gas which impinge in a given time, say one second, upon the liquid. That number, unknowable at present, has been shown by Krönig, Clausius and Maxwell to be proportional to the surface of contact, to the time and to the pressure of the gas. In whatever way finally the result of the operation depends upon these three factors surface, time, and pressure, it can be shown that they are interchangeable. The time can be shortened if the surface or the pressure, or both, are increased, and *vice versâ*. For this reason I have defined a "unit of contact" to mean that unknown number of molecules which would impinge upon unit area in unit of time the gas being under unit pressure. If we take it that in most apparatus belonging to class 2 and 3, the gas is usually under atmospheric pressure, or differs but slightly from atmospheric pressure, we need not take any further notice of the pressure

Bearing in mind then that it is not the extent of surface only, but also the time during which the contact surface is active which determine the final effect, I proceed to compare the two methods from this point of view. In order not to fix our ideas at once upon a special case, I will state the problem generally. Let one volume of a liquid be treated with V volumes of a gas.

Assume that we force the gas through a column of liquid, dividing it into bubbles of radius r. The number of bubbles will be $\frac{3V}{4r^3\pi}$, the surface of each bubble is $4r^2\pi$, hence the surface of all bubbles together is $\frac{3V}{r}$. As the velocity of the bubbles is about 1 foot per second, the bubbles will be H seconds in ascending if H is the height of the column of liquid. Thus the value of the contact is the product $H \times \frac{3V}{r}$.

Next assume that we subdivide the 1 cubic foot of liquid into drops of the same radius r, and that we allow these drops to fall through the gas the height being again H feet. As before we find the number of drops in one volume of liquid to be $\frac{1}{\frac{4r^3\pi}{3}}$ the surface of each drop $= 4r^2\pi$, hence the total surface produced $= \frac{3}{r}$. The time which each drop takes to fall through the light H is $t = \sqrt{\frac{2H}{g}}$, and the product of the surface, and the time time which it lasts is $\frac{3}{r} \cdot \sqrt{\frac{2H}{g}}$.

The ratio of the values thus obtained for the two modes of dealing with the problem is independent of the radius of the bubbles. The product of the contact surface and time, which I call simply the contact, for the bubbles is $\frac{1}{2} \cdot V \sqrt{2gH}$ times as much as the value obtained for the drops. This expression shows that the contact obtained by the sub-division of the gas is as much greater than that obtained by the drops, as the volume of the gas is greater than that of the liquid, and as the average velocity of the drops is greater than that of the bubbles. To give an idea of what this means assume that the volume of the gas is 1,000 times that of the liquid, and that the chosen height is 8 feet, then the contact obtained by subdividing the gas is 8,000 times as much as that obtained by subdividing the liquid.

It will have become clear by this argument, that the second reason why the method of drops is not as good as the method of producing gas bubbles is to be found in the very short time which the drops only require to fall through a considerable height.

I can well conceive, however, that to some minds neither argument is convincing, since it might be much more than 8,000 times as expensive to divide the gas, than to divide the liquid, and in technical operations *£ s. d.* are of the greatest importance and finally decide every question.

Taking again the last example, the amount of mechanical work to be done in subdividing the gas corresponds to pumping V cubic feet of gas against the pressure of the column of liquid of height H. If the liquid were water, the work would be a little less than V × H × 62·5 foot lbs., the contact obtained for this expenditure of work was $H \times \frac{3V}{r}$ hence for every foot pound of work done we obtain a contact expressed by $\frac{3}{62{\cdot}5 \times r}$.

In the case of subdividing the liquid (say water) the only work we have to do is to raise the one cubic foot to a height H, this work amounts to H × 62·5 foot pounds. We obtain for this work a contact $\frac{3}{r}\sqrt{\frac{2H}{g}}$ or per foot pound $= \frac{3}{62{\cdot}5{\cdot}r} \cdot \frac{2}{\sqrt{2gH}}$.

The ratio of these two values is $\frac{1}{2}\sqrt{2gH}$, which means that per foot pound of mechanical energy we obtain as many times more contact with bubbles than with drops, as the average velocity of the drops is greater than the average velocity of the bubbles ($\frac{1}{2}\sqrt{2gH}$, being the mean velocity of the drops falling through height H).

From every point of view this method of dividing the liquid into drops is inferior, theoretically, to the method of bubbles, and from the purely practical point of view, the method is worse still. It is a well known fact that it does not require fine openings to subdivide the gas, if only the liquid through which the gas rises is in violent motion. To produce finely divided drops, on the contrary, is an almost insuperable difficulty. The rise of drops does not depend upon the inner diameter of a delivery tube, but only upon its outside diameter. To obtain small drops requires tubes of small exterior diameter, fine holes in plates are no good. The usual proportion is to use so called spray producers, apparatus in which a fine stream of liquid of considerable velocity is caused to impinge upon a flat solid surface or upon a second jet of liquid. Such apparatus frequently do not divide more than 50 per cent. of the liquid flowing through them into fine spray, the rest of the liquid runs away as a little stream, and the apparatus presents the very great difficulty of keeping the fine openings of the jets free from obstruction.

I will conclude this subject of drops by an account of a lamentable failure with a Gay Lussac tower. It happened that a large Gay Lussac tower had to be emptied. We heard of a method of using the tower empty, by causing the sulphuric acid previously filtered to be introduced into the tower through a number of spray producers. We decided to try this experiment. The spray was beautifully fine, but the drops descended the tower without visibly affecting the gas, and arrived at the bottom but slightly richer in nitrous acid, than they entered the tower at the top. The stopping up of the spray producers was a great trouble in spite of the precaution of filtering the acid. After about a weeks trial we repacked the tower with coke, and I for one shall not soon again advocate such a substitute for a coke tower.

The coke tower I hold to be at once the representative, and the most worthy representative of apparatus of the third class, where the liquid is subdivided by being spread over large surfaces of solids.

The construction and general arrangement of a coke tower I need not explain. Its history is also well known. Gay Lussac proposed it in 1827 for the recovery of nitrogen compounds in the manufacture of sulphuric acid, but the first coke towers were erected by Mr. Gossage for the condensation of hydrochloric acid in 1836.

We have seen that one of the causes why subdivision of liquids is not successful is the great velocity of the descending drops. If, therefore, we reduce the velocity of the descending fluid, we may hope to construct apparatus in which a great amount of contact is produced at very little cost. There is no material better adapted for the purpose of retarding by friction the flow of a liquid than the rough blistered surface of coke. I do not know the actual velocity of flow of the liquid inside a coke tower, but from small scale experiments which I have made I have reason to believe that the particles of water in a small stream require about two to three seconds to move round a piece of coke of about 2 inches average dimensions. Observations on large towers lead to the belief that about 10 to 15 minutes is the time of descent of a particle of water through a column of 40 ft. of coke. It is difficult to ascertain this correctly.

It is equally impossible to calculate the surface exposed in a coke tower. But it is easy to say what that surface must be at least as a minimum. In a coke tower about 60 per cent. only of its cubical contents are actually occupied by coke, and except at the bottom layer pieces not greater than 4 inches (and very often less) average dimensions are now generally used. If we calculate the surface of 4-in. globes, so that the cubical contents of these globes in the aggregate is equal to 60 per cent. of the cubical contents of the tower, we shall have the lowest estimate of surface which can be made for a coke tower, for the globe is that form which presents the minimum of surface for a given amount of cubical capacity. Proceeding on these lines we find that the least surface which is presented in a coke tower, with coke such as mentioned amounts to 10·8 sq. ft. per cub. ft. of tower capacity. In a coke tower 7′ × 7′ × 40· we should therefore have as minimum 21,168 sq. ft. of surface, but we cannot say by how much the real surface exceeds this amount.

The next question which arises is how long is this contact surface active upon the particles of a given stream of gas. That depends upon the rate at which the gas is caused to pass through. If we pass through the tower 20 cub. ft. of gas per second, these 20 cub. ft. will be in the interstices between the coke, which I have stated to be 40 per cent. of the capacity of the tower, the gas will, therefore, fill the interstices of 50 cub. ft. of the coke tower at any given moment, and will be in contact with the amount of surface contained in these 50 cub. ft. of space, *i.e.*, with 540 sq. ft. for such a length of time as is needed to traverse the whole tower, *i.e.*, to displace the gas contained in the interstices of the whole tower, which will take $\frac{1960 \times 0·40}{20} = 39·2$ seconds. Multiplying the surface 540 sq. ft. by the time 39·2 seconds we obtain 21,168 as the value of the contact, which acts upon 20 cub. ft. of gas, or per cub. ft. of gas passing per second the value is $\frac{21168}{20} = 1058·4$.

We perceive that the result is arrived at without the intermediate consideration by dividing the whole active surface by the quantity of gas passing per second.

This result may be written, if S is the total surface, and Q the volume of gas passing per second $= \frac{S}{Q}$; the fraction expresses the amount of contact surface which is available per unit volume of the gas for one second, and this number is independent of the particular form of the apparatus, or any of its dimensions, provided the current of gas pass through the whole apparatus, and not only part thereof.

In ascertaining the contact for the previous classes of apparatus, we had not to consider the question of how much gas was to be treated per second, because neither the velocity of the ascending gas bubbles, nor the velocity of the falling drops can be altered at will, they are given by the laws of gravitation. But in either case it is easy to calculate the amount of contact per unit volume of gas, and by doing so it is possible to compare any apparatus of any class as to their relative efficiency.

The general applicability of the very simple formula for the contact value $\frac{S}{Q}$ can be proved, but the amount of mathematics I would have to inflict upon you, makes it undesirable to go further into the proof, which resolves itself into a calculation of the probability that a molecule of gas will pass through any form of apparatus containing an absorbing surface, without ever coming in contact with that surface, due regard being paid to the mean length of straight path of the molecules, their velocity of diffusion, and the direction and velocity of the gaseous current.

It must not be supposed, however, that the chemical effect upon the gas is directly proportional to the fraction $\frac{S}{Q}$. If with 500 sq. ft. contact surface per cubic foot of gas available for one second, we can absorb 50 per cent. of the absorbable part of a gas, passing at a certain rate, it would be wrong to suppose that 1,000 sq. ft. would absorb 100 per cent. of the gas. It would even be wrong to suppose that the second 500 ft. would do 50 per cent. of what the first 500 left undone. All that the formula $\frac{S}{Q}$ expresses is that if for any two pieces of apparatus it has the same value, the result upon the gas will be the same, if for one apparatus it has double the value than for another, double the quantity of gas can be brought to the same final condition.

The formula $\frac{S}{Q}$ does not only compare the efficiency of different apparatus for treating gases with liquids. It applies also to apparatus where a solid has to be acted upon by a gas, or *vice versâ*, a gas by a solid. And in its application to these cases, it is easier to prove it experimentally. The formula as the result of mathematical operations is however equally the outcome of experience, being the necessary consequence of all those experiments which together form the basis of the kinetic theory of gases.

With this formula $\frac{S}{Q}$ as a measure of the contact, we will now compare apparatus of the various classes.

We found that in the particular coke tower the contact per cubic foot of gas was at least 1058·4. By sub-dividing the gas into bubbles of $\frac{1}{4}''$ diameter, we should obtain a contact surface of 288 sq. ft. per cubic foot of gas, and in order to make the contact equal to that of the coke tower, it would have to last $\frac{1058·4}{288} = 3·6$ seconds. This means that the gas would have to be forced through a column 3·6 feet deep. The expenditure of power to do this would be nearly (not quite) 225 foot lbs.

I have already shown that the work necessary to be done if the liquid is divided into drops is greater than that when dividing the gas into bubbles.

The expenditure of work in the coke tower is that of lifting the liquid to the top of the tower, the work done in moving the gas though the tower is almost negligible.

Even on the assumption that the liquid amounts to as much as $\frac{1}{100}$ of the volume of the gas to be treated the work for lifting the liquid is only 25 foot lbs. or only 11 per cent. of that necessary to obtain the same contact with bubbles. Thus the coke tower is by far the cheapest apparatus for obtaining intimate contact.

Another great advantage of the coke tower is the large amount of absorbing liquid which it holds, particularly when new, even one hour after the supply of liquid has been interrupted. Experiments which Mr. A. Carey has been good enough to make for me show that the coke contained in one cubic foot of a tower will hold—

After 2 minutes draining	3·85 lbs. water
„ 15 „	3·30 „
„ 60 „	2·80 „

This means that a coke tower of the size I have discussed contains while working about 7,500 lbs. of liquid, over and above that actually flowing, and one hour after shutting off the supply it will still contain about 5,500 lbs. of liquid. Thus small irregularities in the supply of liquid are of but little consequence, and alterations in the constitution of the gases are not so seriously felt as they would be if the stock of absorbing fluid were less.

For these many good qualities the coke tower has enjoyed for a long time a great reputation. But latterly it has been found fault with and its efficiency has been questioned more particularly for the following reasons. It is said (this Journal, 6, 586), that the interstices between the pieces of coke must be pretty large and very irregular, naturally the gas ascends by preference in the widest and straightest channels, and just these are evidently least supplied with water in comparison to the air space. Even in a properly packed tower the channels are comparatively very large and especially very irregular.

This is all very true, but these irregularities average themselves in a way that makes them the feature of the apparatus. The very irregularities of form and of size cause eddies or vortices in the gas which will secure a more intimate mixture than could be obtained by any other means. It is a great mistake, too, to suppose that because there are a few wider channels, the gas will go through these by preference. A careful consideration of the laws of motion of elastic fluids will dispel any such opinion. The pressure of the gas decreases uniformly from the inlet end of the tower to the outlet, and by reason of the differences of pressure between the successive layers, gas will pass through every crevice between those layers, the gas divides itself between the various channels (much in the same way as electric currents divide between wires of different resistances), however small, so long as there is an opening. Nor does the liquid descend as irregularly as the criticism implies. Special experiments which I made together with Mr. Carey have shown a much better distribution of the liquid than I expected to find under the circumstances under which the experiment was tried.

Upon the central point of a coke tower 4 feet × 4 feet in section a rapid stream of water was directed perpendicularly to the section of the tower. At the bottom of the tower the water was collected in a number of troughs, the quantity delivered per minute by each trough was measured, this experiment was repeated with different depths of coke, and with pieces of coke of different size.

The following table gives the results.

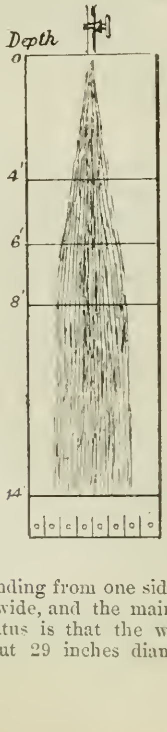
Table 2.—DISTRIBUTION of WATER by COKE TOWER.

Percentage of water flowing from each channel.

——	Depth of Coke.	Supply of Water.	1.	2.	3.	4.	5.	6.	7.	8.
		Litres per Min.								
Coarse coke	2′	?	..	..	..	48·0	50·1	..	..	..
	4	3·64	..	..	7·2	48·2	41·2	3·4	..	..
	6′	3·20	..	Drops	6·8	40·6	38·2	13·0	1·4	Drops
	8′	6·66	..	1·5	13·0	45	31·2	8·1	1·2	„
	14′	3·78	Drops	4·6	17·2	36	26·5	12·2	3·5	
Fine coke	4′	8·13	..	..	6·7	51·0	40	2·3	..	..
	4	1·74	..	Drops	5·0	55	39·5	0·5	..	..
	8′	6·56	..	„	9·0	51	33·0	7	Drops	..
With small splash plate	8′	9·94	Drops	1·71	10·3	46·1	31·3	8·1	0·6	..
	8′	3·49	„	Drops	8·0	41·0	41·0	10	Drops	..

I have attempted to indicate the general results also by a diagram, the liquid gradually spreads over a wider area down to 8 feet depth, from that to 14 feet depth the area does not increase very perceptibly. The diagram indicates the manner of collecting the liquid in troughs as well.

DIAGRAM of DISTRIBUTION of SINGLE GET of WATER in COKE TOWER.



Each trough, extending from one side of the tower to the other, was 6 inches wide, and the main result obtained by means of the apparatus is that the water spreads over a circular area of about 29 inches diameter in descending through a column of coke 14 feet high, and has nearly reached that distribution after a descent of four feet of coke. The distribution is not uniform over the whole area of the circle, the central portions receive rather more per square inch of the water than the circumferential part, as is shown by the following comparison of the amounts actually flowing from the channels, with those which ought to flow from them theoretically, assuming a uniform distribution over a circular area.

The slightly unsymmetrical distribution of the theoretical amounts is due to the slight eccentricity of the stream with reference to the bottom of the tower, the tower being probably slightly out of perpendicular. I need hardly say that a single jet is never used in practice, and that the water of each does not distribute absolutely uniformly over the area of flow is an advantage, because the water supply from several jets will then be all the more uniform where their areas of supply overlap each other. Thus all the practical and theoretical investigations of the coke tower have led me to the one irresistible conclusion that it is, if well constructed, one of the best contrivances for presenting a liquid to a gas. It gives a large contact for a very slight expenditure of power, and in this respect far surpasses any other apparatus known to me.

The most perfect substitute for the coke tower which is known to me is that beautiful contrivance, the plate tower of Messrs. Lunge and Rohrmann, parts of which I have here exhibited, I do not know which to admire most, the ingenious design of Professor Lunge or the perfect manner in which the design is carried out by Mr. Rohrmann. The apparatus has been repeatedly described in our journal and I may pass over a description of it, the more so as I have here a few pieces of the plates and also a distributor made by Mr. Rohrmann. You will all agree that the design of the plates and particularly the plates themselves are marvellous productions. To prevent a plate of 2′ × 2′, less than half an inch in thickness, from warping is decidedly a feature in the art of the potter.

Many substitutes have been proposed for the coke tower. Generally such substitutes consist of a chamber with shelves over which the liquid flows, the gas flowing in contrary

Percentage Distribution.

Depth.	Channel No.	2.	3.	4	5.	6.	7.
8′	27″ circle actual	1·5	13·0	45	31·2	8·1	1·2
	„ theoretical	3·3	21·7	27·5	26·8	19·2	1·5
14′	29″ circle actual	4·6	17·2	36·0	26·5	12·2	3·5
	„ theoretical	4·45	20·25	25·8	25·4	20·3	3·7

direction. When the liquid to be treated contains solids in suspension, the coke tower is not applicable and recourse must be had to these substitutes. It is, however, very difficult to obtain anything like as large a surface of contact by means of plain or corrugated surfaces as can be obtained by means of coke. We must not forget that the numbers I have used for the surface obtainable by coke are minima, and in many coke towers, much smaller pieces of coke are employed than those I have spoken of, so that fully double and perhaps treble the numbers which I have assumed are actually obtained.

The United Alkali Company have erected one of these plate towers at one of their smaller works, but I am sorry to say we have been too short a time at work to have obtained any decisive results as to its performance yet. Nor is the tower used as a substitute for a coke tower, it is used as an auxiliary chamber in the manufacture of sulphuric acid. I cannot therefore say whether the tower when used in lieu of a coke tower will fulfil the very sanguine expectations of its inventors. Professor Lunge thinks that it will probably do 10 times as much work as a coke tower of its own size. Since I have never seen so small a coke tower I cannot say what one would do, nor can I say that there are any theoretical reasons for expecting such results from a plate tower. I have carefully calculated the whole of the active surface of a Lunge and Rohrmann plate tower, containing 30 layers of 6 plates each 2 ft. × 2 ft. and each plate containing over 1,200 holes; the total area including upper side and under side of plate as well as the cylindrical surface of all the holes amounts to 1,742 sq. ft., and including the area of the holes 1,980 sq. ft. To this surface must be added the value of the surface of the drops of sulphuric acid assuming the tower to be used in lieu of a Gay Lussac. I have also calculated the value of this, for extremely small drops, and considering that the whole of the drops of sulphuric acid fall from shelf to shelf. I find quite in accord with what I have said before, that the value of the drops is so small, that it amounts barely to ½ per cent. of the value of the shelf-area. A tower of 30 plates occupies a space between its plates of 240 cubic ft., therefore we have in every cub. ft. of tower space 7·3, at most 8 sq. ft. of surface presented to the gas if we consider the under side of the plate equally as valuable as the upper side and the holes filled by a skin of H_2SO_4. I have shown that 1 cub. ft. of a coke tower presents 10·8 sq. ft. of useful area as a minimum, and it is difficult to see by what process of strictly accurate reasoning one can arrive at the conclusion that 7·3 sq. ft. of the smooth surface of pottery will do 10 times as much work as a minimum of 10·8 sq. ft. of rough coke-surface, which in reality may really amount to 20 sq. ft. It could only be so if on every square inch of the pottery surface there were 15 times as many molecules impinging per second than on a square inch of coke area. This would presuppose the equivalent of a pressure of 15 atmospheres.

Professor Lunge counts it as a disadvantage of the plate tower that it contains a very small amount of liquid; in a plate tower of the dimensions I have stated, there would be about 400 lbs. of water, whilst if the same tower were filled with new coke it would hold about 900 lbs. of water. This drawback is not, however, so great as it appears in the case of a Gay Lussac tower, because the pores of the coke soon become filled up, when it will not hold so much liquid. There are no pores to become choked in the plate tower, and that is an advantage.

It is but fair to Professor Lunge and to the coke tower to say, that the plate tower is supposed to be in series with a coke tower and not to be used independent of the coke tower, when it serves as Gay Lussac or as Condenser.

There is not, therefore, any immediate danger of Gay Lucca's and Gossages invention being totally forgotten.

The lessons which my investigations, partly theoretical and partly practical, have taught me are. (1.) That in apparatus for dealing with gases and liquids; the subdivision of the liquid into drops or spray is of little practical use and requires the expenditure of too much mechanical power for a given effect. The sub-division of the gas into bubbles forced through a column of a liquid is a better proceeding, but the cheapest mode of presenting a liquid to a gas is by means of a coke tower, and that it is difficult to combine by any arrangement of plane surfaces all the advantages which the coke tower possesses in so marked a degree. (2.) The comparative value of any apparatus for producing contact is the amount of total surface presented to the gas per cubic foot of gas per second. At first sight it might appear as if the formula $\frac{S}{Q}$ could not be a true measure of the value of such apparatus, since it apparently takes no account of the greater or less complete sub-division of the gas into numerous fine streams, but a little further reflection will show that it does do so.

The fraction $\frac{\text{Surface} \times \text{time}}{\text{volume of gas}}$ which I have given as the measure of the value of any apparatus of this description is in reality the inverse value of a velocity. The partial fraction $\frac{\text{Surface}}{\text{Volume}}$ is the inverse value of the average distance between any gaseous molecule and the absorbing surface. The complete expression measures the amount of time, which the particular apparatus allows any molecule for traversing unit distance for the purpose of approaching the absorbing surface. Simple as the expression is, there is much meaning in it which is not revealed at first sight.

The truth of the formula forced itself upon my mind during the many years experience with such apparatus long before I found the mathematical proof, which is one of the most difficult problems that I ever attempted to solve.

Discussion.

The Chairman remarked that Dr. Hurter had as usual given them a most interesting and valuable paper. He had no doubt but that it would be good news to those who had long used the coke tower, to hear that this old friend was not to be substituted immediately by the novelty which had been shown to them that evening. He suggested that possibly the new tower filling might be more suitable for replacing the solid flints in the Glover tower, rather than as a substitute for porous coke.

Mr. E. K. Muspratt said that none of the members would be really able to criticise Dr. Hurter's paper. All his papers were really above criticism, and showed such a perfect union of mathematical with chemical and physical knowledge, that he was afraid very few members of the Society would be able to do him justice. They who had practical experience were always glad to find that as a rule Dr. Hurter's scientific exposition of the subject really accorded with practical experience in the works, and he could certainly say that it did so in the case of alkali works. For a great number of years they had been well aware of the enormous advantage obtained for the absorption of gases by a coke tower, but the advantages were not understood and the reasons for the enormous advantages not being understood, led to attempts to employ a great number of erroneous and expensive apparatus to absorb gases in another manner. He referred specially to the great number of apparatus that had been erected for the purpose of absorbing gases by means of spray. Those had nearly all failed, and Dr. Hurter had shown the reason of their failure. The Chairman had mentioned that possibly the plate tower might supersede the Glover tower, which was generally filled with flints, although no doubt they were aware that the Glover tower at first was partially filled with coke. It was only because an accident happened, when some workmen neglected to keep a stream of acid going down, that the coke took fire, and led to doing away with coke and filling the tower entirely with flints. One disadvantage with coke, filling for Gay Lussac towers, was that the coke in time got covered with sulphate of lead and consequently became much less efficient. In Germany they had attempted to replace the coke by bricks or hollow cylinders of earthenware, and in the south of France by volcanic stones. With respect to the plate tower, although several had been erected in Germany, they had not any really accurate account of their efficiency. It seemed that the accounts were very conflicting, and Dr. Hurter, he was sorry to say, had not been able just then to give them a report on how the plate tower at Widnes was doing. He understood that they had not had sufficient experience to report properly upon it.

Dr. Hewitt said that the late Dr. Angus Smith was very much interested in a method for condensing hydrochloric acid by means of spray, and expressed a hope that the spray mode of dividing the liquid into drops might prove to be a more efficient condenser than the coke tower. Had he had the pleasure of listening to the paper he would have been compelled by Dr. Hurter's ingenious mathematical reasoning to give up such an idea. There was not the least doubt that spray apparatus was by no means so effective as the coke tower for condensing soluble gases.

Dr. Hurter, in reply, said, he was much obliged for the kind reception which the somewhat dry paper had obtained. Mr. Brunner had drawn attention to the possible use of the plate tower as a Glover tower. This was the only application which the inventors did not recommend, because they were afraid the plates might not stand the high temperature. He had omitted to say that in the application in lieu of a Gay Lussac tower there was an advantage in avoiding the reducing action of coke on the nitrous vitriol, involving a loss of nitrogen compounds.

The use of flints in lieu of coke in Glover towers, and the substitution of bricks or earthenware in lieu of flints, was one of the examples where diminution of active surface was compensated by a gain in time. Whilst flints formed the packing which left least space for the gas, bricks might be so arranged as to leave more, so that though the surface might not be so large, the velocity of the gas was decreased. While coke gave 40 per cent. of interstices, flints only gave from 25 to 30 per cent.

He had made similar observations in the Deacon process, where a considerable increase of surface gained by reducing the size of the pieces did not bring with it a correspondingly better result, simply because the velocity of the gas was increased, the interstices having diminished more rapidly than the surface of the material increased, the smaller pieces packed more densely than the larger pieces, and left less open space for the gas.

As to condensing hydrochloric acid by means of spray, there was a considerable difference in the application of spray to an easily condensible gas in a comparatively pure state, whilst applied to the pot gas the spray might give rise to hopes, but the hopelessness of spray would be evident when applied to the gases of an open furnace. He remembered the experiments made at some of the Newcastle works. The heat of combination of the hydrochloric acid gas with water evolved in so small a space raised the temperature of the residual gases beyond that at which they arrived at the apparatus.

THE PINK COLOURATION OF CALCIUM CHLORATE LIQUOR.

BY T. L. BAILEY, PH.D., AND P. H. JONES.

It is generally acknowledged that the pink colour of the liquor obtained on saturating lime with chlorine in the earlier stages of the chlorate of potash manufacture is due to the presence of manganese in the form of a permanganate. Strangely, however, most of the articles published on the question are in favour of iron as the producer of the colour.

Opl. (Dingl. Polyt. J. **215**, 237) refers the formation of the colour to this source; and Mylius in Hofmann's Report on the development of Chemical Arts, would seem to infer (Chem. News 1876, **34**, 139) that, because the colour is produced when Deacon gas is used in the manufacture, manganese is not necessary to its formation. The fact is here ignored, however, that manganese is contained in greater or smaller quantity in all limestone and chalk; and it must be remembered too, that very minute quantities of manganese are sufficient to give a strong permanganate colouration.

T. P. Blunt on altogether weak grounds attempts to uphold the theory of calcium ferrate being the sole cause (Chem. News 1876, **34**, 171).

On the other hand G. E. Davis (Chem. News 1876, **34**, 183) states, that at intervals during five years he had examined chlorate liquors with a view to ascertaining undoubted facts regarding the presence of manganese, and he had always found manganese to be present as permanganate, whether Deacon's process or Weldon's process was used for the manufacture of the chlorine. The absorption spectrum was relied on for the information.

There is, however, no positive proof against the formation of a ferrate, although, at the same time, it is well known that ferrate solutions decompose rapidly on standing. Accordingly it seemed to us that it would be of particular interest to ascertain, whether the pink colouration could possibly be produced (as asserted by Mylius) in absence of manganese. The idea suggested itself to prepare a perfectly pure oxide of calcium (or at all events oxide of calcium free from any trace of iron and manganese) and then to chlorinate samples after addition of small quantities of iron and manganese compounds respectively under various conditions obtaining in the works.

Preparation of Lime.

Marble was dissolved in concentrated hydrochloric acid and to the liquor, after very slight dilution, ammonia was added carefully, with a view to precipitating the iron and manganese and a small quantity of lime; the whole was filtered through glass-wool, and a portion of the filtrate was evaporated down, acidified, and tested for iron by ferrocyanide and ferricyanide of potassium, and for manganese by peroxide of lead and nitric acid, in the latter case the material having been freed from chlorides by boiling down with nitric acid. From the calcium chloride solution, obtained as described, calcium carbonate was precipitated by pure ammonium carbonate prepared by passing well-washed carbon dioxide into ammonia. The carbonate was very thoroughly washed with distilled water by decantation, dried and converted into oxide by ignition in a muffle. Further quantities were made with the additional precaution that the calcium chloride before conversion into carbonate was crystallised and recrystallised several times from distilled water.

Conversion into Chlorate.

The chlorine was generated from potassium bichromate and concentrated hydrochloric acid, the purest obtainable; the gas was passed through three bottles containing distilled water. Two grms. of pure lime were placed in a flask with 100 cc. of distilled water, and chlorine was passed through the solution to saturation, the contents of the flask being kept hot in a water-bath and finally boiled.

Six experiments made in this way with lime prepared in three separate batches gave no indication of pink colouration at any stage of the proceedings.

Chlorination experiments were next conducted on samples of the pure lime, to which was added ½ per cent. of ferric hydrate (tested previously for manganese by nitric acid and peroxide of lead); no pink colouration could be obtained under these conditions.

In the third set of experiments calcium carbonate and hydrate of iron were ignited together in the muffle, so that the carbonate of lime was converted into lime in presence of the iron. With samples thus prepared, however, no pink colouration was obtainable on chlorination.

On adding the slightest quantity of a manganese salt or manganese hydrate to the lime, however, and then passing chlorine to saturation the pink colour was always very satisfactorily obtained.

It was, however, conceivable that with stronger solutions the results might be different; accordingly the above experiments were still further repeated, using 10 grms. of lime instead of 2, and still keeping 100 cc. of water, so that the material formed a thin paste. The results were, however, as decisive as before.

The conclusion we draw from these experiments is that the colouration cannot possibly be due to formation of calcium ferrate under existing working conditions.

Solutions of sodium ferrate are obtainable by passing chlorine into strong caustic soda solutions containing iron, and hence there remained the possibility of a formation of sodium ferrate by small quantities of sodium salts existing in the lime. A sample of pure carbonate of lime was ignited with a small quantity of bicarbonate of soda and hydrate of iron and the resulting product chlorinated. No pink resulted. Hence, it would seem that small quantities of sodium salts, for instance, cannot bring about the formation here of a pink ferrate, and we are forced to the conclusion that manganese alone can provoke the colouration, and that, as Davis has shown, by transformation into permanganate.

SUGAR BEET-ROOT GROWING EXPERIMENTS IN ENGLAND, SCOTLAND, AND IRELAND IN 1892.

BY G. SCHACK-SOMMER, PH.D.

(*Abstract.*)

For the fourth consecutive year the author has continued his experiments on the growth of sugar-beetroot. (This Journal, 1890, 153 and 1891, 318.) The results are detailed in "Sugar," 1893, **5**, 7—11 and fully confirm the previous view that sugar beet-root can be grown in this country with quite as satisfactory results as on the continent. A main feature in the tabulated results is the success that has attended the growth of the sugar beet-root in Scotland Full details, including locality, soil, manure, and weight of roots per acre, are given in the tables.

Manchester Section.

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Vice-Chairman: Edw. Schunck.

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H. Grimshaw.
J. Grossmann.
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J. M. Irving.
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Sir H. E. Roscoe, M.P.
C. Truby.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893.

Meeting held Friday, 3rd March 1893.

MR. IVAN LEVINSTEIN IN THE CHAIR.

SOME EXPERIENCES IN THE MANUFACTURE OF CRUDE CARBOLIC ACID.

BY GEORGE E. DAVIS.

Some years ago (1884) I was brought face to face with the production of carbolic acid from the light oils of coal tar, and as there is not much written upon this subject of a practical nature, I have presumed that a *résumé* of some of my experience might be acceptable to members of this section. At the outset I may state that previously to 1884 I had only a book-knowledge of carbolic extraction, and therefore preferred to follow my leaders as far as they would take me, instead of experimenting anew on my own account.

Lunge mentions in his "Coal Tar and Ammonia," the difficulty of laying down a hard and fast line for the proper limits of the fraction from the tar still, known as "light oil" or "carbolic oil," from which the crude carbolic is extracted; it was therefore thought desirable to obtain samples of "light oils" from other tar distillers who were working a similar kind of tar. An examination of these samples showed the average specific gravity to be 0·992, which I found could be reproduced in my own case by changing over to creosote, when the product running from the still warm would just sink in water; the light oil yielded from a 20-ton still being about 300 gallons.

The pattern samples and my own fractions contained 19 per cent. of substances absorbable by caustic soda of 1·10 sp. gr., it was therefore presumed we were on the right track. The next step was to ascertain how much alkali the oil required, and this was effected by the method detailed in Lunge's work (Distillation of Coal Tar, p. 213), and from this was calculated the quantity of alkali to be used in actual manufacturing work.

Upon getting to work all went merrily for a time. We were extracting some 16 per cent. of "crude" from the light oil and had accumulated some 1,000 gallons or so in our tanks. Moreover, carbolic had risen in value and now was the time to sell. Burns has well written—

> "The best laid schemes o' mice and men,
> "Gang aft a-gley,"

when we came to test the bulk of this crude carbolic, it would not respond in any way to the well-known Lowe test, and in our ignorance we attributed this to our want of skill in manipulation. It was therefore deemed advisable to despatch samples to the various buyers of "crude" asking for tenders. The replies from one and all were "the sample contains no crystallisable, it is worth nil." This did not satisfy me, and, moreover, there were 1,000 gallons of crude on which caustic and acid has been expended, so I resolved to experiment myself. Now Lunge mentions, as a "secret," a process of Behrens for the use of a minimum of soda solution in procuring crystallized carbolic acid, but the latter portion of the paragraph leads one to the belief that too much is not to be expected from it, though I have found by many experiments that in most tar works, a quantity of soda insufficient to dissolve the whole of the phenols is always employed. However, this was not known to me at the time.

My first experiment was to dissolve up a barrel of the crude carbolic (or 40 gallons) in sufficient caustic soda of 1·10 sp. gr., and to carefully measure the quantity of caustic soda employed. The sulphuric acid (1·75 sp. gr.) necessary to neutralise the measured quantity of caustic soda was carefully divided into three portions and added in sequence to the crude carbolate of soda liquor, the carbolic acid rising to the top, being collected separately after each addition of acid, the first portion thrown up was called A, the second B, and the third C. Upon testing by Lowe's method, the following numbers were obtained:—

——	A.	B.	C.
1. Specific gravity at 16° C...	1,054	1,060	1,064
2. Per cent. water...........	10·0	12·0	14·0
3. °C of 62·5 per cent........	197°	192° C.	190° C.
4. Crystal point of No. 3	Below 0° C.	17° C. 62·0° F.	23° C. 73·4° F.

This was very interesting and encouraging, and so the experiment was varied by treating another barrel of the "crude" with one-third the quantity of caustic solution as in the first instance, and separating the crude carbolate of soda for final decomposition with sulphuric acid. This process was again repeated, and thus two quantities of crude carbolic were obtained by neutralisation, while the third remained as residue in the mixer.

Tests of the first and second portions were made with the following results, they correspond to B. and C. in the former series.

——	First Fraction.	Second Fraction.
1. Specific gravity at 16° C...........	1,063	1,060
2. Per cent. water....................	14·0	12·0
3. °C. of 62·5 per cent.	191° C.	192° C.
4. Crystal point of No. 3	22° C. 71·6° F.	17° C. 62·6 F.

It may be as well to mention that the crude carbolate of soda from which these two fractions were obtained, had a specific gravity of 1090 at 16° C., and 100 cc. threw up 22 cc. of crude carbolic. The whole of the unsaleable "crude" was now treated with rather less than two-thirds of the caustic soda solution necessary to dissolve it completely, and when neutralised with acid, the crude carbolic—

1. Specific gravity at 16° C.	1,060
2. Per cent. water..........................	14·0
3. °C. of 62·5 per cent......................	192° C.
4. Crystal point of No. 3.....................	17° C. 62·6° F.

It will thus be seen that the soda solution has an unmistakable preference for phenol over cresol, so that when a mixture of these two is treated with soda solution, the phenol is first absorbed and the cresols last.

The foregoing experiences led me to revise our method for the extraction of carbolic acid. The "light oil" was treated with three successive portions of soda of 20° Tw., and the crude from each kept separate. The first fraction A., of which 62½ per cent., crystallised at 22° C. (71·6 F.), the second fraction B. crystallising at 15·5 C. (60° F.), while the third fraction C. did not contain any crystallisable acid. A. and B. were sold, while C. was retained in the works for the manufacture of disinfecting powder.

Soon after the date of these experiences I was visited by an old carbolic maker who offered me a process whereby, it was stated, much more carbolic could be obtained from a given quantity of light oil than by existing processes. It was pointed out to him that all the crystallisable phenol was already extracted with some uncrystallisable as well, but, however, as he was so importunate, I agreed to try his method side by side with my own.

The mixer used I designed in 1875 from experiences with an agitator in use in the neutralising well at Hardshaw Brook Chemical Works. This was an ordinary cast-iron ship's screw. I found in experiments with this method on a small scale that if the screw was enclosed within a tube and made to rotate very rapidly a most effective agitation was the result, and I venture to say that there is no better method in existence for the incorporation of dissimilar liquids. This was the mixer I used in 1884, substituting a cast-iron spiral just fitting the tube for the ship's screw formerly tried. We had several in use; they were made at the Thorncliffe Iron Works, near Sheffield.

But to return to the "improved" carbolic process. The ordinary temperature at which we worked was 80° F. (27° C.), and the so-called improvement consisted in acting on the light oil with 19° Tw. Caustic soda solution at a temperature of 150° F. (66° C.). The light oil employed was of 0·996 sp. gr., and contained 24 per cent. of bodies absorbable by caustic soda. The quantity taken was 460 gallons, which was well agitated with 160 gallons of caustic soda solution of 1·095 sp. gr. for two hours at 27° C. From previous experiments we know that this treatment would extract the whole of the crystallisable carbolic the light oil contained. After settling, about 3 gallons of the crude carbolate were drawn off, neutralised, and the crude carbolic tested; we will call it A. The agitator was then set going and steam turned on until the contents were 150° F. (66° C.). This was continued for one hour, when the contents were allowed all night to settle. In the morning the crude carbolate was run off, the "carbolic" thrown up and tested. We will call this A^1. The tests were as follows:—

——	A.	A^1.
1. Specific gravity at 16° C.	1,064	1,060
2. Per cent. water	15·0	14·0
3. °C of 62·5 per cent..................	190° C.	192° C.
4. Crystal point of No. 3	21° C.	17° C.
5. Temperature of first 10 cc.........	183° C.	180° C.

The partly-denuded oil was now of sp. gr. 0·989 at 16° C., it was again agitated at 80° F. (27° C.) with 160 gallons of caustic soda solution of 1·095 sp. gr., and the crude carbolic thrown up precisely as in the first instance. We will call this sample B. Steam and agitation were now employed as before, and the crude carbolic obtained we will call B^1. The tests of these two samples were as follows:—

——	B.	B^1.
1. Specific gravity at 16° C...........	1055	1052
2. Per cent. water....................	11·0	10·0
3. °C. of 62·5 per cent................	196° C.	195° C.
4. Crystal point of No. 3.	Fluid at −4° C.	Fluid at −4°C.
5. Temperature of 1st 10 cc...........	180° C.	187° C.

In order to see whether B_1 contained any "crystal" that could be utilised, 30 gallons were well agitated with 15 gallons of caustic soda solution and the crude carbolate separated, the carbolic being thrown up in the ordinary way. This "crude" (B″) though small in quantity would not crystallise even at −6° C. proving conclusively that all the crystallisable carbolic had been extracted previous to the treatment which provided the B samples and moreover the quantities of A and A_1 showed that there was no advantage (rather the reverse) in heating the mixture beyond 27° C.

I may say that these experiments have several times since been verified. As late as this year a sample of light oil was sent me to decide whether the bulk was worth treating by West-Knights and Gall's process for the extraction of the carbolic, it contained 18 per cent. of matters absorbable by caustic soda.

When treated with the soda necessary to obtain the whole 18 per cent. the product was uncrystallisable; when 12 per cent. was extracted it was uncrystallisable, while when only 7 per cent. was absorbed, the resulting "crude" crystallised at 15·5° C. (60° F.).

As I have mentioned, the process of West-Knights and Gall perhaps a few words upon it may not be out of place.

West-Knights and Gall's process was founded on a perfectly new reaction. When milk of lime is agitated in a solution of sodium sulphate there is scarcely any appreciable action, but if a phenoloid body (such as carbolic or cresylic acid) be present, sulphate of lime and carbolate of soda is formed, so that a mixture of calcium hydrate and sodium sulphate in equivalent proportions answers as well for crude carbolic extraction as an equivalent of caustic soda. The crude carbolate of soda so obtained is of precisely the same quality as if caustic soda had been employed in the extraction.

Now having obtained a crude carbolate of soda it is a simple matter to produce crude carbolic from it. Most of you are acquainted no doubt with Hardman's process, in which the crude carbolate of soda is decomposed by carbonic acid gas, producing carbonate of soda and crude carbolic, the carbonate of soda being causticised with lime for use over again. Lunge in his "Coal Tar and Ammonia" seems to be in doubt whether this process has been a success (page 379) but to my knowledge the method has been working successfully at the Blackburn works of this firm for some years, the source of carbonic acid being the waste carbonic acid from the ammonia stills. It will also be seen that here is a process for the manufacture of carbonate of soda from sulphate of soda by a wet method—indeed Staveley has patented such a method though how it could be worked and sustained I am unable to tell, as to produce the carbolate of soda by the means employed would be to infringe West-Knights and Gall's patent, and Hardman had previously shown that the decomposition of the carbolate could be practically accomplished by means of carbonic acid gas.

But West-Knight's and Gall's method is one for the continual production and decomposition of sulphate of sodium from the crude carbolate. The crude carbolate is decomposed by strong sulphuric acid in the usual way; the slightly acid sulphate of soda solution forms the bottom layer, and contains no inconsiderable quantity of the best carbolic acid in solution. This has for many years been the ordinary process, and in most works the waste from it has been a source of trouble and anxiety. West-Knights and Gall neutralise this liquor with lime, the result is sulphate of soda solution ready for use over again with an equivalent of lime, the working loss being made up from time to time by the addition of fresh salt cake. It is to be noticed that by using this process there is no "waste" to find its way into sewer, drain, or watercourse, which in these latter days is something to commend it.

The above process is easy to work, the "carbolic oil," solution of salt cake and slaked lime are briskly agitated together for about the same length of time as when caustic soda is employed. The oil is denuded of its "carbolic" which enters the aqueous solution, while a hydrated sulphate of lime remains suspended in the fluids. The best practical method of procedure at this stage is to filter-press the whole contents of the mixer, or to extract the total fluids in a vacuum filter. It presses easily and the aqueous and oily fluids come through together. These now go to a settler, where in an hour or so two layers are formed, the lower layer carbolate of soda; the upper, decarbolised oil. The carbolate is finally run off into a decomposing tank where the carbolic is thrown up with sulphuric acid in the usual way.

It has been objected that the sulphate of lime being precipitated in the oil must cause a loss by reason of the entanglement of the latter within the former. In practice this loss is very small and can be minimised by displacement with water which can be used over and over again. Even the little that remains might be utilised if need be, and it is readily combustible and leaves a white sulphate after ignition in a suitable furnace. I have tried this process on several occasions and have marvelled that it has not been generally adopted long ere this.

Discussion.

Dr. Dreyfus said they were very much indebted to Mr. Davis for bringing the subject before them. The fact had, he believed, not yet got into print, but nevertheless it was a fact that fractional saturation had to be employed if good crystallisable carbolic acid were desired. As to the strength of the caustic soda, he had employed it from 17° Tw. to 22° Tw. and had found no difference in the results. The process described by Mr. Davis as West-Knight's and Gall's seemed to him just what was wanted; caustic soda had been advanced very much in price, and if lime could be made to do the work of caustic it would be a great saving. His firm used 50*l.* to 60*l.* worth of caustic soda per month, and he should certainly institute at once some experiments on the subject, and if satisfactory he should apply for a license.

Mr. Stenhouse said he could scarcely agree with the last speaker as he found the strength of the caustic soda materially affected the crystallising point. If, for instance, when using 20° Tw. soda the crystallising point came out a few degrees below 60° Fahr. he used weaker caustic for the next few batches, which generally brought up the crystallising point to the proper degree.

Dr. Dreyfus here pointed out that the same number of gallons of weaker caustic really amounted to less caustic, so that Mr. Stenhouse and himself were not at variance.

Mr. Stenhouse also said it would be profitable for tar-distillers to extract crude carbolic acid from the lighter portion of the creosote oil as well as from the "light oil" of the specific gravity mentioned by Mr. Davis. At the Rochdale gas-works not only was the light oil from the tar treated twice for carbolic acid, but creosote oil of about 6° Tw. was also washed once with about one-third its volume of caustic soda solution of 18° to 19° Tw. In this way crude carbolic acid crystallising at 60° F. was obtained from the creosote oil and mixed with that obtained from the light oil. He might add that it paid well to treat the creosote in the way mentioned.

Mr. Irven said that the paper had interested him very much, but he thought that Mr. Hardman's process as worked at Blackburn was superior to West-Knight's and Gall's as this latter process was troubled with the production of a large quantity of solid sulphate of lime which would have to be got rid of.

Mr. Davis, in reply, said he was pleased the subject had excited so much interest; he could corroborate the remarks of Mr. Dreyfus that for equal weights of caustic soda the range of specific gravity of the solution did not materially affect the results any more than this, that weak solutions of caustic dissolved more real phenol than strong ones by reason of the introduction of more water, and strong solutions formed an emulsion of the oily products, which being thrown out by the acid in neutralising, spoilt the carbolic. In fact, "sheep-dips" were made from cresol and higher tar phenoloids by boiling with strong caustic soda, and the object was to emulsify as many of the products as possible so that the solution might turn milky when mixed with water. Some manufacturers he found always took a definite quantity of 60°—80° Tw. solution and simply diluted it with water to suit the idiosyncrosies of the carbolic maker. He (Mr. Davis) could scarcely agree with Mr. Irven's criticism of West-Knight's and Gall's process, as he had evidently forgotten that in Hardman's process the products of the action of carbonic acid were crude carbolic and carbonate of soda, with a large working loss of carbonic acid, the carbonate of soda having to be causticised with lime before using again, so that Hardman had a molecule of calcium carbonate to throw away, while West-Knights and Gall had a molecule of calcium sulphate. There was another point, however, in favour of the latter process. Hardman had to make up his waste with soda ash or caustic soda, while West-Knights and Gall required but salt-cake: and in this connection it might be pointed out that the strongly acid "nitre-cake" was quite good enough, and might be procured for a few shillings per ton, and the acid it contained might be made to replace some of that required for neutralisation.

ON THE PURIFICATION OF COMMERCIAL ALCOHOL.

BY J. CARTER BELL, A.R.S.M., &C.

Chemists who are accustomed to use considerable quantities of alcohol are often greatly inconvenienced by the impurities found in ordinary commercial alcohol. Two of the chief impurities are aldehyde and acetone, and the presence of these compounds are the cause, I believe, of the dark-brown colour which appears when potash or soda are added to alcohol. Many processes have been devised for removing the above impurities. I have studied and experimented with a considerable number of these so-called improvements without much success. As there is a considerable difference in the boiling point of the three compounds, this difference would naturally suggest a process of distilling. It is, however, a well-known fact that the separation of traces of impurities, however low their boiling point may be, from large quantities of a liquid boiling, say below 100° C., is an impossibility, and experiments to purify alcohol by distillation showed, as I anticipated, that there was very little difference between the distillate and that which was left in the retort, both giving the dark-brown colour where potash was added, which is so characteristic of aldehyde in the presence of certain organic bases which almost invariably are to be found in methylated spirit. I have tried the methods of having a weak solution of potash in alcohol, and having a saturated solution, allowing these solutions to stand for about a week before distillation. The result has certainly been an improvement, for the brown colour was not so deep in tint when potash was added to the distillate. Another method which I have tried is to shake the alcohol well with various oils, chiefly using mineral oils; after agitation the mixture is allowed to stand for some hours, when the alcohol is drawn off and distilled at a low temperature; the distillate is something similar to that obtained by distilling alcoholic potash. Some time since a process was recommended to purify alcohol by means of chromic acid: the spirit was to be well shaken with a mixture of 2 parts of sulphuric acid and 1 part of a saturated solution of bichromate of potash; the free acid was to be neutralised and the alcohol to be carefully distilled. I have tried that process and the result is now before you, and you see an alcohol which assumes a dark-brown colour on the addition of potash. One process, which I have not yet tried, is the alkaline bisulphite method. As is well known the bisulphites form with the aldehydes, and acetones, crystalline compounds not very soluble in alcohol, the alcohol is submitted to a distillation, and the distillate is treated with the alkaline bisulphite.

This dark-brown colour is very annoying to the chemist who uses Kœttstorfer's method with alcoholic potash for the analyses of oils and fats, for this colouration is very apt to mark the end of the reaction, and again it is very uncertain to work with such an alcohol that is so deeply coloured, for the deeper the colour the greater is the impurity. The following method which I have devised overcomes all these difficulties, and the chemist in his laboratory can prepare any quantity of pure alcohol fit for all analytical purposes.

For a long time I have been in the habit of saving up the waste alcoholic potash which had been used for the purposes of saponification. This alcohol was redistilled and again treated with potash, and I have always noticed that the colour gradually became lighter on successive distillations. In the process of saponification an excess of alkali is always used, but I thought it would be well to try some experiments by having an excess of fat; this method succeeded perfectly, and I obtained a colourless alcoholic potash solution. This process is exceedingly easy for obtaining either large or small quantities in a very short time. The following is the mode of procedure:—

Take 500 cc. of alcohol about 85 or 90 per cent. strong, put into flask of about 1,000 cc. capacity, dissolve about 25 grms. of stick potash in the alcohol, when dissolved add about 250 grms. of melted lard, or some saponifiable oil, put the flask connected with upright condenser into hot water, in about 10 minutes the fatty matter will be saponified; during this time it is better to shake the flask to hasten saponification. When this is completed distil off the alcohol and about 450 cc. of distillate will be obtained, which will not turn brown on the addition of potash, after several days, and when the solution is kept in a strong light only, a slight yellow colour may be developed.

The quantity of potash used for saponification should not exceed 4 or 5 per cent. If large quantities are used so much fat has to be employed and the great mass of soap formed locks up the alcohol; on the other hand, if the oil be not added in considerable excess over the potash there is a greater difficulty in distilling the alcohol off, so much so, that when the temperature is raised, sometimes the mass froths and goes over bodily into the receiver. But if about twice as much oil is added as the potash dissolved in the alcohol will saponify, frothing of the alcoholic soap solution is prevented, and no difficulty will be encountered in distilling off the alcohol.

Newcastle Section.

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John Watson.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

SESSION 1892–93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Durham College of Science, Newcastle, on Thursday, March 9th, 1893.

MR. JOHN PATTINSON IN THE CHAIR.

ON SEGREGATION.

BY T. W. HOGG.

From the time that Abel first noticed the expulsion of globules of sulphide of iron from cast iron, and that the last portion of phosphoric pig-iron to solidify contained the most phosphorus, there has been a gradual accumulation of results bearing more or less upon the subject of this paper, which consists of a short account of observations which I have made at intervals during the last few years, and have grouped together under the title of segregation for convenience.

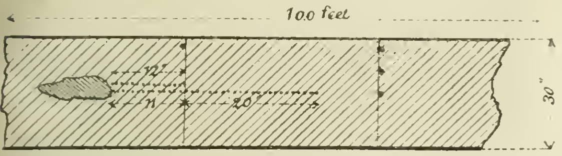
Howe, in his splendid treatise on the Metallurgy of Steel gives a most complete collection of analysis with regard to segregation in steel ingots.

From the nature of the opportunities usually offered it is hardly to be expected that there should have been obtained anything but an unsystematic series of results, and the various analyses which I bring before you will hardly commend themselves as any improvement in this respect. They must be looked upon merely as an addition to our collection of things curious and interesting.

Some time ago Mr. J. W. Spencer, who has always taken great interest in this subject, placed at my disposal a very large cylindrical ingot of mild steel for the purpose of ascertaining whether any more definite information could be obtained with regard to the accumulation of impure metal in the centre; with this object in view, the ingot was cut into three parts, and analyses made of borings taken from the different parts, as in the following table:—

Weight of ingot = 11 tons — 1 cwt.
Length 10 ft., and diameter = 30 in.

Fig. 1.



Drillings from the face of the top part:—

——	Centre.	1 in. from Centre.	Near Edge.
Iron	98·40	98·60	99·30
Manganese	0·27	0·25	0·20
Carbon	0·75	0·58	0·20
Silicon	0·042	0·034	0·03
Sulphur	0·15	0·12	0·036
Phosphorus	0·20	0·10	0·042
Copper	0·052	0·052	0·054
	99·864	99·736	99·862

Drillings from bottom portion:—

Iron	99·30	99·40	99·30
Manganese	0·22	0·21	0·22
Carbon	0·24	0·24	0·24
Silicon	0·034	0·034	0·034
Sulphur	0·037	0·037	0·037
Phosphorus	0·050	0·047	0·047
Copper	0·048	0·054	0·054
	99·939	100·022	99·932

Drillings were then taken from the centre of the top portion proceeding upwards for 11 inches, where the contraction cavity was reached, and another series taken at a distance of one inch from the centre, and also another lot proceeding downwards through the centre of the middle portion for a distance of 20 in.; in all of these the borings from each inch in depth were retained and kept separate. The carbon only was determined, as it may be taken as a guide towards the segregation of the other elements; the *results* showed no important variation and no other determinations were made.

Distance in Inches.	1.	2.	3.	4.	5.	6.	7.
From centre upwards ..	0·75	0·75	0·79	0·83	0·81	0·79	0·75
One inch from centre upwards.	0·58	0·60	0·61	0·70	0·70	0·65	0·60
From centre dowawards	0·75	0·66	0·70	0·69	0·61	0·58	0·50

Distance in Inches.	8.	9.	10.	11.	12.	13.	20.
From centre upwards..	0·70	0·75	0·71	0·73	..	..	..
One inch from centre upwards.	0·60	0·61	0·61	0·61	0·60	..	..
From centre downwards	0·50	0·40	0·40	0·40	0·39	0·39	32

These results may be taken as an indication of what most frequently takes place in such ingots, viz., that the central core of impure metal is of an elongated character and not abrupt, a condition which only takes place rarely and under circumstances not quite understood.

It is, however, this latter condition which I believe to be the cause of many apparently mysterious breakages; it is evident from a consideration of the relative strengths of hollow and solid shafting that the deficiency due to a core of impure metal *of itself* would be almost inappreciable.*

There must therefore be some other cause at work, and I have been led to conclude from many cases which have come under my notice that during the long soaking heat which large ingots have to undergo upon reheating that there is a *partial reabsorption of the impurities*, and when there has been a case of abrupt segregation, this reabsorption will be of a most pronounced character, the result of this will be that the molecular continuity of the crystals of stronger metal will be interrupted by the gradual penetration of the more fusible sulphide and phosphide of iron, and not only this, there is very great probability that a more decidedly crystalline structure will be induced with the result that the steel becomes thoroughly rotten at this part, and is liable to break upon the slightest provocation.

The two following examples are given to show what curious things happen in very large steel ingots occasionally. The first is a very peculiar irregular stalactitic formation found inside the contraction cavity of a large ingot. This irregular mass is interesting on account of its size, being 6½ in. in length, and it weighs 1¾ lbs. The following analyses were made to ascertain whether it was in any way connected with either segregation or liquation.

A = analysis of steel stalactite.
B = analysis of ingots.

——	A.	B.
Iron	98·70	98·70
Manganese	0·49	0·43
Carbon	0·26	0·28
Silicon	0·074	0·06
Sulphur	0·033	0·03
Phosphorus	0·048	0·039
Copper	0·034	0·034
	99·739	99·603

---

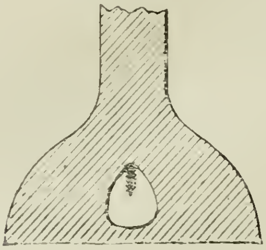
* As a good example it may be interesting to compare the reduction in strength of a 10-in. shaft after a 1-in. hole is bored through. The ratio is obtained from the formulæ—

$$\frac{\pi}{16}\frac{D^4-d^4}{D} \div \frac{\pi}{16}D^3$$

and is thus found to be only $\frac{10000-1}{10000}$.

it was found hanging from the top of the cavity as in the following figure—

Fig. 2.

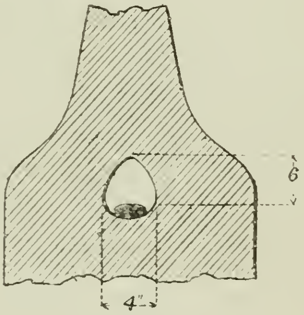


and its formation is probably due to the immense contractive force of the solidifying mass, drawing down some still semi-fluid metal from the neck of the ingot into the cavity, the conditions necessary for the production of such a curiously formed mass may be rare, but as these cavities are not often visible inside, stalactitic forms may often be present.

The second example I bring before your notice as it presents an interesting contrast to the one just described, it is not one of my own observation but as it is one of the most interesting cases of segregation in steel ingots yet described, it is quite worth reproduction here, especially as there has not yet been any notice of it in our Journal. The account is given in "Stahl und Eisen," July 11, 1891.

A Bessemer steel casting 7 tons in weight was made at the works La Louviere, Belgium, for a large roll; this was found to have a large pipe or contraction cavity, as in the figure.

Fig. 3.



This cavity was measured and found to be 4 in. wide × 6 in. in depth. The lower portion of it was perfectly sound and the surface of the top portion being quite spongy. At the bottom of the cavity there lay a large cake which was easily detached with a chisel; this cake was 2 in. in diameter and $\frac{5}{8}$ in. thick. The following series of analyses weie made:—

——	C.	Si.	P.	S.	Mn.
Teeming sample	0·24	0·336	0·089	0·074	0·97
Upper journal of roll	0·215	0·338	..	..	0·91
Lower journal of roll	0·314	0·28	..	..	0·98
Interior of roll 12 in. below the cavity.	0·309	0·252	0·077	1·055	0·96
Under surface of cavity supporting the cake.	0·68	0·326	0·318	0·325	1·49
Cake itself	1·274	0·41	0·753	0·418	1·08

This cake no doubt owes its origin to the core of impure metal having been gradually squeezed up into the cavity.

That globules of sulphide or phosphide of iron should be found on the outside of iron castings is not surprising, but it is difficult to account for the formation of small globules varying in size from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter sometimes found on the outside of large steel castings, and possessing the following characteristics. They are remarkable to begin with in that they have a perfectly white coating which was found to be almost chemically pure silica. On striking these globules with a hammer, a few of them broke with a white spiegel-like fracture, and contained—

	Per Cent.
Combined carbon	5·24
Manganese	0·30

The others partially flattened out and then broke with a dark graphitic fracture. These were sufficiently numerous to make a complete analyses:—

Iron	94·70	..
Combined carbon	1·00	0·35
Graphitic carbon	2·54	Traces.
Silicon	0·68	0·30
Manganese	0·20	0·80
Sulphur	0·17	0·04
Phosphorus	0·14	0·05

In the second column is given the composition of the steel itself. It is puzzling both why the coating should be of pure silica, and also why the globules should differ so much in their composition, as they both came from the same casting.

On breaking pig-iron there is often noticed a peculiar fine grained patch near the centre of the fractured surface, the following analyses are of interest as showing that there may occasionally take place a redistribution without the usual attendant alteration in any of the other elements.

A = composition of fine-grained patch.
B = composition of surrounding metal.

——	A.	B.
Manganese	0·92	0·91
Combined carbon	2·93	3·60
Graphiea carbon	0·39	0·44
Silicon	2·42	2·42
Sulphur	0·036	0·036
Phosphorus	0·033	0·033
Copper	0·10	0·10

A case such as the following must not be confounded with segregation very often on breaking gits from steel castings, a dark portion is found in the centre of the fracture. If this be examined a very high carbon is found, as is shown in the following example:—

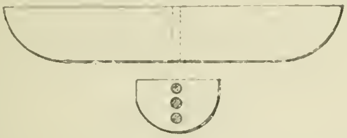
——	Centre.	Surrounding Metal.
Carbon	1·45	0·33
Manganese	0·61	68
Sulphur	0·05	0·035
Phosphorus	0·063	0·06
Silicon	0·40	0·42

This effect is due to the fact that it is the practice to throw considerable quantities of charcoal blacking upon the top of the feeder, and this highly carbonises the steel still fluid there; as the casting solidifies this highly-carbonised steel is drawn down through the centre, and hence the dark-coloured central portion found on breaking.

Many years ago I drew attention to the fact that in a pig of very rich silver-lead alloy the central and upper portions contained *less* silver than the mother-metal, the extent of the variation is sometimes very great; and as the following three examples are particularly good examples of this, it may be some excuse for recurring to this subject.

The figure will show the position from which the portions were obtained for the assays.

Fig. 1.



the top and bottom portions being each ½ in. from the outside surface of the pig.

A.

	Silver per Ton. Ozs.	dwt.	grs.
Top	380	17	20
Middle	390	7	8
Bottom	404	1	16

Difference = 23 oz. 3 20 between top and bottom.

B.

Top	326	13	8
Middle	373	14	12
Bottom	381	10	22

Difference = 54 oz. 7 14.

C.

Top	107 oz.	16	0
Middle	136	7	16
Bottom	139	9	16

Difference = 32 oz. 13 16.

The following results from a rich antimonial lead are also of interest. The portions taken the same way gave—

For antimony—

	Per Cent.
Top	19·30
Middle	19·93
Bottom	19·20

For copper—

	Per Cent.
Top	2·15
Middle	1·62
Bottom	0·63

The silver found was—

	Silver per Ton.		
Top	50 oz.	13	23
Middle	39	4	0
Bottom	55	3	2

The above variations in the copper. leaving the antimony practically stationary, are particularly interesting in view of the fact that it has found that in combinations of lead, antimony, and copper, the copper and antimony unite and separate from the lead.

In concluding this short paper, my object has been simply to bring before your notice new facts, bearing in mind the enormous quantity of apparently conflicting evidence relating to the subject of segregation generally, I think any apology for neglect of theoretical considerations unnecessary.

* * *

ON THE INFLUENCE OF ALUMINIUM UPON THE CARBON IN FERRO-CARBON ALLOYS, AND THE SPECIFIC GRAVITY OF PURE FERRO ALUMINIUM.

BY T. W. HOGG.

Faraday himself introduced aluminium into the iron and steel world, he ascribed the excellent qualities of wootz to the presence of this element, and he also claimed to have reduced alumina by means of carbon and iron together, these observations have never been corroborated by anyone; it is not to be wondered at therefore that this beautiful metal has frequently deceived other observers.

In the present short paper, I wish to describe a few alloys with special reference to the reputed property that aluminium is supposed to possess in changing the combined carbon to the graphitic state when added to ferro carbon alloys.

It may be well in the first place to remember that a clear distinction must be drawn between graphitic carbon separated as such, and found floating upon the top of the fluid mixture, and that precipitated and held in suspension during the solidification of the alloy.

It was formerly believed that the conditions of solidification after complete fusion and the temperature at which the fusion had been effected determined in great measure whether carbon was retained in one state or the other; apart, however, from the fact that rapidity of cooling favours the retention of carbon in the combined state it is certain that the elements silicon and manganese have a much more important influence, in this respect these elements act in opposition to each other, the manganese raising the limit of saturation and retaining the carbon in the combined state, silicon reducing the limit of saturation and inducing the separation of graphite.

In preparing the alloys which I exhibit, the materials used have been such as to reduce the quantity of bodies other than carbon, iron, and aluminium, to a minimum, the results thus obtained are of great interest as they in every case show that the carbon is retained in the combined state.

In the first experiment 5 lbs. of pure aluminium was added to pure Swedish pig-iron, a sample in which the carbon was nearly entirely in the graphitic state being used, these were melted separately, and then mixed and poured back several times, a proportion of dross was formed which increased in quantity each time the mixture was poured back, the weight of dross formed was 3 lbs., and it contained 2·1 per cent. carbon, the remainder being a mixture of alloy with highly aluminous slag.

The alloy weighed 42 lbs., and it contained—

	Per Cent.
Aluminium	11·30
Silicon	0·51
Carbon combined	3·14
Carbon graphitic	Traces.

The original pig-iron containing 3·90 per cent. carbon of which 0·85 was in the combined state.

As the repeated pouring back increased the amount of separated matter, the experiment was conducted over again and the mixture poured into the mould at once after the melted pig had been poured into the aluminium, this alloy contained 9·62 per cent. aluminium, a larger quantity of pig-iron being used and the combined carbon was found to be 3·85 per cent. and the graphitic carbon, none; just at the moment of solidification there was a slight efflorescence of graphite on the surface of the alloy, but there was none present in the mass.

Another experiment was conducted, using in place of Swedish pig, the hardest converted bar steel, with an addition of charcoal, for the additional object of ascertaining the limit of saturation with carbon, in a high percentage, ferro-aluminium, the result obtained was—

Aluminium	17·70	
Carbon combined	2·94	3·15
Carbon graphitic	0·21	

This alloy was broken up into small pieces and smelted with a large excess of charcoal, there being sufficient present to raise the proportion by 4 per cent., the result obtained was—

Aluminium	17·18	
Carbon combined	2·81	3·02
Carbon graphitic	0·21	

it is therefore evident that the limit of saturation with carbon is about 3 per cent. when the aluminium is nearly 18 per cent.

A ferro-manganese containing 18 per cent. manganese would retain double this quantity of carbon and ferro-silicon barely one quarter as much.

It may be of interest in connection with these alloys containing carbon to compare them with some in which this element has been excluded, and specimens are shown having the following composition :—

—	No. 1.	No. 2.
Iron	89·90	79·86
Manganese	Traces	Traces
Carbon	0·11	0·07
Silicon	0·065	0·04
Sulphur	0·010	Traces
Phosphorus	0·037	0·03
Aluminium	9·62	20·00

These alloys are most beautifully crystalline and lustrous, and do not readily tarnish. The lower percentage alloy can scarcely be distinguished in appearance from the specimen of phosphor tin which is placed beside it.

With regard to the specific gravity of pure ferro aluminium, these two latter specimens gave an excellent opportunity of comparing the actual with the calculated value.

The pieces were in each case dipped several times in boiling water and then cooled before finally weighing; risk of error through the presence of retained air bubbles was thus reduced.

The 9·62 per cent. Al alloy was found to have a specific gravity of 6·99, the calculated value being 6·54 to 6·65, according as the figures 7·80 or 7·88 are taken for iron, and 2·6 or 2·70 for the aluminium.

The 20 per cent. Al alloy possesses a specific gravity of 6·31, the calculated value varying from 5·59 to 5·69.

The densities of the alloys are thus shown to be decidedly higher than the calculated values.

The following specimens were shown to illustrate this paper :—

1. Pure ferro aluminium containing 20 per cent. Al.
2. Pure ferro aluminium containing 9·6 per cent. Al.
3. Ferro carbon aluminium showing the carbon in the combined state. Al = 11·30 per cent.
4. Ferro carbon aluminium showing the carbon in the combined state. Al = 9·62 per cent.
5. Ferro carbon aluminium, showing that aluminium may overpower the influence of other bodies, and induce chilling. Al = 9·82 per cent.
6. Pure Swedish pig-iron, showing most of the carbon in the graphite state.
7. Pure converted bar steel, showing the carbon in the combined state.
8. Ferromanganese aluminium, showing the carbon in the combined state.
9. A specimen of the first ferro aluminium sent to this country by the Cowles Company, showing the carbon principally in the graphite state, owing to the influence of elements other than aluminium.
10. Pure Swedish pig iron with the addition of aluminium, showing the change from the graphite to the combined state of the carbon.
11. The steel stalactite referred to in the paper on segregation.

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SESSION 1892—93.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

May 1.—F. W. Richardson, F.C.S., &c. "Silk, with special Reference to its Chemical Constitution, and its Estimation in Fabrics."

Meeting held March 6th, 1893.

PROFESSOR SMITHELLS IN THE CHAIR.

ON THE MORDANTING OF WOOL WITH CHROMIUM.

BY L. LIECHTI AND J. J. HUMMEL.

Part I.

Dr. Schunck says in his "Remarks on the Theory of Dyeing" (this Journal, Vol.VII., p. 819, 1888). "The dyeing of woollen fabrics has had much less attention paid to it, so far as the principles involved are concerned, than that of cotton dyeing." In recent years there have certainly appeared several more or less important papers with the object of explaining the chemistry of the dyeing process, still we are very far indeed from having attained finality in this matter. As so often happens in life itself the end seems more difficult, if not impossible, to reach whenever the first steps have been taken.

Already in 1853 Camille Koechlin, so full of achievement in connection with calico-printing, refers to wool (Bull. Soc. Ind. de Mulhouse, November 2nd, 1853) as "cette fibre revêche qui n'admet pas nos doubles décompositions froides," and then he proceeds to point out some difficulties which the fibre presents.

If for example, the question is to produce Prussian Blue ($Fe_7 C_{18}$) on wool. According to the following equations—

I.

$$2\,Fe_2(SO_4)_3 + 3\,K_4FeCy_6 = Fe_7Cy_{18} + 6\,K_2SO_4$$

II.

$$2\,Fe_2(OH)_6 + 3\,H_4FeCy = Fe_7Cy_{18} + 12\,H_2O$$

the process of formation is extremely simple, and indeed the production of this colour on calico presents no difficulty. The material has simply to be padded in a suitable iron solution, then passed through cold alkali in order to precipitate ferric hydrate on the fibre, and after washing the material must be passed through a bath of hydro-ferro-cyanic acid, whereby the blue is immediately developed.

With silk the difficulties are already very much greater, more concentrated baths have to be employed and the operations must be many times repeated in order to fix the necessary amount of ferric hydrate upon the fibre.

Further, during the development of the colour, it is practically impossible to work in cold baths, and the operation must be assisted by heat. This seems to be necessitated by reason of the behaviour of the silk itself, which, unlike cotton, is a solid fibre, and offers therefore much greater hindrance to the penetration of the different solutions. It is quite possible indeed that the different behaviour exhibited during the various operations of dyeing, by silk, wool, and cotton, is not unfrequently due to the difference in their degree of permeability, which is not inconsiderable. For example, in the case before us, it is practically impossible to mordant wool effectually by padding in a cold solution of an iron salt, hence the dyer is compelled to adopt a totally different method.

Many of the older publications which refer to wool-dyeing are of comparatively little worth, since the experiments recorded lack the necessary traits to give them a scientific value, moreover the conclusions are entirely incorrect and more or less fanciful. Even now wherever the results published refer to experiments which have been made under different conditions and without the use of equivalent amounts of the several ingredients employed, the difficulty of arriving at proper conclusions is increased. Further, works-chemists connected with practical wool-dyeing appear to be much more reserved and secretive than their colleagues connected with calico-printing, and there is little doubt that in consequence of this fact many important observations are lost, which otherwise would well repay research and thereby add to our stock of scientific knowledge.

The study of the chemical reactions which occur in cotton-dyeing presents for the most part little or no difficulty, and since the processes can be almost as readily followed as if they were conducted in a test tube few contradictions are met with. On the other hand, the same study in connection with wool-dyeing is one of extreme difficulty, especially the analytical part of the work.

A closer examination of the difficulties will verify this statement—

1st. Up to the present chemically pure wool-fibre is unknown to us. The analyses of some authors show the presence of as much as 3·23 per cent. ash with 0·29 per cent. SiO_2, and our own tests show the constant presence of a little CaO and Fe_2O_3.

2nd. The percentage of sulphur present varies enormously according to different observers, a fact which is scarcely to be wondered at considering that its determination is not easy. Bibra gives 0·8—0·09 per cent., Chevreul 1·78 per cent., Grothe 1·3—3·4 per cent., Fresenius 3·44—3·48, and so on. Part of the sulphur certainly seems to be organically combined, while another portion is more readily removable by a treatment with alkali.

3rd. Notwithstanding the most careful scouring, certain impurities always remain in the wool, and to these must be added such as result from incomplete and careless scouring, for example: insoluble soaps of calcium, magnesium, aluminium and iron, which once fixed on the wool, practically cannot be entirely removed; further, there may be present alkali acquired during the scouring, or sulphurous and sulphuric acid from the bleaching, &c.

4th. Owing to the impermeable character of wool even the mere washing of mordanted wool presents difficulties. It is, indeed, impossible to wash away completely and quantitatively, even when the rinsing is continued for several days, that portion of the mordant solution adhering to or penetrating the wool-fibre, but which is not absolutely fixed. Hence one is compelled to abandon for the present the analysis of the mordanted material, since not only are the difficulties connected with it too great, but it demands also far too much time.

We have, therefore, endeavoured to form some idea of the quantity and composition of the mordant fixed on the wool in the following manner: The weighed wool (10 grms.) was mordanted in tared dyed vessels using 600 grms. liquid, and the evaporated portion was subsequently made up with distilled water—*i.e.*, till the whole again weighed exactly 600 grms.—before measuring off a certain portion for analysis. The difference between the amount of the various constituents of the mordant employed and that found to remain in the waste mordanting liquor was considered as having been fixed on the fibre. Even this method is not wholly free from objections, but in the absence of satisfactory methods of analysis one must rest content with what is attainable.

The most important mordants in wool-dyeing are certainly the chromium mordants—indeed they have been called the mordants of the future; and C. Koechlin says of chromic oxide "c'est la base la plus resistante, celle qui détermine le plus d'insolubilité et de solidité." Hence our original idea was to confine our attention solely to the study of chromium mordants. As the work proceeded, however, we felt compelled to turn aside occasionally from the path at first pursued, with the object of gaining a deeper insight into the general behaviour of the wool-fibre. Our contribution, however, must only be regarded as tentative and incomplete, many workers are required before one can attain to anything like a full knowledge of the question, hence it is very desirable that as many as possible should attack this wide and difficult field of investigation. We quite agree with Bowman when he says in his work on the "Structure of the Wool fibre," on page 348, "we have probably more to learn chemically than mechanically, but this knowledge is more difficult to acquire." It is perhaps well to point out that there is a world of difference between the experiments of the theoretical and practical man. The dyer finds himself deeply interested at different times, first with one then with another detail, chiefly because he desires to obtain some particular result either in a cheaper manner or in shorter time, or perchance because he is compelled to make *some* progress either in consequence of the complaints of the manufacturer or because of competition. The experiments of the investigator on the other hand aim at embracing a wider area, and he endeavours to take up a higher and more ideal standpoint from which to obtain newer and more general views. Unfortunately this method and the value of such work is as a rule very much under-rated by practical men. How unpleasant it is, for example, for the chemist to have his suggestions met with the oft-repeated remark, that to carry them out would be far too expensive. Apart from the fact that on closer examination this is often found not to be the case, indeed the very opposite sometimes occurs, it not unfrequently happens that the apparently greater expenditure is amply compensated for by more certain work, brighter and faster colours, and such as injure the fibre less. It is scarcely conceivable that a calico-printer would refuse to use citric acid, lime juice, tartaric acid, &c. because of their comparatively high price, whereas even now many a dyer of equal standing believes that he can substitute for the above substances, more particularly for tartaric acid, the cheaper sulphuric acid, just because he is not aware of the fact that in many cases they exercise totally different effects.

1. *Bichromate of Potash as a Mordant for Wool.*

This is a subject to which of late years a good deal of attention has been directed, and respecting which much has been written. Although the details connected with the application of bichromate of potash to wool seem to be less complex than with other mordants—*e.g.*, chrome-alum, the views concerning it as expressed by different writers show considerable divergence.

It is interesting to note that the first to observe the formation of a chrome and logwood black was Runge, its practical application being suggested by Prof. Leykauf (Nürnberg).

Camille Koechlin (1853) first drew attention to the extraordinary fastness of the chrome dyes. Already before this English dyers had made considerable use of bichromate of potash as a mordant, but they considered that the colours obtained by its aid were not so fast as those given by iron and copper mordants. No doubt this was owing to the fact that they employed it chiefly in dyeing logwood blacks. Since the early days it does not appear that any important changes have been made in the mode of applying bichromate of potash to wool, at most it is now used in smaller proportion than formerly, but even this is uncertain, so meagre is the literature on the subject. This fact suggests by the way, the desirability of the older dyers of to-day furnishing the material for a history of dyeing, for there are no doubt locked up in their note-books interesting observations worthy of examination and study if they were only rendered accessible.

Before proceeding to give details, it is necessary to describe how all our mordanting and dyeing experiments have been carried out. Not unfrequently there appear to be contradictions between what is observed in practice and in the laboratory of the chemist, and it is well to explain how these may arise and to reconcile if possible the apparently contradictory statements sometimes met with.

It must be at once conceded that it is altogether impossible to work in the practical dye-house and in the laboratory exactly under the same conditions. In the experimental dye-house of the Yorkshire College, for example, 10 grm. patterns of woollen cashmere are worked in each dye vessel, stirring almost continuously with a glass rod, and keeping the material as much as possible below the surface of the liquor. In practice, on the other hand, a certain portion of the fabric, as it passes over the winch of the dye-bath, is always exposed to the air, hence cooling and evaporation takes place. In this case, therefore, it is very probable, when dyeing with logwood in an alkaline bath, *i.e.*, one containing chalk, a useful oxidation of the colouring matter takes place. Another and perhaps more important difference is that in the laboratory the bath boils down and becomes more concentrated, whereas in practice, when the steam is blown direct into the dye liquor, the bath becomes more and more dilute through condensation of the steam. This condensation is frequently so considerable, that a portion of the liquor has to be run off to enable one to continue the dyeing process. If we attempt in the laboratory to work with the small proportion of water with respect to cloth, which the practical man on economical grounds feels bound to employ, the dyed patterns are apt to be spotted and irregular, and hence unsuitable for exact comparison. Generally speaking, the amount of water employed by the practical dyer is about 30 times the weight of the cloth.

After demonstrating the importance connected with the concentration of the mordant and dye-baths by preliminary experiments, we decided to use 600 cc. water per 10 grms. wool. The apparatus employed consisted of a large copper sand-tray suitable for holding eight glass beakers. After thoroughly wetting out the patterns they were entered into the cold solutions, which were then gradually heated to the boiling point in the course of one hour, this temperature being then maintained for 1½ hours. The patterns were afterwards squeezed through rollers and well washed in a large quantity of water, then squeezed and washed in fresh water several times, and finally squeezed again. In some cases the patterns or portions of them were passed through a cold dilute alkaline solution, then washed and squeezed.

Special importance is attached to the amount of water employed, because as will be seen in a subsequent paper, a peculiar dissociation occurs in the case of alum mordants, and the extent to which it takes place depends essentially upon the amount of water used, *i.e.*, upon the state of dilution of the mordant. It is evident, too, that the amount of acid to be added to a bath to prevent such dissociation must depend upon the concentration of the bath. Suppose, for example, one gram ferric nitrate is diluted with 300, 600, 900 cc. water respectively; in order to avoid precipitation through the formation of basic salts, experiment shows it to be necessary to add 2.16, 2.47, 2.7 c.c. normal hydrochloric acid, that is, amounts which stand in the ratio, 1, 1.14, 1.25, or equal to a difference of 25 per cent. The practical inference to be drawn from this is, that the addition of such amounts of acid as give good results with a bath containing 900 cc. may, with a bath containing only 300 cc., act very injuriously in certain cases, and *vice versâ*.

Many contradictions may occur therefore through neglecting this point, and it explains too the reason of the great differences noticed, for example, in the recipes given for single-bath processes, for dyeing with the acid azo-colours, benzidine colours, &c.

The different statements met with, as to the amount of bichromate of potash to employ, also the utility of the addition of acid as well as its relative proportion, are for the most part to be ascribed to the varying quality of the water employed, apart from any alkali still left in the wool from the scouring process, a circumstance already referred to by other writers. According to Knecht wool takes up from *neutral chromate of potash* only 36 per cent., and from *bichromate of potash* only 48 per cent. of the amount of chromium which it fixes when boiled in a bath of *chromic acid* itself.

An addition of calcium acetate to the chrome bath has already in the ordinary course of our students' experimental work, been found to give bad results, and it is more than probable therefore that the chromates of calcium and magnesium behave similarly to the chromate of potassium. It may be accepted indeed that the loss of chromium due to the use of hard water rich in bicarbonates of lime and magnesia is considerable, and that in such cases the addition of acid to neutralise these earths cannot but act beneficially.

The most detailed and important data referring to the action of bichromate of potash in the mordanting of wool are those of Knecht and Nietzki.*

With respect to bichromate of potash when used alone, *i.e.*, without the addition of acid, Knecht advances the following theory: Under the influence of the wool (in consequence indeed of its attraction for the chromic acid) the bichromate of potash is decomposed, chromic acid is fixed upon the fibre, being chemically combined with it, and there remains essentially neutral chromate of potash in the bath thus :—

$$K_2Cr_2O_7 + H_2O = H_2CrO_4 + K_2CrO_4$$

Nietzki states that in addition to this a reducing action takes place, which he expresses by the formula—

$$5\ (K_2Cr_2O_7) = 5\ (K_2CrO_4) + Cr_2(CrO_4)_3 + 3O.$$

Further, in accordance with the following equation, Nietzki considers that alkali is liberated, thus :—

$$K_2Cr_2O_7 + H_2O = 2\ (CrO_3) + 2\ KHO.$$

Knecht has replied to Nietzki's views, and expresses the fear that, if correct, the wool would suffer through the action of alkali and oxygen, in accordance with the following equation :—

$$5\ (K_2Cr_2O_7) + 5\ H_2O = Cr_2(CrO_4)_3 + 10\ KHO + 9\ O_2$$

Unfortunately this equation has an error in it which if corrected in the following manner—

$$5\ (K_2Cr_2O_7) + 5\ H_2O = 2[Cr_2(CrO_4)_3] + 10\ KHO + 3\ O_2$$

would reduce the defect of oxidation to one-third. This danger, however, is not so serious when the matter is considered from the practical point of view. When three per cent. bichromate of potash is employed, the above five mols. $K_2Cr_2O_7$ represent 1·475 kilos. bichrome for 49·166 kilos. wool. This last number must, however, be trebled, since according to Knecht only one per cent. bichromate is actually utilised; this makes, therefore, 147·5 kilos. wool on which six atoms, *i.e.*, 96 grms. of oxygen can act. Further, those who have endeavoured to calcine wool will know full well how difficult the operation is, and what a large amount of oxygen is required to complete the operation. All this tends, therefore, to show that the fear of destroying the wool by oxidation is unfounded. As to the caustic alkali, its destructive action is removed very largely, if not entirely, in consequence of its combining with a portion of the bichromate of potash to form a neutral chromate. Nietzki does not consider that any weakening of the fibre takes place, neither has Witt or Lehne discovered any.

Whiteley adopts Knecht's view that the wool takes up from the bichromate of potash only chromic acid, and states further that the waste mordanting liquor contains no chromic oxide. Witt, too, considers that chromic acid is fixed on and combines with the wool, and that since chromic acid as such cannot of course act as a mordant it must first be reduced to chromic oxide, *e.g.*, by sodium bisulphite, cream of tartar, oxalic acid, &c., and that the basic salt thus formed combines with the colouring matter in the dye-bath, or it is reduced in the dye-bath itself at the expense of a portion of the colouring matter.

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* Presuming the work of these authors on this subject to be well known, it is only referred to in so far as seems necessary to explain their views, and the same may be said with respect to the notes of others found scattered about in various journals.

Our own experiments with bichromate of potash have given results similar to those obtained by previous investigators, and for the most part they confirm them. Whenever wool is boiled with a solution of bichromate of potash it is first seen to acquire a *pure yellow colour*, probably due to the absorption of chromic acid; gradually, however, it acquires a more or less distinct *brownish or olive-yellow tint*, which becomes more and more pronounced as the boiling continues; at the same time the bath acquires a slightly alkaline reaction. Now brownish or olive-yellow is the colour of the basic chromium chromate $Cr_2O_3CrO_3$, the so-called chromium superoxide—

$$CrO_2, \textit{ i.e.}, (Cr_2O_3CrO_3) \text{ or } 3CrO_2 \text{ or } Cr_3O_6.$$

This compound, readily prepared apart from the fibre, is very readily decomposed by boiling caustic alkali into a soluble chromate and chromic oxide thus:—

$$Cr_2O_3CrO_3 + 2\ NaOH + 2\ H_2O = Cr_2(OH)_6 + Na_2CrO_4.$$

Nietzki endeavoured to prove the composition of the chrome mordant fixed on the wool by the means of this reaction, but curiously enough without success, for he found on boiling the chrome mordanted wool with ammonia and also with sodium carbonate, that everything was dissolved from the fibre. If, however, the mordanted wool is thrown at once into a boiling solution of dilute carbonate of soda, the decomposition of the mordant is soon effected, and in this manner the wool becomes coloured a greyish-green with chromic hydrate. Boiling water even will effect the same decomposition.

In the waste mordant solution too one may usually detect the presence of a little chromic hydrate, by boiling the solution with a little ammonium chloride and ammonia. This is also an evidence of course that a reducing action has occurred. The precipitate has frequently a slightly brownish tinge due to the presence of a little chromic acid in combination.

The above experiment, however, is not intended to show that the whole of the chromium is present upon the wool as $Cr_2O_3.CrO_3$, it merely explains the brownish or olive colour of the chrome mordanted wool and proves the presence of Cr_2O_3 in addition to CrO_3. If of the available bichromate of potash only about one-third (Knecht gives 32·9 per cent.) is utilised, the compound fixed on the wool should be a more acid chromium chromate than $Cr_2O_3.CrO_3$, and according to Nietzki at an early stage of the mordanting process there is certainly on the wool $(Cr_2O_3.\ 3\ CrO_3)$, *i.e.*, $Cr_2(CrO_4)_3$.

In our opinion the following equation probably represents what takes place during the mordanting of wool with bichromate of potash, since it conforms with the facts of the case.

$$3\ (K_2Cr_2O_7) + 3\ H_2O = 2\ (Cr_2O_3.CrO_3) + 6\ KHO + 3\ O_2.$$

It is well to add that so far as our observations go, one must never expect to obtain on the mordanted wool a sharply defined chemical compound, for, according to the quality of the wool, the concentration of the bath, the duration of the boiling, and the completeness or otherwise of the washing after mordanting, there remain on the wool different amounts of mordant, and in many cases it must vary somewhat in chemical composition. If at an early stage of the mordanting process, for example, there is comparatively little or even no Cr_2O_3 and much CrO_3, the relative amounts of the two will vary considerably during the continued boiling, and again during the washing afterwards, so that there will remain on the wool finally a compound which is comparatively richer in chromic oxide.

In the mordanting of wool therefore, we are confronted with conditions altogether different to those met with in the case of cotton, and the difficulties encountered, as already pointed out by Witt, will probably continue until we gain a more definite knowledge of the protein substances generally.

Scurati-Manzoni has also observed the above-mentioned reduction to Cr_2O_3, and ascribed it to the presence of the sulphur in the wool, because as the wool gradually acquired a greener colour, he found increasing amounts of potassium sulphate in the bath. By boiling for 10 hours the wool became quite green, and by working with a pressure of two atmospheres the whole of the bichromate of potash was reduced in three hours even. The wool had then a dirty green colour and evidently contained therefore a very basic hromium chromate.

The conditions of working here employed are of course altogether out of the question in practice, but it seemed to us possible that one might obtain the same result in another manner. For this purpose wool was saturated with solutions of potassium chromate and bichromate of such a strength that the amount of mordant absorbed was equivalent to the use of 3 per cent. bichromate of potash in the ordinary manner. After drying, the fents were steamed, and in this way not only was the bichromate, but even the chromate of potash almost entirely reduced, particularly the former, presumbably according to the following equations—

$$(K_2Cr_2O_7 + 4\ H_2O = Cr_2(OH)_6 + 2\ KHO + O_3).$$

$$2\ (K_2CrO_4) + 5\ H_2O = Cr_2(OH)_6 + 4\ KHO + O_3.$$

This experiment conclusively demonstrates the fact that *reduction may be effected by the wool-fibre itself*, and one need not necessarily therefore adopt Nietzki's view, that owing to the amido-acid character of the wool-fibre, both K_2O and CrO_3 are fixed simultaneously.

The chromic hydrate formed in this manner proved to be a good mordant, while the fibre had apparently not suffered. The wash water of the wool had an alkaline reaction.

Now when we consider how tedious the present methods of mordanting wool are, and how often the material suffers through felting, it is very probable that, in certain cases, *e.g.*, in the mordanting of slubbing, one would obtain better results in many respects by this padding and steaming process. The method appears to us to be well worthy the attention of dyers, and we strongly recommend it for trial on a practical scale.

The addition of reducing agents to the ordinary bichrome mordant bath, *e.g.*, glucose, &c., was found to have no action, partly because of the great dilution, partly because reduction seems only to take place in acid solutions.

In recent years attempts have been made to replace bichromate of potash by fluoride of chromium, because it is maintained that the former gives impure shades, due to the presence of chromium chromate or to oxidation products of the colouring matter; according to Kopp, bichromate of potash even hinders the formation of bright coloured lakes, and it also attacks the fibre. Certain it is that different shades are obtained in dyeing, according as one mordants with bichromate of potash or with a chromic oxide salt, and no doubt the intelligent dyer will always adopt the form most suitable in any given case. Bichromate of potash has, however, certain advantages over the chromic salts, which will probably give it the preference for some time to come.

Some of the objections urged against the use of bichromate of potash as a mordant disappear whenever it is employed in suitable amount, *i.e.*, not in excess. As a rule, 3 per cent. on the weight of wool is recommended. Grison considers 2 per cent. as sufficient, and warns the dyer not to use above 2½ per cent. Jarmain recommends at most 3 per cent., with 4 per cent. he says "the colour becomes impaired, and with 12 per cent. over-chroming occurs."

Now, experiments in the Yorkshire College dye-house show that with alizarin the colour improves as the amount is increased from 3 to 20 per cent., and that large amounts are only very injurious in the case of logwood and some other dyestuffs (over-chroming). Taking the view that only one-third of the bichromate is really effective, and that for a full claret colour, with 12 per cent. alizarin, there is required 20 per cent. bichromate, we find that these proportions are just those which are requisite to form normal chromium alizarate—

$$295:3600 = 1:12{\cdot}2$$

$$Cr_2O_3 + 3\ (C_{11}H_8O_4) = Cr_2\ (C_{14}H_6O_4)_3 + 3\ H_2O$$

This is interesting to those who share our views that the law of chemical equivalents reigns in the domain of dyeing as elsewhere.

The question is often asked what becomes of the chromic acid which bleeds from the mordanted fibre into the dyebath. Now, the fibre itself is incapable of really fixing chromic acid as such, as some maintain, and during washing, especially in hot water, a larger or smaller quantity is dissolved from the fibre. So much, indeed, is this the case that some have been led to declare that the mordanting of wool with bichromate of potash is of a purely physical nature, since by washing nearly the whole of the chromium may be removed.

With respect to chromium chromate, prepared apart from the fibre, it has long been known that by continued washing with slightly alkaline water it is entirely deprived of its chromic acid, leaving chromic oxide behind (Runge's "Grundriss der Chemie, 2, 36), and we find the same result occurs if water only is used, *i.e.*, in the absence of any alkali. Further, it has been equally long known, that on boiling chromic acid with organic substances it is reduced.

Now, it appeared very improbable that such small quantities of chromic acid as would bleed out from the mordanted wool could oxidise alizarin in the dyebath. On the other hand, the presence of chromic acid in the waste alizarin dye liquor could never be detected. In order to obtain some information on the point, it was decided to allow bichromate of potash and alizarin alone to act upon each other, that is, under the same conditions as in dyeing, but without the presence of the wool. 1 grm. alizarin (20 per cent. paste), 0·082 grms. bichromate of potash, and 500 cc. distilled water were boiled together for three hours, keeping the volume of the liquid constant by making occasional fresh additions of water. After some time the liquid became reddish, and gradually a lake was formed which was collected and washed. The filtrate, which had a slightly alkaline reaction, still contained a good deal of chromic acid, but only traces of alizarin. It was noticed, however, that a portion of the alizarin sublimed away with the steam. The lake consisted of chromium alizarate and a little free alizarin. Alizarin alone is therefore capable of reducing chromic acid.

With the presence of wool the reaction proceeded even more favourably. Along with 1 grm. alizarin (20 per cent. paste) the theoretical amount of bichromate of potash was employed, viz., 0·082 grms.; also the following amounts:—0·123, 0·164, 0·205, 0·246, 0·328 grms. The wool was entered into the bath at 40° C., and then boiled for two hours. All the baths contained lake, which gradually increased in quantity from baths one to six. All had a neutral reaction, and were totally free from alizarin. No. 1 contained the merest traces, No. 2 slightly more, and the rest gradually increasing amounts of chromate of potash. Notwithstanding the absence of lime salts, the dyed wool stood soaping very well, and all the colours were bright claret reds, very similar to each other in shade. It must not be forgotten, however, that the wool itself contained a little lime. Cotton submitted to the same process merely acquired a pale peach colour, while the bath contained a good deal of lake.

The reaction which takes place in this interesting method of dyeing in single-bath may possibly be expressed by the following equation:—

$$K_2Cr_2O_7 + 3\ C_{14}H_8O_4 = Cr_2\ (C_{14}H_6O_4)_3 + 2\ KHO + 2\ H_2O + 3\ O$$

although its correctness remains to be proved by further experiment. Probably the potash here takes the place of lime in inducing formation of the lake.

It is worthy of note that in all the varied mordanting experiments made, the production of ammonia from the wool was observed; quantitative determinations were not made, but it appeared as if bichromate of potash developed much less ammonia than chromic acid or bichromate with the addition of different acids. Large additions of acid developed more ammonia than small additions, and sulphuric acid more than organic acids or cream of tartar.

Certain observers state that sodium bichromate acts more energetically than the potassium salt; but for our purpose the use of sodium bichromate offered no special interest, hence its behaviour was not studied. When acids are used as well, it is evident the action of the two salts must be the same.

2. *Bichromate of Potash and Sulphuric Acid as a Mordant for Wool.*

According to the character and amount of acid employed, different compounds are produced. Although, as is generally known, the equation

$$K_2Cr_2O_7 + H_2SO_4 + H_2O = K_2SO_4 + 2\ H_2CrO_4$$

does not really express the reaction which takes place on mixing aqueous solutions of bichromate of potash and sulphuric acid, but that potassium poly-chromates and acid potassium sulphate are formed, still, for the sake of brevity, the equation may be assumed as correct, and chromic acid, though unknown in the free state, may be expressed by the formula H_2CrO_4.

In the mordanting of wool, the effect of a mixture of equal molecules of bichromate of potash and sulphuric acid is known to be practically the same as that of a solution of crystallised chromic anhydride (chromic acid); moreover, at the end of the mordanting process the waste liquor contains potassium sulphate.

The most striking fact, however, connected with the use of chromic acid is that the whole of it can be fixed upon the wool, which never occurs in the case of bichromate of potash. With the addition of gradually increasing amounts of acid up to a certain point the absorption of the chromic acid by the wool proceeds so rapidly that the practical dyer may well be on his guard against unequal mordanting.

Another source of inequality, the danger of which however, is probably not so great as some have supposed, is that due to the exposure of woollen materials in the chrome mordanted condition to the action of light whereby reduction takes place, and perchance a larger quantity of chromic oxide is deposited in one part than in another.

To re-examine this effect, wool was mordanted with chromic acid, and after squeezing, at once exposed in a photographic copying frame for 24 hours; it was then washed and dyed with logwood. The dyed colour in the part protected from the action of light certainly appeared somewhat paler than the rest, but in practice the difference of conditions in separate parts of the fabric would probably never be so marked as in this experiment.

Another circumstance, however, and one which may have more serious results in producing irregular colours, is that of "feeding," *i.e.*, a residual mordanting which takes place when mordanted pieces are allowed to lie or hang in the unwashed condition. In consequence of the energy with which wool attracts chromic acid, the mordanting action proceeds even in the cold, namely, in those parts of the wool to which liquor has drained, and it there gives rise to a darker colour.

According to Jaquemin wool and silk have the property of combining with chromic acid, as such, so firmly (in his opinion, chemically), that the latter cannot be removed by washing or soaping. In contact with other organic substances, however, reduction takes place, thus—

$$5\ (H_2CrO_4) = Cr_5O_{12} + 5\ H_2O + O_3$$

$$Cr_5O_{12} \text{ is } Cr_2O_3 . 3\ CrO_3,$$

so that here again only one-fifth of the oxygen is given off. It is well to note, however, that Jaquemin worked under conditions which do not obtain in practice. He mordanted at a temperature of 30° C. in baths containing more than $2\frac{1}{2}$ times as much bichromate of potash and sulphuric acid as is usually employed.

If one works at a temperature of 100° C. for about $1\frac{1}{2}$ hours reduction always takes place, and the mordanted wool has a brownish-yellow or pale olive colour. When using 3 per cent. bichromate of potash only about 1 per cent. is attracted by the wool, whereas with the addition of sulphuric acid double this amount is fixed on the fibre. It does not appear to be permissible to determine the chromium volumetrically in this case, since considerable amounts of chromic oxide were invariably found in the bath. The reduction increases with the duration of the boiling until it may be entirely completed; it increases also to a certain extent with the use of larger amounts (2—3 mols.) of sulphuric acid. This fact seems to have been already noticed, since Jarmain mentions the formation of chrome-alum in concentrated baths of potassium bichromate and sulphuric acid, thus—

$$K_2Cr_2O_7 + 4\,H_2SO_4 = K_2SO_4 + Cr_2(SO_4)_3 + 4\,H_2O + 3\,O$$

Lodge considers reduction as taking place, thus—

$$3\,K_2Cr_2O_7 + 6\,H_2SO_4 = 6\,KHSO_4 + 2\,Cr_3O_6 + 3\,H_2O + 6\,O$$

$$\text{or} = 3\,K_2SO_4 + Cr_2(SO_4)_3 + Cr_2O3\,.\,2\,CrO_3 + 6\,O.$$

According to Whiteley both the bath and the wool contain chromic oxide, and the latter chromic acid as well. Topper also succeeded in extracting chromic acid from the wool. As already stated on mordanting with chromic acid deep olive coloured wool is obtained, and by a treatment with boiling sodium carbonate the chromium chromate is decomposed the wool acquiring a chrome-green colour, chromic acid going into the solution.

The reaction may perhaps best be expressed as follows:—

I.

$$5\,H_2CrO_4 = 5\,H_2O + 3\,O + Cr_5O_{12}.\ (\textit{i.e.}\ Cr_2O_3\,.\,3\,CrO_3)$$

II.

$$3\,H_2CrO_4 = 3\,H_2O + 3\,O + Cr_3O_6.\ (\textit{i.e.}\ Cr_2O_3\,.\,CrO_3).$$

It may be mentioned that chemists are acquainted with a chromium chromate of the formula $[Cr_2O_3\,.\,2\,CrO_3 + 9\,H_2O]$, that is, a compound intermediate between those given in the foregoing equations.

To throw if possible a little more light on the question, 10 grams wool were mordanted with chromic acid equivalent to 3 per cent. potassium bichromate; after washing, the fent was boiled for 1½ hours in 600 grms. water, along with 10 grms. of fresh unmordanted wool, both samples being finally washed and dyed. This experiment confirmed the fact that the union of the chromic acid with the wool is of a very loose character, since the second sample became decidedly mordanted, assuming a deep cream colour, whereas the first fent lost its olive colour, *i.e.*, chromic acid was removed, and there remained grayish-green chromic oxide behind.

The colours obtained on dyeing corresponded exactly to the amount and condition of the chromium fixed on the wool.

As expected then, the second boiling along with the sample of fresh wool acted similarly to the boiling of the chrome mordanted wool with sodium carbonate. The amount of chromic acid thus extracted is of course always very small, because it must be remembered that the major portion (two-thirds) is fixed on the wool as chromic oxide.

This experiment explains clearly a fact long since observed in the course of our students' work, namely, the marked difference in the ultimate shade obtained if the chrome mordanted wool is boiled in a fresh bath with water only, previous to dyeing with logwood, by which treatment the blue is much brighter and similar to that obtained when the wool is mordanted with bichromate of potash and tartaric acid.

Since the ratio between the chromic acid and chromic oxide fixed on the wool during the mordanting process varies with the quality of the wool, the amount of acid and water employed, and especially according to the duration of the boiling, quantitive determinations offer little interest. In several determinations made with wool mordanted with chromic acid corresponding to 3 per cent. bichromate of potash, it was found that the amounts of chromic acid removed from the bath, *i.e.*, taken up by the wool, were 65·3, 65, and 64·9 per cent. respectively, numbers which agree therefore with those given by Knecht. The chromium was determined gravimetrically as chromic oxide. It is interesting to note that according to Lodge, chlorinated wool, when mordanted with 3 per cent. bichromate of potash, takes up about twice as much as ordinary wool, viz., 76·64 per cent. instead of 38·68 per cent.

If wool is mordanted with 3 per cent. of bichromate of potash, it is not usually possible to fix the whole of the chromic acid on the fibre, the bath almost invariably showing a pale yellow (not orange) colour; if, however, only 1·5 per cent. is used, absolutely colourless baths are obtained, especially if 2—3 mols. sulphuric acid are employed along with it.

In order to see how far it is possible to exhaust a chromic acid bath, a fent was mordanted with 3 per cent. bichromate of potash with the addition of an equivalent amount of sulphuric acid (about 1 per cent.); the exhausted bath was then made up again to 600 grms., 1 per cent. sulphuric acid was added, and a second woollen fent was mordanted. The process was then repeated a third time.

With the third fent the bath was totally exhausted. Only a very slightly acid reaction was shown by the waste liquor of the first bath.

Wool padded in chromic acid solution, so that the amount absorbed is equivalent to 3 per cent., attracts, even during the padding operation, so much chromic acid, that it is not entirely reduced to chromic hydrate by a subsequent steaming process, and the wool is coloured a full deep yellowish olive (chromium chromate) instead of green as one might have expected, and as one would probably obtain with weaker solutions of chromic acid. The wool thus treated proves to be very difficult to wet out.

During the mordanting of wool with chromic acid it is somewhat striking to observe the rapidity with which the wool attracts it, especially with the use of 2—4 mols. sulphuric acid. So rapidly, indeed, does it occur, that in practice it is very difficult to avoid irregular mordanting, and this defect may partly explain why many dyers prefer to use bichromate of potash alone, almost exclusively. The slight roughening of the fibre, observed in practice, causing loose wool not to spin so well and with more waste, may be due to the employment of excess of acid. Apart from these defects, however, all our experiments show that chromic acid is by far the best mordant, in so far that it fixes the largest amount relatively of chromium on the wool. The best results were obtained with 3 per cent. of bichromate of potash and an addition of 2 per cent. of sulphuric acid; with 1 per cent. bichromate the addition of even as large a proportion as 1 per cent. sulphuric acid gave good results, whereby a much greener mordanted wool was obtained.

In one experiment the following proportions were employed—3 per cent. bichromate of potash with addition of 1, 2, 3, 4, 5, 6 molecules sulphuric acid. During the first half hour the fents had an orange colour increasing in depth from one to six; afterwards they became gradually of a greener hue, Nos. 1 and 2 still showing a yellowish tint, No. 3 less so, and Nos. 4 to 6 exhibiting all about the same greenish tint. These appearances show that reduction had taken place at the expense of the wool. On dyeing the mordanted fents with Alizarin Bordeaux G., No. 1 fent took up the colour most rapidly, but No. 2 showed the best tone of colour. From 2 to 6 the waste mordant liquors showed an increasingly acid reaction.

In another experiment two patterns were mordanted, one with 3 per cent. bichromate of potash alone, the other with the addition of 4 mols. sulphuric acid; they were afterwards dyed with 10 per cent. alizarin (20 per cent. paste) and an equivalent amount of calcium acetate. Both dye-baths were entirely exhausted, the first had an alkaline, the second an acid reaction. In the mordanted condition No. 1 pattern was olive-yellow with a slight greenish tint, the second was darker and much greener. In the dyed condition No. 1 was a claret of bluish tint, while No. 2 was decidedly redder.

If patterns are mordanted with *smaller* amounts of chromic acid, *e.g.*, with 1 per cent. $K_2Cr_2O_7$ + 1 mol. H_2SO_4, and with 1 per cent. $K_2Cr_2O_7$ + 3 mols. H_2SO_4, they are relatively greener than when 3 per cent. $K_2Cr_2O_7$ is used, because indeed the same quantity of wool has only one-third the amount of chromic acid to reduce, and there is present on the wool more chromic oxide and less chromic acid. The bath of No. 2 was entirely exhausted, and gave a correspondingly deeper dyed colour.

Somewhat striking is the result of the following experiment. A pattern was mordanted 5 per cent. $K_2Cr_2O_7$ + 3 mols. H_2SO_4, *i.e.*, with a large excess of mordant and an excessive proportion of acid. When dyed with 12 per cent. alizarin (12 per cent. paste), a deep brownish claret colour was obtained. Not a trace of chromic acid was to be found in the dye-bath.

The objection frequently raised that it is impossible to obtain certain shades with the use of the chromic acid are no doubt for the most part due to the employment of the mordant in excessive amount, still, whenever strong mordanting is necessary, chromic acid has undoubtedly the advantage over bichromate of potash.

If wool, silk, and cotton are mordanted with chromic acid under exactly the same conditions, the usual opinion that silk and wool behave similarly does not hold good, for whereas the mordanted wool presents a greenish-olive tint of greater or less intensity, the silk acquires at most a cream colour, while cotton is practically unmordanted. On dyeing the three mordanted samples in alizarin, the wool is seen to acquire a deep claret colour of a slight brownish hue, the silk becomes pale pink, and the cotton one which is very much paler still.

All authors agree with us that chromic acid mordants better, that is stronger, than bichromate of potash. Most recommend 3 per cent. $K_2Cr_2O_7$ + 1 per cent. H_2SO_4; Lodge gives 2 per cent. H_2SO_4, and Kertesz 3 per cent. H_2SO_4. Nietzki observed on using excess of sulphuric acid, *e.g.*, 3 molecules, that the chromic acid is rapidly and almost completely taken up by the wool. This observation agrees with ours, but it is difficult to understand why his samples after washing appeared yellow, since ours had invariably a greenish-brown or olive colour, sometimes the green (chromic oxide), sometimes the brown (chromium chromate) predominating. Leaving out differences of intensity the colour varied from a pale reseda colour to pale olive.

Nietzki suggests that the ultimate dyed colour produced is due to a triple combination of wool, colouring matter, and chromic acid. There is, however, no fact which can be advanced in support of this supposition, and we have always been inclined to adopt the view, shared also by Herzfeld and Witt, namely, that in the dyed colour the chromium exists as a chromic oxide lake, reduction taking place chiefly by means of the foreign organic substances which almost always accompany the colouring matter employed, sometimes by the impurities contained in the water (Cochenhausen), frequently by the colouring matter itself, as in the case of logwood, and lastly by the sulphurous acid of those colouring matters which have been rendered soluble by combination with sodium bisulphite.

If a filtered aqueous solution of Coerulein S, made in the cold, is heated with not too much bichromate of potash, a fine colour-lake is obtained. If there is a deficiency of readily oxidisable substances present, then the wool itself continues and completes the reduction. This fact can be established experimentally, for in no single case did we ever succeed in detecting chromic acid in the dye-bath.

In most cases of dyeing an oxidising action on the part of the mordant is undesirable, and in some cases it is actually injurious, hence many attempts have been made to entirely reduce the chromic acid before dyeing. The method proposed some time ago by Knecht, namely, by the use of sodium bisulphite, effects this in the simplest manner, but this method has long been known, for already in 1853 C. Koechlin mordanted wool with bichromate of potash, and after washing, effected reduction by means of sodium bisulphite, repeating the operations four or five times. Witt, too, has long adopted the same method. In 1881 one of us used the method with silk. Further, in 1866, Chaudet recommended the treatment with a variety of reducing solutions after mordanting—*e.g.*, sulphurous acid, alkali sulphides, organic acids, alcohol, sugar, &c. Grison too, who recommends 1·5 per cent. $K_2Cr_2O_7$ + 8 per cent. H_2SO_4, effected reduction by means of sodium bisulphite, or by using a solution of arsenious acid (10 grams per litre), treating the mordanted material with this until it acquired a green colour, and repeating the operations if necessary. Then, again, in 1857 Francillon padded wool or silk in bichromate of potash or chromic acid, and effected reduction after a few hours, by hanging the materials in the sulphur stove or by means of a solution of sulphurous acid.

In order to avoid, if possible, the necessity of employing two operations, several experiments were made by us to effect reduction in the mordanting bath itself; for example, mixtures of 3 per cent. bichromate of potash with increasing amounts of sodium bisulphite were tried, but the results were unfavourable. With the addition of 3, 4, and 5 mols. sodium bisulphite the baths acquired a brownish-olive colour, and they decomposed at 30—40° C.; with 6 and 7 mols. the wool became green coloured.

On dyeing the patterns all the results obtained were worse than with bichromate of potash alone; the best proportion was 3 mols. bisulphite per 1 mol. bichromate. With the use of chromic acid the results were even worse, and altogether useless, the baths being decomposed.

On the other hand, the following method gave better results. Two sets of patterns, three in each set, were mordanted with 3 per cent. bichromate of potash, and 1, 2, 3 mols. sulphuric acid. After boiling for one hour, 3 mols. sodium bisulphite were added to each bath of the second set, whereby the liquors became somewhat turbid, increasingly so from Nos. 1 to 3, with a corresponding increase in the greenish colour acquired by the patterns. On dyeing with logwood the patterns of the first set gave a brownish-black, those of the second a bluish-black.

Similar results were obtained on mordanting with chromic acid, if after most of the chromic acid had been fixed, we added sodium thio-sulphate (hyposulphite) say 1 and 2 mols. The baths remained clear and unprecipitated to the end, they had a yellow colour and contained no chromic oxide, while the mordanted patterns contained chromium chromate. When dyed with logwood the results were satisfactory but not sufficiently important to invite further study.

The results of two other experiments may also be recorded. One pattern was boiled with 3 per cent. bichromate of potash, 2 mols. oxalic acid and 3 mols. sodium bisulphite, a second pattern with the same but replacing the oxalic with tartaric acid. The first bath became gradually turbid, and a little impure chromic hydrate separated out, the solution showing a neutral reaction. The second bath remained clear. On dyeing with logwood poor irregular shades were obtained.

The following experiment shows that the reactions which take place during mordanting are not always so simple as one is inclined to think. A sample of wool was mordanted with $K_2Cr_2O_7 + H_2SO_4 + 6\,NaHSO_3$ with the expectation that the following reaction would occur—

$$K_2Cr_2O_7 + H_2SO_4 + 6\ NaHSO_3 = K_2SO_4 + Cr_2(SO_4)_3 + 4\ H_2O + 3Na_2SO_4.$$

The wool, however, first absorbed chromic acid, then it assumed a brownish colour owing to the formation of chromium chromate; at length the wool was totally decolourised and the bath became turbid, with the formation of a pale green precipitate containing Cr_2O_3, SO_2, and H_2SO_4, only very little of which was fixed on the wool. Similar unexpected appearances were frequently observed in the course of our experiments, and were caused, no doubt, partly by the action of the wool fibre and partly perhaps by reason of the great dilution of the solutions.

Other series of experiments were made with the object of effecting reduction in the mordanting bath by means of glucose, employing both bichromate of potash and also chromic acid, with increasing additions of the glucose. Here, too, the results were negative, the acid baths undergoing but slight reduction. The dilution of the bath in all these mordanting experiments is so great that the expected chemical reaction never occurs at all, and it appears not improbable that in consequence of this condition being ignored unauthenticated assertions are occasionally put forward.

Altogether it appeared as if little advantage could be looked for by the addition of reducing agents to the mordanting bath, and further experiments in this direction were abandoned in favour of searching for some suitable salt of chromic oxide. Moreover, the desired end can readily be obtained by employing organic acids in conjunction with bichromate of potash. At one time "cream of tartar" alone was employed for this purpose, but more recently oxalic and tartaric acids have been utilised. How such additions act chemically has never yet been determined. The usual statement is that since the mordanted wool acquires thereby a more or less greenish tint these acids have effected reduction of the bichromate. If, however, the subject is approached more closely, with the view of determining the exact character of the reaction in a quantitative manner, the question is far from simple, and we are still far from having solved it.

Experiments made with the object of throwing, if possible, some light upon the matter will be described in our next paper.

DISCUSSION.

The CHAIRMAN (Prof. SMITHELLS) said that it was owing to the munificence of the Clothworkers' Company, in making a special endowment for original research at the Yorkshire College, that it had been rendered possible to carry out the research, to an account of which they had just listened; it was greatly to be hoped that this example would be widely followed, for the modern tendency was to endow elementary scientific instruction to the neglect of the highest and most productive kind of scientific work. As to the paper itself, it was satisfactory as evidence that the chemical changes in the *processes* of dyeing were beginning to be studied; hitherto the *composition* of the dyes themselves had mainly attracted attention. The matter was not an easy one to elucidate. Wool, like protoplasm, was not a definite chemical compound, and the fixation of colour upon it involved chemical and physical questions of great complexity. It was interesting to see the application of physical chemistry to the problems of the dyer. Witt, in regarding wool as a solvent for mordant and colouring-matters, brings up the interesting question of solutions of liquids in solids, and no doubt the clue was well worth following. It was remarkable that a mixture of bichromate and sulphuric acid in molecular proportions should behave exactly like a solution of chromic acid, for to liberate a given acid from a salt by means of a stronger acid, one usually required more than the equivalent amount of the latter, unless the first acid was a very weak one. The fact that a dilute solution of ferric nitrate required the addition of relatively more hydrochloric acid than a stronger one, to prevent precipitation of basic nitrate, was an example of mass action, and could be anticipated from theoretical considerations. He understood that the chief conclusion of the authors was that the wool actually reduced chromic acid to a state of oxidation corresponding to chromic chromate, and he thought they had made out their case.

Mr. RAWSON considered that no experimental evidence of the formation of chromium chromate ($Cr_2O_3.CrO_3$) upon the fibre had yet been given; the substance deposited was probably not a chemical *compound*, but a *mixture* of the two oxides, for washing with cold water removed the chromic acid. Prof. Hummel had stated that the mordant-liquor became alkaline, but what was the indicator used? Bichromate was acid to some indicators, neutral to others. And it was unlikely that potash would be liberated in quantity more than sufficient to convert the excess of bichromate present into chromate. The percentage of ash in well-washed wool was, in his experience, never so high as 3 per cent., seldom indeed more than 1 per cent.

Mr. RICHARDSON called attention to the fact that, in considering dyeing processes, the wool itself must be taken into account as a reacting substance. He, too, thought there was insufficient evidence of the formation of chromium chromate, and, to account for the fixations of chromic acid by the fibre, suggested a reaction of the kind expressed by the following equation, which takes into account the amido character of the wool.

$$2\ (\text{wool} = \text{amido-compound}) + K_2Cr_2O_7 + H_2O$$
$$= 2\ KOH + O_2 + 2\ [(\text{wool} = \text{amido compound})\ CrO_2].$$

Mr. WILKINSON understood from the paper that chromic acid as such was not a mordant, and asked if wool steeped in it would dye, that is, would the fabric dye if all the baths in the process were kept acid?

Mr. WHITAKER observed that Prof. Hummel had derided practical men somewhat, but was glad to hear him later soliciting their help in the matter by giving him their every-day experience in chroming goods in the dyeworks. He also asked the lecturer in what condition he considered logwood should be when used with a chrome mordant, viz., in the fresh-cut state or after oxidation, and *vice versâ*, the best chrome mordant for logwood in either condition?

Mr. C. E. CRAVEN suggested that the use of a smaller amount of bichromate and sulphuric acid might be advantageous.

Mr. WARD asked if chrome alum had been experimented with?

Mr. PROCTER remarked that chromium was now largely used in the leather industry in America. The raw pelt was impregnated with chromic acid, which was then reduced on the fibre to chromium sulphate by means of sulphurous acid; the chromic acid as such having no tanning power. A consideration of this process might help to elucidate the similar process in the case of wool. The hide fibre was mainly gelatine, and probably exhibited the phenomenon of solid solution. The process was certainly to a large extent a physical one; the hide-fibre, for example, would withdraw from aqueous solution a large but indefinite amount of any acid, and this could be again removed by prolonged washing with large volumes of water, or more rapidly by treatment with chalk and water, which fixed the acid as it diffused out. A similar relation between wool-fibre and chromic acid would serve to explain the completeness of the reaction between sulphuric acid and bichromate of potash in mordanting; the chromic acid being continuously withdrawn from the solution, the balance of mass which Professor Smithells suggested as probable would not take place.

Prof. HUMMEL, in replying, considered that Witt's solid solution theory was not here applicable. That a mixture of bichromate and sulphuric acid in molecular proportions behaved as a mordant, exactly like a solution of chromic acid, was an experimental fact. Chromium chromate was undoubtedly formed at one stage upon the fibre, for the latter, at this stage, exhibited an olive-yellow colour precisely similar to that of the precipitate known as a chromium chromate, which is formed apart from the fibre on mixing solutions of chrome alum and potassium chromate; further, chromic acid could be removed from the fibre at this stage by boiling with water, or with a solution of sodium carbonate, leaving green chromic hydrate upon the fibre. Mass action was no doubt concerned, for, in order to remove all the chromic acid, it was necessary to boil with successive fresh quantities of water; many indicators had been used to determine the alkalinity of the solution, but which particular ones gave conclusive proof of alkalinity he did not remember; the potash liberated in the mordanting process, of course, went to convert the bichromate into neutral chromate, hence the yellow (not orange) colour of the waste mordant liquors. The decided alkalinity observed might, of course, be due to ammonia formed by the action of the boiling water upon the wool. The authors had themselves made no determination of the amount of ash in wool; in their introductory remarks they merely quoted from previous observers to point out difficulties connected with the subject. A knowledge of the constitution of the wool-fibre was, of course, desirable, but at present matters were not ripe enough to introduce the wool itself into a chemical equation. Knecht had supported his hypothesis, that chromic acid, as such, combines with the fibre, upon the fact that a "solution" of wool in hydrochloric acid gives a precipitate with potassium bichromate, but no one ventures to say that the wool substance is not entirely changed by the action of the acid. Colouring matters of an acid, or phenolic, character must have basic mordants in order to form lakes, and *vice versâ*. Hence chromic acid could not itself act as a mordant towards the phenolic colouring matters for which it is used, but must first be reduced to chromic oxide or a basic salt of chromium, and the main result of the research was to prove that this reduction does partly take place, and, indeed, at the expense of the material of the fibre itself. If wool were simply dipped in a solution of bichromate and sulphuric acid, and then dyed, some colour would doubtless be obtained on the fabric, but much of the chromic acid would dissolve out from the material, and there partially oxidise and precipitate the dye. If, however, the wool was not merely dipped in the solution but boiled in it for some time, then the chromic acid would be more or less reduced by the substance of the wool itself, and a proper mordanting of the fibre resulted. The effect of washing the mordanted fibre was to remove chromic acid, and, when logwood was used as the dye, to produce a slightly brighter and bluer, but not quite so full a black. Chrome alum had been experimented with as a mordant by the authors, with results that would be described in a future paper. A knowledge of the process of the chrome tanning of leather would hardly avail to explain what took place in the case of wool, since the operation was carried out in the cold with leather, but at a boiling temperature in the case of wool.

Glasgow and Scottish Section.

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G. Watson.

Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, February 7th, 1893.

MR. CHAS. A. FAWSITT IN THE CHAIR.

THE FLASH-POINT AND HEAT OF BURNING OF MINERAL OILS.

(This Journal **1892**, 885—893; and **1893**, 20—26).

REPORT OF COMMITTEE.

In pursuance of a resolution passed at the meeting held in Edinburgh on December 6th last, your Committee appointed the following sub-committee to investigate and report upon the present legal flash-point of mineral oil:—The chairman, (Mr. C. A. Fawsitt), Mr. G. Beilby, Mr. John S. McArthur, Prof. Edmund J. Mills, Mr. Edward C. C. Stanford and Mr. Daniel R. Steuart.

At a meeting of Committee held this day the sub-committee submitted the following report: —

Your sub-committee is of opinion that:—

1. The present legal flash-point (*i.e.*, 73° F.) for mineral burning oil is too low, and therefore, under ordinary circumstances, dangerous.

2. The Government Abel-test is perfectly satisfactory for determining the lowest temperature at which inflammable vapours are evolved.

3. 100° F. by this test should be the minimum legal standard.

4. The Government Abel-test is not invariably employed to determine the flash-point, as is evidenced by the fact, that burning oils flashing at from 73° F. to 86° F. Abel-test, are constantly imported and sold, bearing brands of from 120° F. to 150° F., and thereby the public are misled.

5. All burning oil imported into this country should have the Abel test plainly branded on the cask.

6. Many fatal accidents have occurred from the use of this inflammable oil, and as a measure of precaution so-called "safety lamps," constructed of metal, have been recommended. Unless the oil itself is safe, a new source of danger is introduced by "safety lamps."

Your Committee have unanimously adopted the above report, and have now the honour to lay it before you.

It was thereupon resolved unanimously: "That this meeting of the Glasgow and Scottish Section of the Society of Chemical Industry hereby approves and adopts the above report of the Committee on the flash-point of mineral oil."

ON THE ACTION OF CAUSTIC POTASH AND CAUSTIC SODA ON PURE GOLD AND SILVER.

BY THE LATE W. DITTMAR, LL.D., F.R.S., AND DAVID PRENTICE.

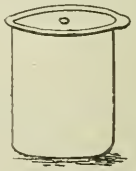
INTRODUCTORY.

Dr. G. G. Henderson, who read the paper, said that this investigation had been instituted by the late Professor Dittmar, and was in progress at the time of his death. It had been completed by Mr. Prentice, and the results attained, he thought, were of sufficient interest—if not entirely novel—to lay before the section.

PART I.—*Action of Caustic Potash and Caustic Soda on pure Gold.*

The object of the following experiments was to show how far caustic potash and caustic soda could be dehydrated without acting on pure gold and silver, and how far they acted on those metals when fully dehydrated.

For this purpose a pure gold crucible and a pure silver one were obtained of the shape shown in the figure. Each was provided with a close-fitting lid, with a perforation in the centre into which a platinum tube was inserted when it was desired to fuse in an atmosphere of hydrogen or nitrogen.



The caustic potash used in all the following fusions was obtained from Merck, and being in lumps was fused in a silver basin and cast into sticks.

It was then tested for iron, alumina, silver (which might have been dissolved off the basin), chlorine, and sulphuric acid, the result showing entire absence of iron, silver, and sulphuric acid, but very small traces, in either case, of chlorine and alumina, which however, were scarcely visible.

The caustic soda used in all the fusions was also tested, but was found to be pure.

Carbonic acid was of course tested for, and was found to be present in both cases.

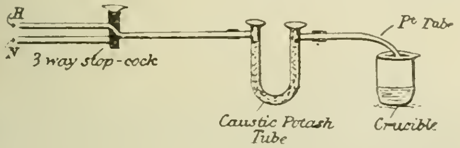
The K_2O and CO_2 in each fusion of caustic potash were estimated, and for the determination of the K_2O by titration a standard solution of sulphuric acid was made up, as well as a (CO_2-free) solution of caustic potash, the acid being standardised against the alkali. To serve as a check on the results obtained by titration, the K_2O was also determined gravimetrically by the sulphuric acid method, which will be detailed further on.

The CO_2 was determined in the usual way by the direct method.

The Na_2O and CO_2 in each fusion of caustic soda were estimated in the same way as above, with the difference that the Na_2O was not determined gravimetrically, but only by titration.

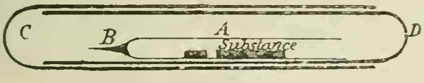
As it was sometimes desired to fuse in an atmosphere of hydrogen, and to drive out the hydrogen by means of nitrogen to prevent explosions, the two gases were prepared and purified in the following way :—

The hydrogen was obtained by acting on zinc with sulphuric acid, and the nitrogen by taking a large tubulated bottle (about 10 litres capacity) and dissolving 12 grms. pyrogallol and 60 grms. caustic soda in water in the bottom of the bottle. This was shaken up for about half an hour (the bottle having communication with another filled with water) and allowed to stand 24 hours, and was then ready for use. The hydrogen, after being evolved from the Kipp, was first passed through a tower containing pumice soaked in mercuric chloride solution to free it from arsenic, then through vitriol, and lastly through a stoppered U-tube charged with freshly-fused caustic potash, and from it into the crucible.



The nitrogen was first passed through vitriol and then through the same U-tube of caustic potash as above, the two apparatus being connected by means of a three-way stop-cock, by means of which it was easy to substitute a current of nitrogen for one of hydrogen.

Method of Weighing the Caustic Potash and Caustic Soda for the Analysis.—The substance was first put into a small glass tube (A), sealed up at one end, and with a small handle (B), which was simply a piece of glass sealed

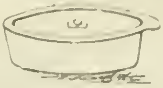


on at that end; this was put inside two other tubes, C and D, fitting closely into one another, and each being sealed up at one end. The substance was of course by this means prevented from taking up moisture from the air. The whole was carefully weighed, the tubes were opened, the small tube taken out by the handle, and the substance emptied into the flask in which the analysis had to be done. The tubes were again put together and weighed, the difference giving weight of substance used.

Method of Determination of K_2O and Na_2O by Titration.—The sulphuric acid used in all the titrations was standardised by the carbonate of soda method, the specific gravity having been previously taken.

The substance, after being weighed in the way described, was dissolved in water in a conical flask, and three drops of a 2 per cent. solution of aurine were added to act as an indicator. A 100 cc. weighing burette was now filled with the standard acid and a 50 cc. measuring burette was filled with the alkali. The burette containing the acid was weighed, and a quantity of acid was run into the flask until the liquid was acid. The red colour was again brought back by addition of alkali (no more being added than was necessary to make the liquid alkaline); from two to three drops of acid served to make the liquid again acid, and it was then boiled vigorously to expel the CO_2. After boiling for a short time the red colour was brought back by addition of alkali; the acid burette was weighed and the other read. This operation was repeated once afterwards, two readings being taken in every titration.

Sulphuric Acid Method for the Determination of the K_2O.—A platinum crucible of the shape figured was tared, and the caustic potash (weighed as described) was put into it.



The bottom of the crucible was now immersed in cold water and the substance dissolved in the smallest possible quantity of water; a slight excess of 60 per cent. H_2SO_4 was also added, and the whole was evaporated to dryness by heating from above and very gently from below. The crucible was then heated strongly over a bunsen and weighed.

Method of Determination of Carbonic Acid.—The substance (from 0·5 to 1 grm.) was weighed out and put into a 500 cc. flask with about 50 cc. of water. Immediately above the flask was an inverted condenser, then following this was the drying apparatus, which consisted of (1) a stoppered U-tube charged with fused $CaCl_2$, and (2) another stoppered U-tube charged with vitriol and pumice, enough vitriol being put in the bend of the second U-tube to show the rate at which the gas passed through it. The CO_2 was caught by two stoppered U-tubes, the first containing fresh soda-lime and the second newly-fused caustic potash; a protection tube of $CaCl_2$ and soda-lime completed the apparatus. 20 per cent. sulphuric acid was added to evolve the CO_2, and the liquid was boiled gently while from 3 to 4 litres of (CO_2-free) air were passed through the apparatus to drive all the CO_2 into the collecting tubes.

Notes.—(1.) In all the fusions a hydrogen flame was used instead of a gas flame.

(2.) In all the fusions done "in air" the lid of the crucible was kept on, the perforation in the centre serving as an escape for the vapour of water.

Fusions of Caustic Potash in Gold Crucible.—In the table below (Table I.) are given the results obtained on fusing caustic potash in the gold crucible.

Experiment I.—The potash was fused for five minutes in air, then cast into a small steel mould, and quickly sealed up in clean, dry, glass tubes. When required for analysis the tube was opened with a file, and the substance put into a stoppered tube, which was kept under a good desiccator till it had to be weighed. When the substance was put into the stoppered tube all the weighings were done at once.

Experiment II. was carried out in the same way as the preceding one, but the fusion was continued for 10 minutes.

Experiment III.—After weighing the potash put into the crucible, the platinum tube was inserted into the perforation in the lid, and hydrogen was passed into the crucible for about 10 or 15 minutes so as to expel all the air. The potash was then fused in the current of hydrogen by heating from below with a hydrogen flame. After five minutes the three-way stop-cock was turned, and nitrogen was passed for five minutes longer. This was done after all the fusions in hydrogen described below.

Experiment IV. was carried out in the same way as Experiment III., but laster longer, viz., 10 minutes in hydrogen and 5 minutes in nitrogen.

Experiment V. was carried out precisely as above, but the current of hydrogen was continued for 25 minutes and the nitrogen for 5 minutes.

The caustic potash used in the experiments was analysed, the K_2O being estimated by titration, and the CO_2 by the direct method, with the following results:—K_2O (1) 63·30 per cent., (2) 63·49 per cent., mean 63·39 per cent.; CO_2 (1) 1·08 per cent., (2) 1·19 per cent., mean 1·13 per cent.

Fusions of Caustic Soda in Gold Crucible.—Table II., below, gives the results obtained on fusing caustic soda in the gold crucible.

The experiments were done in the same way as with caustic potash. It only remains to note that in Experiment III. the crucible, by some unaccountable means,

TABLE I.—FUSIONS OF CAUSTIC POTASH IN GOLD CRUCIBLE.

Experiment.	Time of Fusion.	Atmosphere.	Weight of Caustic Potash used.	Weight lost by Crucible.	Colour of Potash after Fusion.	Total Percentage of KOH and K_2CO_3 after Fusion.
	Minutes.		Grms.	Grm.		
I.	5	Air	9·54	0·0010	Slight reddish	89·75
II.	10	,,	8·6	0·0025	Red	99·01
III.	10	Hydrogen	6·2	0·0005	Almost white	99·66
IV.	15	,,	7·26	0·0004	,,	99·80
V.	30	,,	12·85	0·0005		99·64

TABLE II.—FUSIONS OF CAUSTIC SODA IN GOLD CRUCIBLE.

Experiment.	Time of Fusion.	Atmosphere.	Weight of Caustic Soda used.	Weight lost by Crucible.	Colour of Soda after Fusion.	Total Percentage of NaOH and Na_2CO_3 after Fusion.
	Minutes.		Grms.			
I.	7	Air	9·39	Nil	White	99·91
II.	10	Hydrogen	5·36	Nil	,,	99·85
III.	30	,,	15·71	(*Gain* 0·0005 grm.)	.	99·75

gained 0·5 mgrm., although after the fusion it was boiled in water for a considerable time, as was done after each fusion.

The caustic soda used in the experiments was analysed, with the following results:—Na_2O (1) 73·49 per cent., (2) 73·67 per cent., mean 73·58 per cent.; CO_2 0·64 per cent.

PART II.

Action of Caustic Potash and Caustic Soda on pure Silver.—For the following experiments another quantity of nitrogen was prepared, but, in order to free it from the last traces of oxygen, the method of preparation was modified. Air was shaken up with pyrogallol and caustic soda as described above, and the nitrogen was then passed slowly over red-hot copper, and collected. During the fusions the nitrogen was passed through vitriol and then slowly through a combustion tube containing red-hot copper gauze, and then through two U-tubes, containing calcium chloride and fused caustic potash respectively, before going into the crucible. The hydrogen also, after purification by means of mercuric chloride and vitriol as before described, was, by means of a T-tube, passed through the same combustion tube and U-tubes.

Fusions of Caustic Potash in Silver Crucible.—Table III., below, gives the results obtained on fusing caustic potash in the silver crucible.

Experiment I.—After weighing out the potash into the crucible, hydrogen, purified in the manner described above, was passed through the crucible for about 10 minutes. The substance was then fused for five minutes in a current of hydrogen, nitrogen was then turned on, and the fusion continued for five minutes longer. The analysis of the fused potash was carried out in the same way as when the gold crucible was used.

Experiment II.—Exactly similar to Experiment I., but the fusion was continued for 10 minutes in hydrogen and 5 minutes in nitrogen.

Experiment III.—The potash was fused for 5 minutes in air, the perforated lid being on the crucible.

Experiment IV.—Exactly similar to Experiment III., but the fusion was continued for 10 minutes.

TABLE III.—FUSIONS OF CAUSTIC POTASH IN SILVER CRUCIBLE.

Experiment.	Time of Fusion.	Atmosphere.	Weight of Caustic Potash used.	Weight lost by Crucible.	Colour of Potash after Fusion.	Total Percentage of KOH and K_2CO_3 after Fusion.
	Minutes.		Grms.	Grm.		
I.	10	Hydrogen	7·0	0·0010	Dirty white	98·71
II.	15	,,	6·7	0·0012	,,	99·79
III.	5	Air	5·8	0·0020	Slightly black	94·46
IV.	10	,,	8·5	0·0108	Very black	98·30

TABLE IV.—FUSIONS OF CAUSTIC SODA IN SILVER CRUCIBLE.

Experiment.	Time of Fusion.	Atmosphere.	Weight of Caustic Soda used.	Weight lost by Crucible.	Colour of Soda after Fusion.	Total Percentage of NaOH and Na_2CO_3 after Fusion.
	Minutes.		Grms.	Grm.		
I.	10	Hydrogen	8·4	0·0001	White	98·96
II.	15	,,	7·4	0·0001	,,	99·94
III.	5	Air	8·5	0·0007	Dirty white	99·27
V.	10	,,	6·9	0·0041	Black	99·87

Fusions of Caustic Soda in Silver Crucible.—In the table below (Table IV.) are given the results obtained on fusing caustic soda in the silver crucible. The experiments were carried out in precisely the same way as those done with caustic potash, and for the same periods of time, viz., No. I., five minutes in hydrogen and five minutes in nitrogen; No. II., 10 minutes in hydrogen and five minutes in nitrogen; Nos. III. and IV., five and 10 minutes respectively in air.

Conclusions.

From the figures given above it is seen that the dehydration of both caustic potash and caustic soda is practically complete after about 10 minutes' fusion, whether the fusion is conducted in hydrogen or in air. The action of fused potash on gold is very slight in a current of hydrogen, even after 30 minutes' fusion, and much greater in air, though still comparatively trifling. Fused caustic soda, on the other hand, appears not to attack gold, either in air or hydrogen—at least, within the duration of the experiments. On silver, as is to be expected, the action of the fused alkalis is easily perceptible, and of course is greatest in presence of air; potash, again, is much more active than soda.

Discussion.

The Chairman, after thanking Dr. Henderson for having brought the results of this investigation under the notice of the Section, said that when fusing large quantities of caustic soda in silver basins he had noticed that the basins were much attacked. He had attributed this action to the presence of manganate of soda. He asked Dr. Henderson if he could explain the precise cause of the corrosion and why it was so much intensified in presence of air.

Professor Mills asked for particulars regarding the colours of the gold and silver after the fusion of the alkalis in the crucibles.

Dr. Henderson, in reply, said he was unable to give a definite answer to the Chairman's question, but he thought the action on both gold and silver was one of oxidation. So far as he was aware no record had been kept which would assist him in answering Professor Mills question, but he was under the impression that there was a purple tarnish on the gold crucible, which was easily removed by burning. In the case of silver the action was more a corrosion of the surface.

Nottingham Section.

University College, Nottingham.

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Vice-Chairman: F. Clowes.

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Sir John Turney.
G. J. Ward.
J. T. Wood.

Treasurer: J. M. C. Paton.

Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

April 19.—Messrs. J. T. Wood and W. H. Wilcox, B.Sc., "Further Contribution on the Nature of Bran Fermentation."

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Cement for Packing Steam-, Air-, and Water-Pipes, and also Boilers. Papier-Zeit. **17**, 1919.

Portland cement is mixed with sufficient water to form a stiff paste, so that when applied to a wall it will not fall off or run. This cement may be used for manhole-lids with excellent results. It is applied to the carefully-cleaned surfaces in a layer of from 5 to 8 mm. in thickness. As soon as the cement is applied the lid is carefully put upon it and slowly tightened until the thickness of the layer is reduced to from 3 to 4 mm. After an interval of several hours the cement begins to set, and now the nuts on the lid are firmly screwed down. During the next eight hours the joint is kept slightly moist so as to prevent haircracks. A manhole packed in this manner never becomes loose. In a similar manner flange-joints on water-, steam-, or air-pipes may be tightened by means of cement; such joints, if carefully prepared, prove exceedingly durable, and are much cheaper than india-rubber or asbestos packings.—C. O. W.

Evaporating Apparatus used in the Chemical Industries. J. Dannien. Zeits. ang. Chem. 1892, 479—483.

After drawing attention to the fact that the latent heat of steam, amounting to about 85 per cent. of the total heat expended, is still generally lost, the author deals with the forms of apparatus for conducting artificial evaporation in the different branches of the chemical industries.

I. *Pans fired from below.*—Pans with flat bottoms are still in use in salt-, vitriol-, and alkali-works. Their use is accompanied by high cost of repairs and expensive labour, if salts are deposited. Boat pans and caustic pots are wasteful as regards fuel. Wolf pans with saddle-shaped bottoms, and triple-flued pans such as are now in use at Stassfurt, prevent the burning-on of the precipitated salts; these collect in the cold parts of the pan as a mud and are removed from time to time by flushing out. "Thelen" pans, with semi-circular bottoms and mechanical agitators for removing the salts, work automatically with small cost of repairs and labour.

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* Any of these specifications may be obtained by post by remitting 8d.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

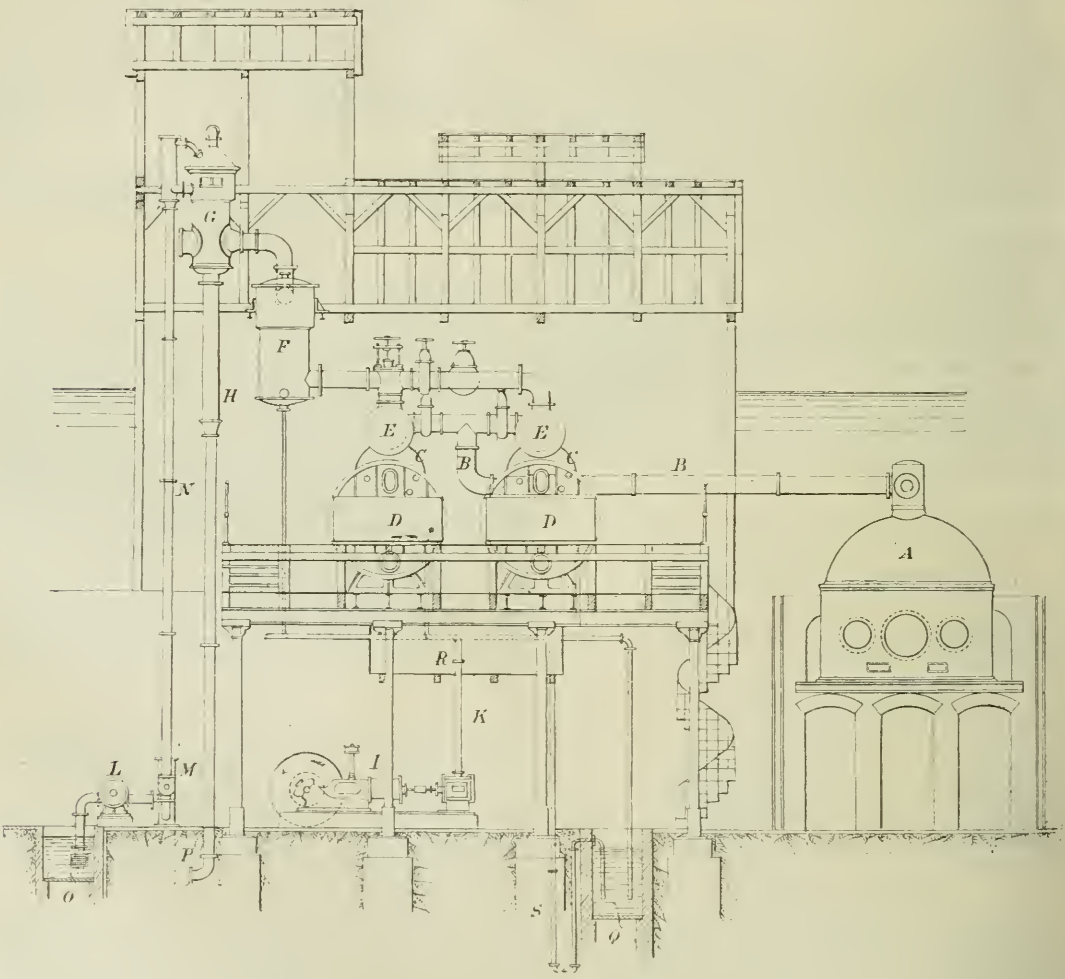
II. *Pans fired from above* are used in connection with furnaces in the alkali industry, also in the manufacture of alum and phosphoric acid and for calcining potash and caustic salts. They have the disadvantages accruing from furnace- or fire-gases—flue-dust and discontinuous working. The film forming on the surface of the liquor impedes the evaporation, and must constantly be broken up. Mechanical apparatus for agitating, and removing the salts, cause considerable expenses for repairs. The author also refers to the towers used for evaporation and denitration in the manufacture of vitriol, as well as those employed in evaporating, carbonating, and oxidising leys in the potash and alkali industries. Small cost of repairs, compactness, and high efficiency in the utilisation of heat, are to be counted as recommendations in evaporation by means of towers.

III. *Evaporators heated by steam.*—These are used in the manufacture of vitriol, alum, and nitre. In connection with steam-pipes mechanical agitation is sometimes used, to keep the surface of the pipes clean. This method of working is clean, but the latent heat of steam is generally lost. To prevent this the steam is sometimes used for heating the feed-liquor, or the steam is condensed in the closed evaporator, the water evaporated being carried away by means of an air-pump, which forms a vacuum and lowers the boiling-point to below 100° C.

IV. *Apparatus repeatedly utilising the heat of the water evaporated.*—These yield the best results. Hundreds of such apparatus are used in the sugar industry.

The chemical industry, however, has been slow to adopt these forms of apparatus. Wüsterhagen, in Stassfurt, has successfully introduced an apparatus for the evaporation of potassium chloride liquors. They are further employed for evaporating caustic-leys, magnesium chloride- and sodium-chloride- (nitrate industry), sulphate-, potash-, and Vinasse-liquors. The advantages accompanying this mode of evaporation are economy in fuel, prevention of loss of material, no inconvenience through presence of steam, and and production of cheap, pure water. Steam enters the heater of the first evaporating vessel and is condensed,

Fig. 1.



A Triple-flued vessel with furnace.
B Range of pipes with valves.
C Heater with fittings.
D Evaporator.
E Steam dome.
F Tubular feed-liquor heater.
G Counter-current cataract-condenser.
H Pipe for cooling water with relief-valve.
I Air-pump.
K Pipes to air-pump.
L Cold-water pump.
M Air separator.
N Pipe to condenser.
O Tank for cold water to condenser.
P Tank for cold water from condenser.
Q Tank for condensed water.
R Filter for salt.
S U-pipe.

giving up its heat to the evaporating liquid, which boils under normal pressure or slight vacuum. The steam from the liquor is carried to the heater of the second evaporator. in which the liquor boils at a still lower temperature owing to the increased vacuum caused by the air-pump employed. The steam from the liquor in the second evaporator is either liquefied in a condenser or further used in a third evaporator, and so on. With the number of evaporators the vacuum increases, and up to a certain limit the economy in fuel. A vacuum evaporating-apparatus evaporates with 1 kilo. of steam, assuming the liquor to be entering at 75° C., the fall of temperature to be 52° C., and the coefficient of transmission of heat = 22 :—

	Kilos. of Water.
With one vacuum-evaporator	0·9
With two vacuum-evaporators	1·93
With three vacuum-evaporators......	2·83

Fig. 2.

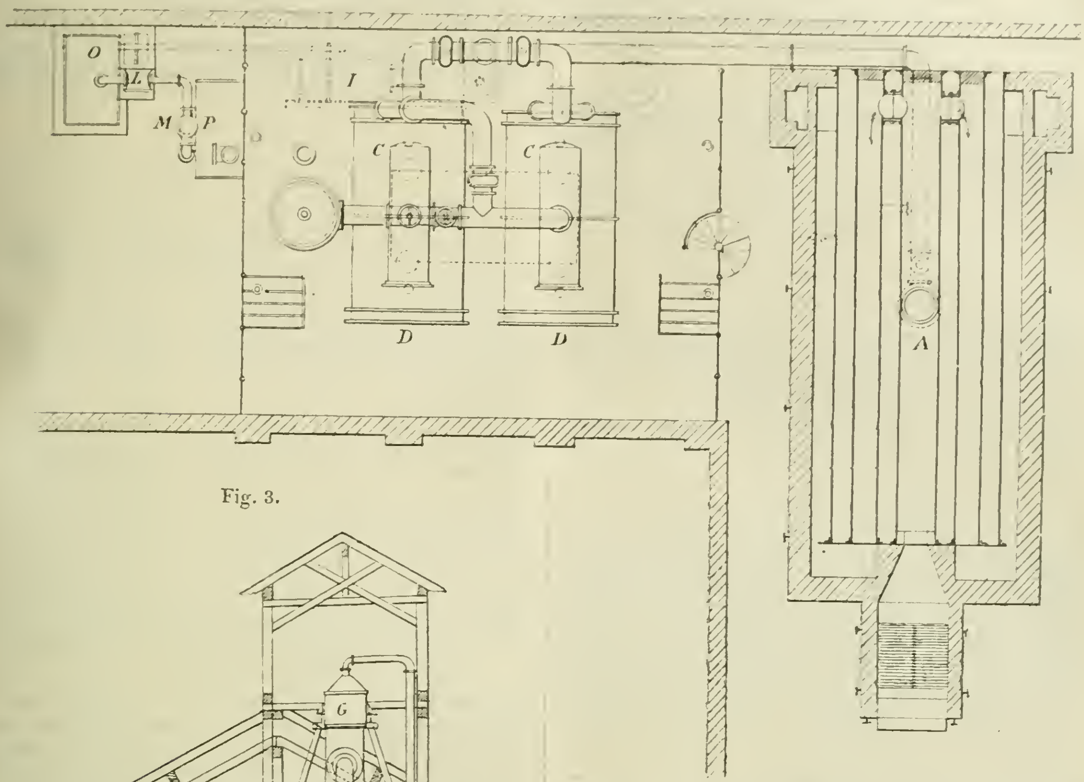
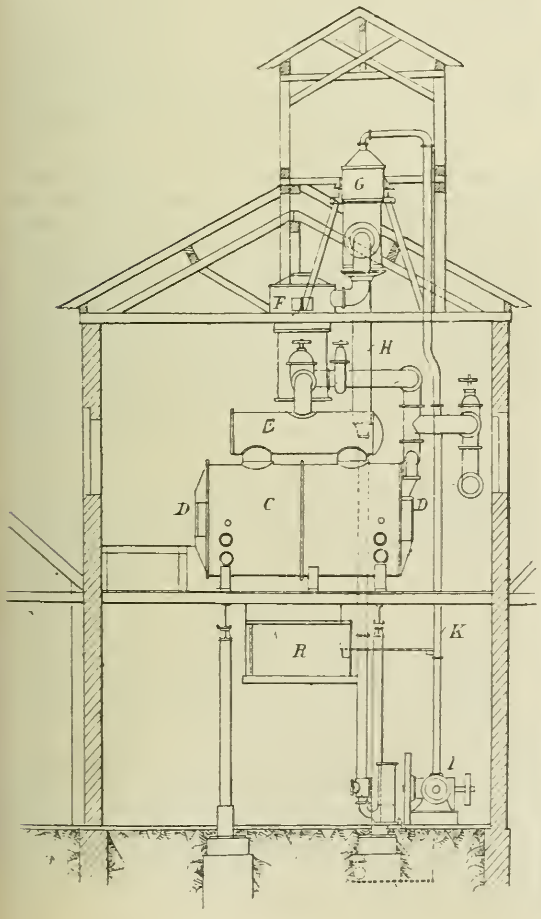


Fig. 3.



Figs. 1, 2, and 3 show vacuum evaporating-apparatus with two evaporators used for concentrating salt solutions, in combination with a triple-flued evaporating vessel, heated by coal, which gives steam of three atmospheres pressure.

Newer apparatus of Yaryan, Greiner, and other types, which have been tried in the sugar industry, are said to be still more efficient.—K.E. M.

PATENTS.

Improvements in Filter Apparatus. A. J. Boult, London. From Oesterreichischer Verein für Cellulose-Fabrikation, Vienna. Eng. Pat. 2551, February 9, 1892.

In this apparatus a horizontal cylinder, whose circumference is made of wire-gauze or other filtering material, is supported at both ends on hollow trunnions, which pass hrough stuffing-boxes in the sides of an open cistern, in which the cylinder is inserted. The trunnions are of a sufficient size to admit of an inclined trough being passed through from one end of the cylinder to the other. The water to be filtered enters through one of the trunnions and passes through the perforated wall of the cylinder into the cistern, whilst the impurities are retained and carried to the top by projecting ledges fixed inside the revolving cylinder, where they drop into the trough, together with a certain amount of the liquid, and are floated away.—B.

Improvements in Refrigerating Machinery. R. J. Cracknell, London. Eng. Pat. 4035, March 1, 1892.

This invention relates to machinery working on the ammonia-absorption principle, wherein two ammonia boilers are alternately used as evaporators and absorbers, and consists in the provision of valves and connections for establishing communications between the vapour-chambers of the two vessels in such a manner as to allow of heat being transferred from the absorber for the time being which is to be cooled, to the evaporating vessel which requires to be heated. Provision is also made for the better absorption by the weak ammonia solution of the gas entering the absorber, by causing the solution to be put in circulation by the incoming gas.—B.

Improved Apparatus for Pumping Air and Gas. W. B. Griffiths and J. Woodley, Cardiff. Eng. Pat. 4465, March 7, 1892.

This apparatus consists of a cylindrical metal drum or holder closed at the top and open below, inserted in a tank filled with water, and caused to move up and down in guides by means of a crank and connecting-rod. A vertical pipe rises in the centre of the drum from the bottom of the tank, through which the air or gas are inhaled and driven out. The pipe is fitted below with inlet and outlet valves, and finished at its upper end with a bell-mouth of a size nearly equal to the inside diameter of the drum, whilst a disc of about the same diameter is fixed to the pipe lower down, the object being to prevent or retard the oscillation of the water in the tank as the drum moves up or down.—B.

Improvements in Filtration. S. R. Lowcock, Birmingham. Eng. Pat. 5787, March 24, 1892.

The filter described, provides for the further purification of a filtered liquid by means of a current of air or oxygen blown through it under pressure. In the application to a sand-filter for water or sewage filtration the upper layers are constituted of fine sand for the purpose of retaining the coarser impurities, whilst through the lower and coarser layers are led pipes with perforations from which the compressed air issues and passes through the filtered liquid. —B.

Improved Wooden Vats. C. B. Inman, Leeds. Eng. Pat. 17,863, October 7, 1892.

This invention relates to rectangular vats of wood or slate, the internal corners of which are rounded by means of strips or fillets inserted in grooves left in the thickness of the material of the sides and floor, or by making the edges of the plates of greater thickness than at other parts and cutting the internal faces at the junctions to form rounded corners.—B.

II.—FUEL, GAS, AND LIGHT.

The Value of Straw as Fuel. Dingl. Polyt. Jour. 73 (1892), 260—263.

The results of an examination of various kinds of straw have been recently published by Reszoff in the Journal of the Russian Technological Society; the most important conclusions arrived at were the following:—

1. The chemical composition and the physical properties of various kinds of straw are not identical.

2. The several kinds of straw may be classified into three groups:—*a. Flax-straw.*—This straw contains the largest proportion of carbon and hydrogen, and the smallest proportion of ash; it has the greatest apparent specific gravity, but the lowest real specific gravity, and it absorbs the least quantity of water on exposure to moist air. *b. Rye and Wheat Straws.*—These varieties are very similar in properties, and stand intermediate between the other two groups. *c. Millet, Oats, Barley, and Buckwheat Straws.*—These straws contain the largest proportion of ash and the smallest proportion of carbon and hydrogen; they have a higher real specific gravity than the members of the other groups, and they have also the greatest capacity of absorbing water from moist air.

3. The increase in the real specific gravity of a straw is coincident with an increase in the percentage of ash.

4. The lower the apparent specific gravity of a straw the greater its capacity of absorbing water from moist air.

The real specific gravity and the calorific value of various kinds of straw are given in the following table; the calorific values were calculated with the aid of Dulong's formula, viz. $8080 \cdot C + (H - \frac{O}{8})\ 34{,}462$:—

—	Sp. Gr.	Calorific Values.		
		Dried at 110°.	Containing 6 per cent. H_2O.	Containing 10 per cent. H_2O.
Flax straw..........	1·628	3,724	3,431	3,237
Winter wheat straw	1·667	3,477	3,199	3,015
Summer wheat straw	1·668	3,478	3,200	3,016
Winter rye straw ...	1·649	3,451	3,175	2,991
Millet straw	1·687	3,312	3,043	2,865
Oats straw..........	1·679	3,216	2,955	2,780
Barley straw........	1·684	3,154	2,896	2,724
Buckwheat straw...	1·692	3.090	2,836	2,666

—F. S. K.

Remarks on the Changing of the Physical Properties of Coke made in By-Product Ovens. J. J. Fronheiser, J. Franklin Inst. **135**, 1893, 34, 35.

The disadvantage of coke made in the by-product oven is stated to be its softness, in consequence of which, when used in the blast-furnace, a large waste takes place by its acting on the escaping carbon dioxide at the upper part of the furnace to form carbon monoxide. The author refers to Sir Lowthian Bell's experiments of heating separately to a red heat in a glass tube for 30 minutes a quantity of equally-powdered hard coke, soft coke, and charcoal, passing 800 cc. of dry carbon dioxide over each and analysing the gases. The results were 5·44, 30·19, and 64·8 per cent. of carbon monoxide respectively. He then states that he has coked in a bee-hive oven under different conditions the same coal, and has obtained cokes of varying hardness. On submitting them to the above test the prepared coke yielded 8·72 cc. of carbon monoxide, the ordinary coke 43·76 cc., whilst charcoal yielded 217 cc., thus showing that the same coal may be made to furnish a harder coke than by the ordinary treatment, thereby overcoming the disadvantage in the case of by-product ovens. The method of treatment, however, is not given.—A. W.

PATENTS.

Improvements relating to the Burning of Liquid Hydrocarbons for Heating and Lighting Purposes, and to Apparatus therefor. W. E. Smith, Brighton. Eng. Pat. 2204, February 4, 1892.

In the ordinary "industrial lamps" oil is forced from a small aperture in the burner in the form of vapour or spray by means of compressed air or steam; this invention provides an additional and independent supply of heavier oil or tar, which is drawn into the already-existing flame, thus producing a flame of much higher illuminating and heating power without any extra consumption of the more expensive light oil.—F. S. K.

Improvements in Machinery or Apparatus for Mixing Inflammable Gas or Vapour with Air, and for Utilising such Mixture. W. Smethurst and J. Wade, London. Eng. Pat. 2207, February 4, 1892.

The apparatus here described consists of a double-acting pump connected with inlet gas valves, air valves, and regulating gas and air valves, into which air and inflammable gas, in any desired proportion, are drawn, and then expelled into a mixing chamber in which are arranged a number of transverse partitions of fine wire-gauze or perforated metal; the mixed gases are then stored in a suitable receiver or led at once to a burner. The mixture of air and gas is burnt according to a device in which is utilised the mixing chamber, containing a porous diaphragm and inner adjustable tube with openings near its lower edge.—F. S. K.

Improvements in Artificial Fuel. J. Swallow and C. West, Leeds. Eng. Pat. 2434, February 8, 1892.

In order to dispense with the use of resin and pitch in the manufacture of briquettes from coal, the inventors propose to substitute a mixture of slaked lime, Indian meal and sugar, or lime and alum. About 1 cwt. of a mixture of lime, Indian meal and sugar in equal proportions, or 1 cwt. of lime and alum in equal quantities is added to about 19 cwt. of coal, coke, or shale, or to a combination of these three, and the ingredients being well mixed, are moistened with water and pressed into moulds, when the briquettes are ready for use. —T. A. L.

Improvements in the Manufacture of Artificial Fuel. G. A. Fuchs, Chemnitz, Saxony, Germany. Eng. Pat. 3053, February 16, 1892.

The binding material used in the preparation of these briquettes is finely-divided lignite or peat, which itself is capable of being converted into hard and tough briquettes by strong pressure in a mould without the application of heat. The quantity of the "binding" lignite or peat added to the small coal depends upon the nature of the latter material, and the proportion; it ranges from 10 to 40 per cent.—T. A. L.

Improved Apparatus for Making Gas from Oils, Fatty Substances, and other Material. J. Moeller, London. Eng. Pat. 4728, March 10, 1892.

In making oil-gas it has hitherto been the practice to let the oil simply drop into the retort by gravitation; according to this patent the oil is forced into the red-hot retort from a small orifice under a pressure of about 20 lb. per square inch, and being thus introduced in a fine spray it is vaporised before coming into contact with the walls of the retort. Solid fatty substances may be employed instead of oil, but must first be melted.—F. S. K.

Improvements in Coking Processes and in the Manufacture of Coke, and in the Recovery of Products. J. Bowing, Tilbury, Essex. Eng. Pat. 16,622, September 17, 1892.

According to the inventor the coking of certain kinds of coal can only be successfully carried out by applying heat at one particular point and allowing it to travel gradually through the mass to be coked. As an instance he supposes the coal to be coked arranged in the form of a sphere and the heat generated or applied at the centre of the sphere. The heat travels slowly outwards from the centre, coking almost the whole of the coal. In practice, the retort consists of two concentric cylindrical chambers, the heat being applied in the inner one, the annular space, from which the air is excluded, being filled with the coal to be coked. The heat travels gradually outwards, and it is stated that even South Wales steam coal, when mixed with from 25 to 30 per cent. of some coking coal, may be coked in an oven of this description.—T. A. L.

Improvements in Valves and Apparatus employed in the Manufacture of Heating and Illuminating Gas. H. Fourness, Liverpool. Eng. Pat. 21,871. November 30, 1892.

This patent simply refers to certain improvements in the construction of the valves, and of the air-regulating mechanism previously described (Eng. Pat. 15,169 of 1891; this Journal 1892, 149).—F. S. K.

Improvements in Apparatus for Boiling or Heating by means of Spirit. E. Strauss, Breslau, Germany. Eng. Pat. 22,832. December 12, 1892.

In heating a kettle or other vessel by means of spirit burning in an open receptacle, the size of the flame is limited by the rate at which the spirit vaporises; in the improved apparatus the receptacle containing the spirit is itself heated by a small spirit-lamp with a wick, whereby a much larger flame is obtained.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Rectification of Petroleum Spirit. A. Veith, Dingl. Polyt. J. 1892, **284**, 301—302.

In a previous article (this Journal, 1892, 151) the author has described Heckmann's fractionating column, and further study of this apparatus when used with an efficient condenser has shown him that it is an extremely valuable instrument, and has brought to light various points in the fractioning of spirits which are worthy of notice. It is obviously impossible to separate completely two liquids of different boiling-points simply by passing their vapours through an apparatus maintained at the boiling-point of the lower one; the most that can be done is to produce a liquid containing proportionally more of the heavy constituent, and a vapour proportionally less; and this proportion—for the same liquids—depends solely on the relative amounts of the two substances in the original gas. From this it will be seen that an efficient fractionator must be constructed in such a manner as to allow of the *complete* removal of the liquid at the instant of its deposition, but at the same time, to avoid loss of fuel, this distillate must not be reduced in temperature below that necessary to insure its assuming the liquid condition. By attending to these two points, the backward flow into the still will be kept at the minimum, and as the uncondensed vapours contain more and more of the more volatile constituents, the separation will become more and more complete, the greater the number of trays in the column. The construction of the fractionator, therefore, and its consequent superficial area, is a matter for exact calculation, depending on the composition of the crude substance for which it is to be used; while, on the other hand, the condenser cannot be too large, the operator being enabled to regulate its action by altering the temperature of the water employed, so that if properly fitted with arrangements for drawing off the distillate at different points the condenser may be made to reinforce the analytical power of the column, the fractional condensation thus effected increasing the efficiency of the whole apparatus.—F. H. L.

Comparative Tests of American, Russian, and Sumatra Oils. Board of Trade Journal, March 1893, 349—350.

The *Java-Bode*, as quoted by the *Penang Gazette*, states that at the request of Mr. van den Berg, representative of the Royal Dutch Oil Co., a chemical and physical analysis has been made of Sumatra (Langkat) oil by Mr. Leyden, of the firm of Messrs. Rathkamp and Co., Batavia.

The results in comparison with Russian and American oil are as follows :—

Specific gravity of 15° C. is for—

Langkat oil, 0·799 (at 28°, 0·789).
American „ 0·791 („ 0·784).
Russian „ 0·825 („ 0·815).

Langkat oil was quite colourlesss, American oil had a prominent yellow colour, and Russian oil was slightly yellowish. There was no difference as to fluorescence. Langkat oil is neutral and contains therefore no sulphuric acid or caustic soda, the same is the case with the American oil, while Russian oil has a slightly acid reaction. All three sorts contained no sulphuric acid. From the trial as to lighting power it was evident that the Langkat oil, after six hours' burning, was only diminished with 4·01 per cent., the American oil being 9·37 per cent. less. The following temperatures were found for the flashing points :—

	° C.
American oil	43·4
Langkat oil	47·6
Russian oil	51·2

From the comparatively high temperature for the Langkat oil it is quite clear that this oil is quite safe for domestic use. When mixing the same amount of Langkat oil and sulphuric acid it is coloured only yellowish, while Russian oil is coloured brownish, and American oil dark brown. The temperature was not changed by this with all three sorts. No change was seen when mixing the three kinds with a solution of nitrate of silver saturated with ammonia. Distilled in the Engler apparatus the following results were obtained :—

—	Langkat.	American.	Russian.
	Per Cent.	Per Cent.	Per Cent.
Under 150° C.	15·9	18·7	13·2
Between 150°—270°	79·6	47·8	74·0
Over 270°	3·4	32·8	12·0
	98·9	98·8	99·2

The photometric trial gave the following results :—

America .... 100 } during the same time
Langkat .... 109 } and quantity of oil.
Russian .... 97 }

It is further evident from these trials that when burning Langkat oil, the wick was not carbonised, as was the case with the other sorts. From this we conclude that Langkat oil can stand a fair trial with American and Russian oil, and has still the following advantages :—

1. The oil is colourless.

2. And quite neutral, and so does not give offensive smell of any kind.

3. Mounts quicker in the wick than any other oil.

7. This oil contains more hydrocarbons, boiling between 150° and 270° C. (body of oil).

8. Contains almost no hydrocarbons over 27 per cent.

9. Lighting power is greater with the same consumption of oil.

10. Lighting power diminishes less after having been burning for a long time.

The Langkat oil contains no resinous or fat matter at all, the American oil traces, and the Russian oil a small quantity.

Analysis of Mixtures of Ammonia and Methylamines. H. Quantin, Compt. Rend. **115**, 561.

See under XXIII., *page* 294.

IV.—COLOURING MATTERS AND DYES.

Cochineal Carmine. S. Feitler. Zeits. f. ang. Chem. 1892, 136—141.

Cochineal, though somewhat ousted from its premier position as a colouring-matter by its synthetical rivals, is still a body of great commercial importance, and of chemical interest on account of the lack of exact knowledge as to its constitution and the best principles governing its preparation. It has long been known that carmine prepared from cochineal does not consist of the pure pigment, as it contains a considerable amount of ash; and Liebermann (Ber. **18**, 1969) has given ground for the opinion that it is a lake with an alumina-lime basis associated with a proteid body. According to his views the ratio of the lime and magnesia (calculated as lime), to the alumina is as 1 : 2, and he has compared it to Turkey-red in which the sulphonic acids of the castor oil may be supposed to play a part similar to that of the nitrogenous constituent in carmine, a parallel made more exact by taking into account the observation of Rosenstiehl and Kopp that a similar relation between lime and alumina obtains in the case of Turkey-red.

Six samples of various qualities were analysed, their technical names being: (1.) Best Naccarat-carmine. (2.) Best genuine carmine. (3.) Best genuine carmine. (4.) Ordinary carmine. (5.) Antique carmine; and (6.) Best Naccarat-carmine.

The last three were adulterated, No. 4 containing 88·5 per cent. of ash, consisting of lead oxide, alumina, and lead sulphate. It had probably been prepared from a sample of eosin with a blue tint by precipitation with lead acetate and alum. No. 5 was much like the sample known as "best genuine," but the ash amounted to 74·56 per cent., and consisted mostly of barium carbonate and some sulphate. According to Bonath it was a baryta lake of corallin. No. 6 was found to be a mixture of genuine cochineal lake and a lake prepared from a coal-tar colouring-matter. It contained 15·28 per cent. of ash, 16·08 per cent. of water, 17·31 per cent. of nitrogenous matter, and 51·33 per cent. of colouring-matter (reckoned by difference). The artificial colouring-matter present was identified as a true lake of phloxin.

Leaving these adulterated specimens out of consideration, the composition of the samples examined which were believed to be genuine, together with those that had previously been recorded by Liebermann and Lafar, is shown by the following table :—

—	Genuine Cochineal Carmine (Liebermann).	Naccarat-Carmine (Lafar).	Best Naccarat-Carmine.	Best Genuine Carmine.	Best Genuine Carmine.
Water	17	15·50	20·48	13·15	15·69
Ash	7	6·87	7·09	9·18	7·24
Nitrogenous matter	20	23·26	27·00	25·19	20·31
Colouring-matter (by difference)	56	54·37	45·43	52·48	56·36

These results, calculated on the dried substance, become—

Ash	8·1	8·14	8·91	10·57	8·59
Nitrogenous matter	24·7	27·6	23·95	29·00	24·09
Colouring-matter	67·2	64·26	57·14	60·43	67·32
(Wax ?) fat	Trace	0·92	3·15	1·18	2·53

The composition of the ash was as follows :—

—	Genuine Cochineal-Carmine (Liebermann).	Naccarat-Carmine (Lafar).	Best Naccarat-Carmine.	Best Genuine Carmine.	Best Genuine Carmine.
CuO	Trace	0·35	0·45	0·24	1·15
SnO_2	0·67	0·14	0·62	0·08	1·35
Al_2O_3	43·09	40·08	35·45	25·95	43·18
Fe_2O_3	Trace	Trace	Trace	Trace	Trace
CaO	44·85	44·20	44·98	31·29	36·76
MgO	1·02	0·61	0·81	2·76	1·11
Na_2O	3·23	5·40	5·71	16·24	Undetermined
K_2O.	3·56	3·20	3·21	1·96	Do.
P_2O_5	3·20	2·71	8·31	6·12	1·80
SiO_2	Trace	0·69	0·51	1·65	Undetermined
CO_2	..	2·31 (by difference)	..	8·11	Do.
SO_3	..	..	..	5·14	..
Cl	..	..	..	0·41	..
Al_2O_3 : (CaO + MgO) (calculated as CaO)	1 : 1·972	1 : 2·044	1 : 2·377	1 : 2·435	1 : 1·618

An experiment was made to ascertain what proportion of the ash of cochineal was present in its aqueous extract, and for this purpose a sample of "Zaccatila cochineal" was used. The quantity was 2·27 per cent. as against 11 per cent. in the insoluble portion, both being reckoned on the original cochineal. The ash from the soluble portion contained 36·90 per cent. of P_2O_5, 6·00 per cent. of Al_2O_3, and 3·30 per cent. of CaO, giving a molecular ratio of the last two constituents of 1 : 1. Another experiment was made to determine whether the colouring-matter of cochineal carmine was identical with that of cochineal itself, viz., carminic acid. According to Hlasiwetz and Grabowski (Ann. **141**, 329) the original substance whence the colour is derived is a glucoside. The author's experiments showed that this is true of cochineal but not of carmine prepared from it, a result possibly due to the decomposing effect of some mould or ferment. Attempts to utilise this decomposition in the preparation of carmine comparable with that of commerce, failed, as well as others in which various metallic salts (aluminium, calcium, and tin) were used to form lakes, the products when dry lacking the fine rich colour of commercial carmine of good quality. It appeared that the mode of drying had much influence on the result, and that the nitrogenous matter (see analyses above) was essential to bring the carmine into the proper state of division. The only other conclusion arrived at was that the best sorts ("Naccarat-carmine") are prepared by filtration of the lake, while the lower grades are obtained by decanting the bulk of the solution and evaporating the residue to dryness. This accounts for the lower content of ash, wax, phosphoric acid, and alkali in the best brands.

—B. B.

PATENTS.

The Manufacture and Production of New Blue Mordant-Dyeing Colouring Matters. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 19,588, November 12, 1891.

In Eng. Pat. 14,353 of 1888 (this Journal, 1889, 770) and Eng. Pat. 15,121 of 1888 (this Journal, 1889, 772), processes were described for producing new dyestuffs from alizarin dyes by treatment first with fuming sulphuric acid and afterwards with concentrated sulphuric acid, the operation being worked as a continuous process or divided into stages by isolating the product first formed. Similar processes have been applied to other alizarin dyes and allied bodies, and reference is made to the following Eng. Pats. of 1890, 8725 (this Journal, 1891, 537), 12,715 (this Journal, 1891, 759), 17,712 and 18,729 (this Journal, 1891, 917), and to Eng. Pats. of 1891, 1883 (this Journal, 1892, 29), and 4871 (this Journal, 1891, 513). This process is now to be applied to certain dinitroanthraquinones yielding valuable mordant colouring matters. The following nitroanthraquinones can be employed :—1·4′-dinitroanthraquinone (Römer, Ber. **16**, 363), α-dinitroanthraquinone (Böttger and Petersen, Annalen, **160**, 147), mixtures of these two, and also the crude mixtures of dinitroanthraquinones obtained by the dinitration of anthraquinone without purification or separation of the constituents. About 10 kilos. of 1·4′-dinitroanthraquinone are mixed with 100 kilos. of fuming sulphuric acid containing about 12 per cent. of SO_3 and heated for about 1½ hours to 160° C., when a colouring matter is produced soluble in water to a dirty violet solution. The melt is then diluted with 200 kilos. of ordinary sulphuric acid containing 95 per cent. H_2SO_4, and heated for two hours longer at 130° C. until the soluble intermediate product is converted into a comparatively insoluble one. The melt after cooling is poured into water, the precipitate filtered off, and well washed with cold water. It may be purified by dissolving in sodium acetate and precipitating with an acid. The new dyestuff when dry is a dark-coloured powder, which has a bronzy appearance when rubbed. It is somewhat soluble in hot water, but dissolves in alcohol, cold aniline and alkaline liquids giving blue solutions. In concentrated sulphuric acid it dissolves to a reddish-brown solution. In cold glacial acetic acid, ether and benzene, it is nearly insoluble. For dyeing or printing the colouring matter may be applied as a paste or alkaline salt. It produces an extremely pure and fast greenish-blue shade on chrome mordanted wool. If a sulphuric acid be employed containing more anhydride than in the example already described, the shade produced is less green, and in fact the colouring matter is a mixture of the greenish-blue dyestuff obtained as above, and the blue colouring matter obtained according to the following patent.—T. A. L.

Improvements in the Manufacture of Blue Mordant-Dyeing Colouring Matters. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 19,589, November 12, 1891.

In the preceding patent the action of sulphuric acid on dinitroanthraquinones is described and the method given for producing a greenish-blue dyestuff. The reaction takes place in two stages, and in the present patent the intermediate product is isolated before being subjected to the second operation. In this way a different product is obtained, and its formation is described as follows:—About 10 kilos. of 1·4′-dinitroanthraquinone are mixed with 50—100 kilos. of fuming sulphuric acid containing about 40 per cent. of SO_3. The mixture is heated to 100—130° C. for about 3 hours or until soluble in water. The melt, after cooling, is then poured into water, the colouring matter salted out, filter-pressed, and dried. About 1 kilo. of this product is dissolved in 10 times its weight of ordinary sulphuric acid and heated to about 130° C. for five hours, or until the dyestuff is insoluble in water. The melt is then poured into water, filtered, washed with warm water, pressed, and dried. It may be employed for dyeing either as a paste or alkaline salt, and gives a violet with alumina and a blue with chrome mordants. When dry it is a dark powder with a metallic lustre. It dissolves in alcohol, ether, benzene, and glacial acetic acid, giving red to reddish-violet solutions with a yellow fluorescence. In caustic soda it dissolves to a blue solution, and in concentrated sulphuric acid to a deep violet-blue with a strong brownish-red fluorescence. It dissolves in warm aniline, forming a red solution. All these solutions show characteristic absorption spectra, and the identity of this substance with that obtained by Lifschütz (Ber. **17**, 891) by the action of concentrated sulphuric acid at 200° C. on 1·4′-dinitroanthraquinone has thus been established. As mentioned in the preceding patent, the α-dinitroanthraquinone or the mixture of crude dinitroanthraquinones may be treated in the manner described.—T. A. L.

Improvements in the Production of Azo Colours on Fibre. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 22,641A, December 28, 1891.

This is an extension of Eng. Pat. 22,641 of 1891 (this Journal, 1892, 1001), and claims the formation of colouring matters on the fibre in a similar manner to that already described in Eng. Pats. 8530 of 1890 and 9636 of 1891. According to the processes there described, cotton, dyed with the colouring-matter obtained by combining the tetrazo compounds from benzidine, tolidine, dianisidine, or diamido-stilbene with amido-naphthol sulphonic acid G or with 1·8-amido-naphthol-β-disulphonic acid, can, after treatment with nitrous acid, be combined with amines, phenols, amidophenols, or with their sulphonic or carboxylic acids. The α-naphthylamine-α-sulphonic acids 1·4, 1·5, and 1·8 usually employed in the preparation of dyestuffs cannot be used in this way, but certain α-naphthylamine-β-sulphonic acids yield dyestuffs diazotisable on the fibre. These acids are the β and δ or 1·6 and 1·7 α-naphthylamine monosulphonic acids described in Eng. Pat. 22,641 of 1891, and the colouring-matters there described, after having been dyed on unmordanted cotton, may be diazotised on the fibre and combined preferably with β-naphthol, giving bluer and bluish-black shades in place of the red and bluish-red shades of the original dyestuffs. The use of the dyestuff from tetrazo-diphenyl chloride and the β acid is disclaimed for this process.—T. A. L.

Improvements in and connected with the Manufacture of Oxyquinoline-phenol-sulphonic-oxyquinoline and its Homologues. A. Lembach, Biebrich-on-the-Rhine, and C. J. Wolff, Wiesbaden, Germany. Eng. Pat. 21,968, December 1, 1892.

The product mentioned in the title is to be employed in the production of colouring-matters, and is obtained either by mixing phenolsulphonic acid with *o*-hydroxy-quinoline or by adding sulphuric acid to a mixture of phenol, hydroxy-quinoline, and water. The product crystallises from water, in which it is easily soluble, in amber-yellow hexagonal prisms and containing four molecules of water. The crystals melt at 78°—83° C., and have the formula $C_{21}H_{23}SN_2O_{10}$, and the product is thus formed by the condensation of two molecules of hydroxy-quinoline and one molecule of phenolsulphonic acid, together with four molecules of water.—T. A. L.

A Black Cotton Dyestuff, Combinations of the Same, and Processes for the Production thereof. A. Bang, Leeds. From G. A. Dahl, Barmen, Germany. Eng. Pat. 4110, March 2, 1892.

The dyestuff described is obtained by combining *p*-amido-diazobenzene with α-naphthylamine, rediazotising and combining the tetrazo compound with a new β-amido-α-naphthol monosulphonic acid (1.4.3′) $C_{10}H_5 . OH . SO_3H . NH_2$. Cotton dyed with the product thus formed can be passed through a bath of nitrous acid, and after washing will combine with phenols, amines, and their sulphonic acids to form new dyestuffs. The preparation of the amido-naphthol sulphonic acid is described as follows:—50 kilos. of α-naphthylamine disulphonic acid—

$$(1.4.3')C_{10}H_5.NH_2.(SO_3H)_2$$

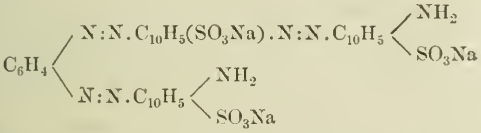
(*i.e.*, the acid II. of Ger. Pat. 41,957, of which the lime salt is soluble in 85 per cent. alcohol) are heated with 100 kilos. of caustic soda and 30 kilos. of water for 3—4 hours to 230°—250° C., forming dihydroxynaphthalene sulphonic acid $(1.4.3')C_{10}H_5.OH.SO_3H.OH$. The melt is dissolved in 300 litres of water and acidified with hydrochloric acid, when the dihydroxynaphthalene sulphonic acid separates out in crystals (Ger. Pat. 57,014). About 50 kilos. of this acid are heated with an equal weight of an aqueous solution of ammonia of sp. gr. 0·91 in an autoclave for 20—25 hours to 180°—190° C. After cooling, the solution is boiled to expel the excess of ammonia and acidified with hydrochloric acid, when β-amido-α-naphthol monosulphonic acid $(1.4.3')C_{10}H_5.OH.SO_3H.NH_2$ separates out in small white crystals. The following method is given for the production of the dyestuff:—10.8 kilos. of *p*-phenylene diamine are dissolved in 500 litres of water, 20 kilos. of hydrochloric acid, 20 kilos. of acetic acid, cooled with ice to 0°—5° C. and diazotised with 7 kilos. of sodium nitrite. In this manner only one amido group is diazotised, and the *p*-amidodiazobenzene obtained is run into a solution of 14·4 kilos. of α-naphthylamine in 12 kilos. of hydrochloric acid and 200 litres of water. After standing several days, *p*-amidobenzene-azo-α-naphthylamine is produced, which is then converted into a tetrazo compound by adding 40 kilos. of hydrochloric acid and a solution of 14 kilos. of sodium nitrite. The tetrazo solution thus obtained is run into a solution of β-amido-α-naphthol sulphonic acid made alkaline with 60 kilos. of soda. The dyestuff separates almost immediately, forming a black powder dissolving to a blackish-red colour in water, and dyeing unmordanted cotton blue-black from a faintly alkaline bath. By passing the cotton thus dyed through a bath containing nitrous acid, and after washing, through a solution of *m*-phenylene diamine, a deep blue-black colour is produced, and in a similar manner other developers may be employed.—T. A. L.

Process for the Production of a Red Colour on Textile Fibres. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 4407, March 5, 1892.

The red azo-colours hitherto produced on the fibre by printing with diazo-compounds on a fabric padded with β-naphthol have, with the exception of that obtained from *p*-nitraniline, not been fast to light and soap, and the red obtained from *p*-nitraniline is too orange for most purposes. A much bluer shade of red is produced by employing *o*-nitro-*p*-phenetidine (2.1.4) $C_6H_3.NO_2.NH_2.OC_2H_5$ obtained from phenacetine by nitration in glacial acetic acid. The colour is improved by soaping and its fastness to light is also increased if it be fixed by means of Turkey-red oil and sodium aluminate, a method which is also employed in the case of the *p*-nitraniline red.—T. A. L.

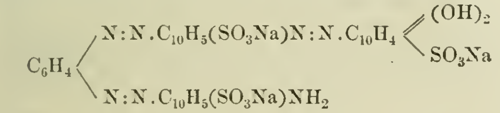
The Manufacture of New Colouring Matters. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5112, March 15, 1892.

This specification is an extension of Eng. Pat. 22,641 of 1891 (this Journal, 1892, 1001) and of Eng. Pat. 22,641A of 1891 (see above). It describes the formation of colouring matters from the 1·6 and 1·7 α-naphthylamine sulphonic acids (the β and δ acids of Clève) by combining certain diazo compounds with them. These combinations may take place in a variety of ways, and two examples are given for producing colouring matters from acetyl-*p*-phenylene diamine and the acids mentioned. Acetyl-*p*-phenylene diamine is diazotised and combined with one molecular proportion of Clève's β acid, the acetyl group is then split off and the resulting diamido compound is converted into its tetrazo compound and combined with two molecular proportions of Clève's δ acid. The colouring matter has the formula—



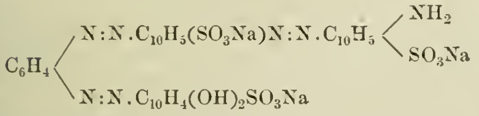
$$\mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{N{:}N.C_{10}H_5(SO_3Na).N{:}N.C_{10}H_5}\left\langle\begin{array}{l}\mathrm{NH_2}\\ \mathrm{SO_3Na}\end{array}\right.\\ \mathrm{N{:}N.C_{10}H_5}\left\langle\begin{array}{l}\mathrm{NH_2}\\ \mathrm{SO_3Na}\end{array}\right.\end{array}\right.$$

It dyes unmordanted cotton and wool bluish-black shades. In the latter part of the operation the tetrazo compound may be combined first with one molecular proportion of Clève's δ acid and afterwards with one molecular proportion of 1·8-dihydroxynaphthalene sulphonic acid, when a dyestuff having one of the two following formulæ is obtained:—



$$\mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{N{:}N.C_{10}H_5(SO_3Na)N{:}N.C_{10}H_4}\left\langle\begin{array}{l}\mathrm{(OH)_2}\\ \mathrm{SO_3Na}\end{array}\right.\\ \mathrm{N{:}N.C_{10}H_5(SO_3Na)NH_2}\end{array}\right.$$

or



$$\mathrm{C_6H_4}\left\langle\begin{array}{l}\mathrm{N{:}N.C_{10}H_5(SO_3Na)N{:}N.C_{10}H_5}\left\langle\begin{array}{l}\mathrm{NH_2}\\ \mathrm{SO_3Na}\end{array}\right.\\ \mathrm{N{:}N.C_{10}H_4(OH)_2SO_3Na}\end{array}\right.$$

Other instances are also mentioned as to the ways in which these operations may be varied. In addition to the amines mentioned in the first patent it has now been discovered that amidoazobenzene and its homologues may after diazotisation be combined with one of the abovementioned acids, and this compound in its turn can be diazotised and combined with amines and phenols, &c. Acetyl-*p*-phenylene diamine can be employed in a similar manner by diazotising and combining it with the β or δ acid, then again diazotising the compound and combining it with an amine or phenol, &c., and finally splitting off the acetyl group. Valuable colouring matters are also obtained by using, in place of amidoazobenzene, the products obtained by the action of sulphur on *p*-toluidine, *m*-xylidine, or ψ-cumidine or the sulphonic acids of the thio-amides so formed. The use of primuline is, however, disclaimed. A pure bluish-green for unmordanted cotton can be obtained by diazotising dehydrothiotoluidine sulphonic acid, combining it with the sodium salt of Clève's β acid, diazotising the amidoazo product, and combining this with 1·8-dihydroxynaphthalene sodium sulphonate. By employing other components, shades varying from bluish-green to greenish-black can be obtained. The simple azo dyestuffs resulting from diazotised amidocarboxylic acids and their derivatives when combined with one of the Clève acids are said to be valuable for wool dyeing. They can also be employed for printing, and, since they can be diazotised on the fibre, yield reddish-yellow to brown and black shades, which are remarkable for their depth and fastness. (See also Eng. Pat. 2789, of 1892; this Journal, 1893, 143.)
—T. A. L.

Improvements in the Manufacture of the Red Basic Naphthalene Colouring Matter which yields Azo-carmine on Sulphonation. J. Y. Johnson, London. From "The Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 5540, March 21, 1892. (Second Edition.)

According to Eng. Pat. 15,259 of 1888 (this Journal, 1889, 877) certain naphthalene derivatives, when heated with aniline hydrochloride, yield a basic colouring matter known as phenyl-rosinduline. In Eng. Pat. 6875 of 1890 (this Journal, 1891, 459) sulphonic acids of phenyl-rosinduline are described, which are obtained by using sulphonated naphthalene derivatives, one of these being dinitro-α-naphthol sulphonic acid (naphthol-yellow S). It has now been discovered that α-nitronaphthalene, when heated with aniline and aniline hydrochloride, yields phenyl-rosinduline, which can be employed for sulphonation according to Eng. Pat. 15,259 of 1888 and Eng. Pat. 19,167 of 1890 (this Journal, 1891, 831), in the former of which is described the production of azo-carmine. About 70 kilos. of α-nitronaphthalene, 180 kilos. of aniline hydrochloride, and 60 kilos. of aniline are heated in an enamelled pot provided with an agitator. At 130° C. the mixture melts and the temperature is then slowly raised to 150°—160° C., when the reaction commences. The temperature is then further raised and kept for about 15 hours at 180°—190° C. until no further production of colouring matter takes place. The whole melt is then poured into 500 litres of water, and 150 kilos. of hydrochloric acid of 32 per cent. HCl and boiled. After dilution with 500 litres of water the crude phenyl-rosinduline is filtered off and again washed by thoroughly stirring with 500 litres of water, and after filtering, is dried at 50° C. It is sufficiently pure for the preparation of the insoluble monosulphonic acid of phenyl-rosinduline and also of the soluble sulphonic acids of phenyl-rosinduline described in Eng. Pats. 15,259 of 1888 and 19,167 of 1890.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Examination of Tissues with regard to the Size employed therein. J. Depierre. Textile Colorist **15**, 1893, 14.

When the object is to find out how a given tissue has been treated in finishing, first the eye has to discover whether the material has been glazed, calendered, or starched upon one side only or upon both sides. By looking through the tissue, it is also ascertained whether and how it has been starched, or "charged." If strongly loaded with size, it feels harsh, but becomes soft on rubbing between the fingers. If on tearing a small bit off from the end of the piece a dust is noticed; it denotes sizing with weighting materials. Finally, it can be discovered by the use of a strong eye-glass, whether the size lies only superficially upon the tissue, or has penetrated into it, and whether it contains mineral components.

This exterior examination suggests already some points indicative of the kind of finish. After this the amount of moisture present, if any, in the material is to be determined. For this purpose a small piece of it is weighed and left in the drying box until no more decrease in the weight is observed. This determination of water gives in fact no eal indications regarding the nature of the size ; but since t is known that cellulose by itself is less hygroscopic than vheat starch or potato starch, *e.g.*, a considerable decrease n weight of the dried sample, at least points to the presence f an abundance of size in the goods. To find out the uantity of size contained in the finished tissue, a weighed ample of known size, say 250 square cm., is treated with nalt in distilled water, dried and weighed again. The lifference of weights shows how much starch is deposited ipon the material. To ascertain farther the presence of oap in the size, the sample is boiled in water, passed hrough boiling acid, washed, dried, and weighed, whereby he total loss at the cost of the sizing mass is found, provided the material has not been dyed, in which case alone he acid passage can be applied.

The percentage of dry sizing mass being thus obtained he further question is to qualitatively ascertain the components of the sizing mass used, which examination is livided into two operations. Several hours' boiling in vater removes starch, preparations of starch, gums, soluble chlorides and sulphates of metals, and earthy components. After filtration a part of the clear liquid is evaporated and mixed with tincture of iodine, which indicates the presence of starch. If this reaction does not take place, the evaporation is carried further and three times the volume of alcohol added, when dextrin and gum are precipitated from the solution, while glue and gelatin are detected by solution of tannin.

To distinguish gum from dextrin, the polarimeter is used. Dextrin is dextro-, gum lœvo-rotatory. When both substances are present together, they can be separated by basic acetate of lead, by which gum alone is, in the cold, precipitated from the solution. If no precipitate is obtained in this way, but on heating the dry residue of the evaporated liquid a black char is left upon the platinum foil, it is due to the presence in the size of mucilage or Iceland moss. Sugar is detected by Fehling's reagent. To examine the filtrate of the aqueous decoction for soluble mineral salts, ordinary qualitative analysis is resorted to. The residue which is left upon the filter ordinarily consists of China clay, less frequently of gypsum or chalk.

Colophony can be discovered by boiling a sample of the tissue with solution of soda, when a soluble resin soap is formed which, on mixing it with acid, gives a precipitate of sylvic acid, while the soaps which may be produced by fats, separate out the fatty acid in the form of an oily layer floating upon the liquid. If it appears desirable to ascertain the nature of these fats, a sample of the tissue must be treated with ether, which absorbs all the fat. By evaporating the ethereal liquid, the total amount of fat contained in the size is obtained.—W.S.

Production of Fibre from the Dwarf Palm in Algeria. J. Soc. Arts **41**, 1893, 442—443.

The dwarf palm grows in great profusion in Algeria, and is one of the principal obstacles to the clearing of the land, so thickly does it grow and so difficult is it to pull up; its roots, in shape resembling carrots, penetrate into the ground to the depth of a yard or more, and when its stem is only cut, it sprouts out again almost immediately. As its name indicates, this palm is very small, and can only attain a certain height when protected, as in the Arab cemeteries, for example. Various uses are made of it ; its roots serve as combustibles, a light kind of charcoal being made out of them, and the natives have employed the fibres that they extracted from the leaves and the stems, mixed with camel-hair or wool, in the manufacture of stuffs for tents ; with the leaf itself they make baskets, mats, hats, fans, bags, and other articles. Considerable attention is now being paid by the authorities to the encouragement of this industry in Algeria, as, in the first place, it affords to the Arabs an easy means of making a living, and, in the second, the land is thus rapidly cleared of a parasite. In 1880 the quantity of fibre exported from Algeria amounted to 9,000,000 kilos. ; in 1885 to 15,000,000 kilos., and in 1891 to 19,000,000 kilos. In preparing the fibre, the following is the system adopted. The leaves are plucked by the Arabs, and carried into the courtyard of the factory in a green state, at a price of 20 francs per ton. As they are at once used, and as they are injured neither by the rain nor the sun, it is only necessary to pile them on the floor in a heap. The first operation consists of sorting. The weeds are removed from the stems which frequently adhere to them, and the broken or dried up leaves are cut away. Another operation consists in carding the leaves. As it is necessary that these leaves should be damped during the work, a tap is placed above the drum, from which a constant stream of water falls upon them. A workman is able thus to card from five to six hundred kilos. of leaves a day. When the leaves have been combed at both ends, they present the appearance of a handful of rough and short fibre. They are then dried, and, after a certain preparation, are ready for use in stuffing chairs, couches, &c. The fibre is also curled by the use of another machine of primitive type. In this operation the cord is subject to the natural impulse of twisting and rolls up upon itself, so that it is only necessary to fix the ends so that it cannot come unrolled. The fibre is kept in this condition for several weeks, and is then untwisted, when it is considered to be sufficiently curled. African fibre is employed in its natural state or dyed. In the latter case, the fibres are passed through various solutions of sulphate of iron and logwood, then curled, and again plunged into the solution.—W.S.

The Khorasan Carpet Industry. J. Soc. Arts **41**, 1892, 109—110.

Consul-General Elias, of Meshed, in a report just issued, states that carpets are made all over Khorasan, but the localities where they are specially produced are the city of Meshed, Birgand, and Turshiz. All Khorasan carpets are piled carpets, or *kali*, a word that is not applicable to any other kind of floor covering. The different kinds are known sometimes by the different patterns and colours of which they are composed, but usually only by the names of the places where they are produced, such as Kaini, Meshedi, Baluchi, and Turshizi. The carpets of certain localities have always some distinction or superiority over those of other places, and the carpet industry is in a more flourishing condition in some localities than in others. Though carpets are woven all over Khorasan—not only in the towns and villages, but also in the tents of the nomad tribes—a large proportion are made for the use of the people themselves, and not for trade. At present carpets of fine quality are manufactured for trade in the two districts of Kain and Turshiz, but good carpets are also made in Meshed. For some 10 years past traders have been in the habit of giving instructions to weavers on the subject of carpets to be exported to foreign countries, and these carpets are said to realise better prices. In Kain the authorities and leading men are personally very fond of carpets, and, as they themselves give instructions to the weavers, a very fine class with good patterns and colours is turned out. These are regarded as superior to the Meshed manufacture. All indigenous dyes used in the manufacture of carpets are obtained from vegetables. Aniline dyes imported from Europe were used formerly in Meshed, but were discontinued. Carpets of inferior quality, made at Birgand, are dyed with aniline colours, but those of better quality, which are made to order, are not. All parts of Khorasan, where carpets are made, produce wool, but in places such as Meshed, Turshiz, and Kain, where they are made for trade, a portion of the wool required is obtained from neighbouring districts. There is not much difference in the quality of the wool produced by the different districts of Khorasan, but that of the Baluch tribes is considered to be the best. The reasons given for that superiority are that most of their sheep are white, and that the Baluchis wash their wool better than any other tribes. Khorasan carpets are, however, not made entirely from wool. The woof is of wool, while the warp is of cotton. The pile is entirely of wool, because wool is more durable than any other material.
—W.S.

The Use of Stannic Chloride in Sizing Cotton Warps. Textile Colorist 15, 1893, 7.

The object of adding stannic chloride to the sizing mass for cotton warps is to prevent the too rapid decomposition of the size. It is harmless when added in moderate proportion, but too much of it attacks the yarn, especially when the tissue is singed before bleaching. For the same purpose and at the same time for charging the yarn, alum, zinc sulphate, zinc chloride, and copper sulphate are added to the size. All these metallic salts, however, attack the reeds, often give the tissue a dirty, stained appearance, and, unless the goods are neither chlorinated nor acidified, but only boiled out in water, are stated often to cause trouble in dyeing. The best preservative for the size is said to be 1 grm. salicylic acid per litre.

PATENTS.

Improvements in the Process and Apparatus for Producing Roving from Fibrous Materials. G. Türk, Lend Gastein, Austria. Eng. Pat. 4621, March 8, 1892.

This invention relates to a process and apparatus for producing roving from the fibrous materials worked in the spinning and paper industries, such as rags, wood cellulose, asbestos, &c. The particular feature of the process is that the formation of fibrous sheets, which are afterwards cut into strips, is replaced by an immediate separation of the fibrous material into strips of suitable breadth, each strip when rolled up forming a thread of roving. The division into strips is accomplished by means of a sieve-roll constructed with alternate bands of material acting as a sieve, such as wire-gauze, and of solid material, as sheet metal. The fibre, which has been previously reduced to the state of pulp, adheres only to the wire-gauze, and thus the strips of fibrous material are formed.—R. B. B.

Improvements in Ornamented India-rubber Waterproofed Fabrics and in the Mode of Producing the same. G. C. Mandleberg, Manchester. Eng. Pat. 6879, April 9, 1892.

This patent describes a method of ornamenting fabrics specially applicable to ladies' waterproof garments. The back of a suitable woven fabric is coated with one or more coats of india-rubber proofing in the ordinary manner. It is then cut into strips, and these strips are brought into contact with the proofed face of the waterproofed fabric to be ornamented, while both surfaces are in a sticky condition. The two are then pressed together in a calendering machine. —R. B. B.

Improvements in Apparatus for Decorticating Ramie and other Fibrous Plants. W. R. Lake, London. From C. Philibert, E. Perreau, and A. Laborde, Paris, France. Eng. Pat. 16,398, September 13, 1892.

The stems of ramie, &c. are placed upon a feed-table. Thence they pass between a pair of rollers, one of which is mounted upon springs to allow of the introduction of a greater or smaller quantity of material. From these rollers the stems pass on to a breaker consisting of two parts having undulations of corresponding form; the lower part serves as an anvil, and the upper as a striking weight. Here the woody portion is broken up. Next the broken pieces of wood are completely detached from the fibre by means of a pair of star-shaped rollers, the direction of whose motion can be reversed at will. The separated fibre is finally removed on an endless band.—R. B. B.

Process of and Apparatus for Treating Vegetable Fibres or Fibrous Substances for Producing Sheets, Roofing and Wall Felts, Matches, Torches, and the like. P. Jensen, London. From E. Stiemer, Karlsruhe, and M. Ziegler, Nachterstedt, Germany. Eng. Pat. 18,572, October 17, 1892.

The fibrous material, such as turf, fallen leaves, jute, &c., is ground and mixed in rag engines with 15—20 per cent. of quicklime, borax, or magnesium sulphate. The mixture is treated with a suitable quantity of water, and the pulp so formed led off on an endless belt, and then passed through suitable presses for removing the water. The half-dried mass is impregnated with a solution of a mineral salt, *e.g.*, ammonium phosphate, after which it is passed over heated drying cylinders, and through a "satining" machine. The sheet material thus produced is suitable for roofing, &c.

If required for matches or torches the sheets are further impregnated with paraffin and resin, and cut into pieces of the necessary length and thickness. It is claimed that this material is specially suited for the manufacture of safety matches, the cost of production being small, and the time of burning comparatively long.—R. B. B.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

PATENTS.

An Improved Process for Dyeing Piece Goods. E. Zillessen, sen., Crefeld, Germany. Eng. Pat. 4934, March 14, 1892.

This invention consists in mordanting one part only of the threads of cotton, silk, wool, or other fibre to be used in weaving a pattern, so that on subsequently dyeing the woven fabric the mordanted and unmordanted parts are differently coloured by the dyestuff used.—W. E. K.

Improvements in Dyeing Cotton and other Textile Fabrics. T. Hoyle and Sons, Limited, and W. M. Neild, Manchester. Eng. Pat. 6304, April 1, 1892.

Fabrics to be dyed in indigo are first sized or starched on one side only, and then passed through the indigo dye vat; preferably two pieces are dyed at a time, with the sized faces in contact with one another. The unsized faces of the fabrics are thus dyed a full level colour, whilst less colour is deposited on the backs of the fabrics in consequence of the resistance offered by the size, and so an economy of indigo is effected.—W. E. K.

A New Process and Apparatus for Printing and Dyeing Fabrics. F. Schreurs, Brussels. Eng. Pat. 19,079, October 24, 1892.

This process consists in causing colouring matter to penetrate the fabric to be dyed by passing it through a special stencil plate or pattern, the penetration of the colouring matter being produced either by pressure of a felt roller charged therewith or by pressure applied to a sheet of felt charged with the colour and stretched in contact with the stencil plate. The stencil plate, which is the main feature of the invention, consists of a gelatin film or pellicle adhering to a tulle support suitably stretched over a frame. This gelatinised tulle, impregnated with bichromate of potash and exposed to light behind any suitable design or photographic plate, is so acted upon that varying degrees of insolubility are produced according to the varying quantity of light that passes through the different parts of the design. The film thus produced acts as a stencil, in which the design consists of parts having varying degrees of permeability. The specification contains details of the special press to be used in printing with such stencil plates. —W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

Liquid Sulphurous Acid. K. Barth, Papier-Zeit. **17**, 1918.

several wood-pulp works the use of sulphur or pyrites urners has been given up in favour of the use of liquid lphurous acid, which is supplied in iron cylinders or tanks. he use of this liquid acid is not without danger, especially uring transport, and from observations made in the course an investigation on the cause of explosion during transort of a tank filled with liquid sulphurous acid, the author omes to the following conclusions:—

The only impurities which can occur in liquid sulphurous cid, and by their action upon metals might cause the estruction and thereby the explosion of the metallic vessels, e sulphuric acid and water. Under the circumstances, owever, under which sulphurous acid is condensed, the resence of sulphuric acid in it is highly improbable, but ater will always be present. If the quantity of the latter e very small, it can have no appreciable effect, but larger uantities cause an alarmingly rapid corrosion of the metal of e vessels through the sulphurous acid. There is of course so a possibility of tanks filled with sulphurous acid ursting, through not being strong enough to withstand the ressure. The following table shows the vapour tension of ulphurous acid at various temperatures according to Regnault :—

− 10° C.	(boiling-point of liquid SO_2)	1·00 atm. (=16 lb.)
0° C.	„ „	1·53 „
+ 10° C.	„ „	2·26 „
+ 20° C.	„ „	3·24 „
+ 30° C.	„ „	4·51 „
+ 40° C.	„ „	6·14 „
+ 50° C.	„ „	8·18 „

Taking 40° as the highest temperature which these tanks ill have to stand during transport, this would correspond an absolute pressure in the tank of 5·14 atmospheres 32·24 lb.). For the sake of perfect safety it would therefore be desirable to test these tanks under a pressure of 0 atmospheres.

Great attention also must be paid to the charging of the anks with the acid, in order to avoid their getting overcharged. Formerly it used to be customary to fill them ompletely, but the bursting of a tank, tested to stand 50 tmospheres pressure, was distinctly traced to this mistake. t present the tanks are only filled to $\frac{9}{10}$ of their capacity, ut even this is too much, considering the high coefficient of xpansion of sulphurous acid above its boiling-point. By aising the temperature of liquid sulphurous acid from 0° to 0° C., its volume increases from 1·000 to 1·106. Taking gain 40° C. as the maximum temperature, the volume of ulphurous acid between the temperatures of from 0° to 0° C., is increased by $\frac{9}{100}$, so that the filling of a tank up o $\frac{9}{10}$ of its capacity appears a rather dangerous practice. everal methods are in use at present for preventing the illing of the tanks above $\frac{9}{10}$ of their capacity, all of which re, however, more or less objectionable, because unreliable, nd the author recommends the provision on every tank of level gauge between well-fitting taps. Of great importance lso is the protection of the tanks from corrosion, which, owever, depends entirely upon the manufacture of the iquid sulphurous acid, purity and dryness of the acid, eing of paramount importance for this purpose. Absolute afety with respect to corrosion is only obtained by lining he tanks with lead. Under all circumstances these tanks, ike boilers, must be retested at intervals of about six onths, and the manholes of the tanks, which are very mall at present, ought to be made large enough to allow f a frequent examination of the inside of these tanks.

—C. O. W.

Rate of Evaporation of Water, and of Solutions of Potassium and Sodium Chlorides. P. Lesage. Comptes. Rend. 1892, **115**, 473.

The author's experiments prove that pure water evaporates more rapidly than aqueous solutions of potassium or sodium chloride; whilst a comparison of aqueous solutions of equal concentration of the two salts, shows that those of potassium chloride evaporate more rapidly than those of sodium chloride. These results are confirmed by Babo's and Wülner's observations on the vapour tensions of water and of saline solutions, it having been shown by the last-named chemist (Pogg. Annalen, 1858, **103**, 542) that whilst the tension of aqueous vapour is lower than that of saline solutions at the same temperature, the vapour tension of solutions of sodium chloride is lower than that of solutions of equal concentration of potassium chloride at the same temperature.—A. R. L.

The Relative Corrodibility of Pure and Alloyed Lead. Eng. and Mining Journal **55**, 1893, 170.

The disputed point as to whether pure or alloyed lead is best able to withstand the attacks of sulphuric acid has lately received considerable attention from Dr. Lunge. After conducting a great number of experiments with various alloys, he draws the following conclusions: 1. There is no difference in the cold between the actions of sulphuric acid on pure and antimonial lead, when the admixture of antimony does not exceed 0·2 per cent.; a lead of the following composition—Sb 1·81, Cu 0·05, Bi 0·01, Fe 0·01, and Sn 0·04 per cent. As 0·10 per cent.—was more strongly attacked than pure lead, in contrast to the general supposition that antimonial lead is more able to withstand the attacks of sulphuric acid; when the acid is warm, the difference in favour of pure lead is more marked. 2. The action of nitrous vitriol is in all cases stronger when air has access than when not; and is always greater than pure vitriol. 3. The addition of a small percentage of copper to the lead does not increase its power to resist the attacks of sulphuric acid when the temperature is below 200° C.; when the temperature is above 200° C. the addition of 0·1 to 0·2 per cent. of copper is advisable, though its effect is not very marked.

PATENTS.

Improvements in the Production of and Apparatus for Obtaining Carbonic Acid Gas and Lime. H. C. Bull, London. Eng. Pat. 22,746, December 30, 1891.

Limestone is charged into externally-heated vertical retorts provided with charging and discharging doors and with a central perforated pipe for drawing off the hot carbonic acid gas from the sides of the retort, through the charge. "Since carbonic acid gas is a very poor conductor of heat, had the gas to rise up to the top of the charge in the case of the absence of the central tube, the process of expulsion of carbonic acid would be a very long one, relatively."—H. A.

An Improved Manufacture of Potassium Carbonate from Potassium Sulphate. P. Römer, Nienburg-on-the-Saale, Germany. Eng. Pat. 1548, January 26, 1892.

The conversion of potassium sulphate into carbonate is effected by the agency of potassium bichromate, equivalent parts of which combine with potassium sulphate in presence of lime, forming a neutral chromate and gypsum. The potassium chromate is then treated with carbonic acid, whereby the bulk of the potassium bichromate originally used is precipitated and potassium bicarbonate remains in solution. On concentrating, a further quantity of chromate separates out, whilst on further treatment with carbonic acid gas potassium bicarbonate is precipitated, and can be freed from chromium compounds by means of alkaline reducing agents or by means of repeated precipitation with carbonic acid.—H. A.

Improvements relating to the Manufacture of Ammonium Nitrate. H. H. Lake, London. From V. Groendahl and J. Landin, Stockholm, Sweden. Eng. Pat. 1868, January 30, 1892.

The process consists in the treatment of a mixture of sodium nitrate and ammonium sulphate with methylated spirit, resulting in the formation of ammonium nitrate and some sodium nitrate in the alcoholic solution, and of sodium sulphate and some ammonium sulphate in the residue. The solution may be partly freed from sodium nitrate by passing through a layer of granulated ammonium sulphate, or more completely by addition of ammonium chloride. The alcohol is distilled off, the residue being almost pure ammonium nitrate.

The insoluble product sodium sulphate contains some salt and ammonium sulphate. On heating this residue the salt is converted into ammonium chloride, which may be eliminated by sublimation, and pure sodium sulphate remains.—H. A.

Improvements in the Recovery of Hydrochloric Acid and Ferric Oxide from Ferrous Chloride. M. N. d'Andria, Levenshulme. Eng. Pat. 3308, February 19, 1892.

These improvements refer to the production of hydrochloric acid from the "waste pickles" obtained in the galvanising and cleaning of iron. The ferrous chloride produced from these acid solutions is to be mixed with its equivalent of oxide, carbonate, or sulphate of magnesia and subjected to red heat in a current of steam. All the hydrochloric acid being evolved, or while it is being given off, a current of air is passed over the charge for the conversion of the ferrous oxide into ferric oxide, which may be separated from the magnesia compound by the extraction of the latter with water or acid.—H. A.

Improvements in the Recovery of Sulphur from the Waste Gases from Claus Kilns or similar Gases, and Apparatus therefor. A. Allhusen, G. E. Edgell, and W. Russell, Gateshead. Eng. Pat. 5225, March 16, 1892.

This invention effects the recovery of the free sulphur contained in the waste gases from the Claus kilns by passing the gases through layers of iron oxide or broken bricks kept at a suitable temperature. The apparatus consists of a number of vertical cast-iron pipes placed within a chamber, which is divided by means of partition walls into three superposed parts. The gases are admitted into the top chamber, from which they pass simultaneously into all the vertical pipes to be delivered into the bottom chamber, where the molten sulphur is deposited. The pipes are heated by the products of combustion of a furnace which is in in communication with the intermediate chamber.—H. A.

Improvements in the Treatment of Bauxite or similar Minerals for the Purpose of Obtaining Alkali-aluminates or Alumina Hydrate. C. J. Bayer, Elabuga, Russia. Eng. Pat. 5296, March 17, 1892.

This invention refers to the utilisation of mother-liquors containing 1 mol. aluminium oxide to 6 mols. sodium oxide, as obtained in a previously-patented process (this Journal, 625, 1888). The proposition is to concentrate these solutions to about 77° — 88° Tw. and to agitate them with fresh quantities of finely-ground bauxite at a pressure of 3—4 atmospheres and 160°—170° C. temperature for $1\frac{1}{2}$—2 hours. The materials should be used in suitable proportions to produce a solution containing 1 mol. alumina to about 1·8 mols. sodium oxide.—H. A.

A New Process or Means for the Production of Chloride of Lime. J. M. Milnes and A. Milnes, London. Eng Pat. 19,180, October 25, 1892.

The object of this invention is the manufacture of bleaching powder by the action of chlorine gas on slaked lime, which is fed automatically into a closed chamber, being there constantly raked up and turned over by mechanical means, and is finally delivered into casks without the employment of manual labour.—H. A.

An Improved Process of Obtaining Ammonia and Ammonia Salts from Nitrogenous Organic Matters. H. H. Lake, London. From L. Sternberg, Jersey City, U.S.A. Eng. Pat. 21,723, November 28, 1892.

In the production of ammonia from nitrogenous organic matters by treatment with superheated steam, a large excess of the latter is necessary for obtaining a good yield. Starting from the supposition that dilute ammonia is not so easily decomposed as strong ammonia, the inventor attributes to the excess steam the rôle of a diluent, which he seeks to substitute by cheaper materials of a non-oxidising nature such as hydrogen, nitrogen, carbon monoxide, carbon dioxide, illuminating gas, water-gas, &c. In carrying out the process, the nitrogenous matter and the mixture of steam and indifferent gas is fed in continuously into the cold end of a retort; the escaping hot gases are scrubbed with dilute sulphuric acid to retain the ammonia, and are finally returned to the process along with some steam generated from the dilute sulphuric acid.—H. A.

Improvements in Apparatus applicable for Distributing or Discharging Powdered Caustic Soda or other suitable Material. W. P. Thompson, Liverpool. From T. P. Stowell, Rochester, U.S.A. Eng. Pat. 22,917, December 13, 1892.

In order to conveniently discharge the contents of a drum at suitable intervals, the bottom of the drum is taken out and a hopper of frusto-conical shape substituted in its place. Inside the hopper is a stirring device worked by a handle from the outside. The disintegrated materials are delivered by means of a disc rotating between two floors, all of them being provided with openings so arranged that they do not register simultaneously.—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Manufacture of Blown Hollow Glass with Metal Insertions. O. Imray, London. From The Aktien Gesellschaft für Glasindustrie, Dresden. Eng. Pat. 5527, March 21, 1892.

The processes now used for the manufacture of glass with metal insertions is limited to such articles as can be made by pressing or rolling. The present invention enables such insertions to be introduced into blown hollow glass. The method employed is to form a hollow glass object by blowing a lump of glass into a mould, then opening the object, introducing the metal insertion, and then blowing a second glass body into the first one, thus forming two hollow glass bodies with the metal insertion between them, the whole being then finished off in any suitable manner. The process enables glass to be produced in sheet form from blown hollow glass cylinders, which are flattened out in the usual way in a flattening oven and then cut into sheets.—V. C.

Improvements in Means for Casting Glass Rollers, Glass Bearings, or other similar Glassware. D. Rylands, Shepcote, near Barnsley, B. Stoner and S. M. Thompson, Stairfoot. Eng. Pat. 6890, April 11, 1892.

The object of the invention is to produce a perfectly smooth and true inner surface to glass rollers or bearings or other similar castings. The smooth true inner surface is obtained by means of a revolving roller, generally of carbon. The mode of applying the roller is different according to the different form of article to be produced; but the following particulars relating to the form of roller and mode of operating the same for producing a glass bearing with semicircular inner surface, will enable the principle of the process to be understood. In this case one-half of the circumference of the roller forms the bottom part of the mould, so that the plastic or semi-solid metal lies on the top of the roller. The polishing is effected by longitudinal strips of carbon, which project somewhat beyond the radius of the roller. Finally, and before the casting has become completely rigid, the roller is stopped in such a position that he projecting longitudinal strips are no longer in contact with the metal. The polished but not perfectly rigid metal now rests upon the smooth half of the roller, which in this position forms the bottom part of the mould. Thus the glass after being polished is enabled finally to set in a perfectly true form upon the smooth and true surface of the roller.—V. C.

Improvements in or relating to Stoneware, Glass, and other Fictile Ware in which Taps are fitted. P. Y. Cliffe, Seacombe. Eng. Pat. 7066, April 12, 1892.

In stoneware receivers and other similar chemical apparatus he taps are usually ground into the nozzles and fixed with cement. They are, however, apt to leak, and to be knocked oose.

To avoid this the taps are formed with a flange and a screw thread fitting a thread formed in the nozzle of the receiver. The tap is furnished with a washer of asbestos or other suitable material, and, if thought desirable, with a coating of asbestos paint.—V. C.

Improvements in Ovens for Baking Earthenware and the like. C. Moellenhoff, Hamm, Prussia. Eng. Pat. 16,887, September 21, 1892.

The invention consists of a circular bench of ovens with aper chambers, each provided with two fireplaces and with an arrangement of flues and dampers, which permits of securing a uniform baking and of using the excess heat after the burning down of a part of the kiln for the preparatory heating of other parts of the kiln. By adjusting the dampers, &c. the heat can be distributed at will in the different chambers. When, for instance, the baking process has terminated in one chamber, the hot gases from this chamber can be diverted into another chamber. Rapidity of manufacture is one of the advantages gained by the process, as the utilisation of the waste hot gases for the preliminary heating renders it unnecessary to wait for the complete drying of the wares.—V. C.

Improvements in Glass Vessels for Secondary Batteries or Accumulators. H. Kroeker, Berlin, Prussia. Eng. Pat. 22,639, December 9, 1892.

On two opposite sides vertical grooves are moulded or formed in the vessel so that they are adapted to receive a plate. Similar grooves are provided for other plates according to the required capacity of the vessel, and between the grooves on each side a projection is made of a width to ensure perfect insulation between contiguous plates. At the upper part of the vessel a shoulder is formed with corresponding grooves, and by means of this the plates are suspended clear of the bottom and insulated from one another.—G. H. R.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Utilisation of Blast-Furnace Slag. R. Zsigmondy. Dingl. polyt. J. 1892, **284**, 233—237.

Slag Bricks.—The manufacture of slag bricks has attained considerable dimensions. The firm of Lürmann, Mayer, and Wieking, of Osnabrück, have alone turned out about 5,073,400 since 1875. The manufacture has also been taken up by other ironworks, notably by the Schwechat ironworks near Vienna. The granulation of the slag, which is an essential part of the process (*cf.* this Journal, 1890, 863), is effected by running the slag along a channel together with a stream of water into a reservoir, in which it is collected. The lime to be mixed with it, in the proportion of 1 part to 6 of granulated slag, is slaked with sufficient water to yield a moist sludge and the two ingredients are thoroughly incorporated in a mill, in which the process is conducted in the following way:—The mixed slag and lime are conveyed by a spout, to which a shaking movement is communicated, to a pair of rolls, which stop the access of unduly large fragments of slag or foreign bodies to the mixer proper, and mingle the slag and lime still more thoroughly while reducing them somewhat in size. The final mixing is effected by a set of three drums with radial projections fitting into each other with only a slight amount of clearance, so that the ingredients are brought into the most intimate contact. A machine absorbing 2—3 horse-power will serve to prepare the material for 9,000 to 10,000 bricks per shift of 10 hours. The mixture is moulded into bricks by a machine, which is provided with a hopper kept filled by the labourer in charge, and an arrangement whereby the quantity necessary to form one brick is let down into the mould and then the aperture closed, while the moveable sides of the mould are brought into position by eccentrics and by this means pressure exerted upon the mass, to shape and consolidate it. The finished brick is pushed out of the machine and the operations of filling the mould and applying pressure repeated. A machine absorbing 7—8 horse-power will turn out at least 9,000 to 10,000 bricks per shift, its capacity being limited chiefly by the time consumed in removing the finished bricks. The bricks thus prepared are weak at first, and have to be handled carefully, and must be stacked and protected from rain for the first day, a precaution that is not afterwards necessary. They become sufficiently strong for use for building purposes after the lapse of 6 to 12 months. Their hardening is partly due to the action of the granulated slag on the lime, and partly to the formation of calcium carbonate. Tests made at the Imperial Testing Station at Berlin, show that these bricks have on an average, a strength in compression of about 140 kilos per sq. cm., and are little affected by saturation with water or by exposure to frost. The amount of water necessary to saturate them is about 12·4 per cent. On account of the hydraulic properties of a mixture of slag sand and lime, bricks can be immersed in water when only a week old without being disintegrated. From the nature of the case they are unsuited to withstand high temperatures, but they are not injured by a moderate degree of heat, *e.g.* the temperature of furnace gases at 250° to 300° C. When used for ordinary structural purposes, such as building walls, they are cemented together by a mortar composed of slag sand and lime, and they have the useful property of affording a good hold for nails, which may be driven directly into them. No evolution of sulphuretted hydrogen from them has been observed. They are also cheap, costing 9 to 10 florins per 1,000.

Cast Slag Bricks.—These are made by casting the slag in a mould built up of bars and angle-pieces so arranged that layers of cubical spaces communicating with one another are formed, the whole being surrounded by sand, and the inlet placed at the bottom, so that the filling of the moulds takes place from below upwards. Sufficient slag is poured to cover the whole set of bricks with a layer 10 cm. thick, in order to ensure slow cooling and the formation of the crystalline instead of the vitreous modification of slag, as the former is considerably the stronger.

A minor use for slag is found in the production of a sort of moulding sand by mixing granulated slag sand with common sand, and its heat is utilised for drying sand moulds, whereby a saving of fuel is effected. A table of analyses of slags of various origins is given.

"*Metallic Plaster.*"—Under this name a mixture of slag with Portland cement has been in use for some time past in England and Belgium. The materials are first mixed dry and then water containing a little sodium and ammonium carbonate to retard the setting, added, and the mixture compressed into paving tiles, *in situ*, the joints being filled in with shavings or other elastic material, to fill up crevices that may form when the fluctuations of temperature are considerable. Smaller tiles may be made, not necessarily *in situ*, and treated in a bath of sodium silicate before being laid.

Slag Cement.—Pinkenburg has given certain information on the preparation and use of slag cement in a communication to the Architectural Association of Berlin. There are about 10 slag cement factories in Germany, with an annual production of 600,000 tons. The Berlin market is supplied by slag cement made from the slag of the Blankenburg and Harzburg blast-furnaces, and costing 5 marks per 170 kilos. delivered. The chief disadvantages of slag cement are its slowness in setting—15 to 22 hours—and its low specific gravity, which cause it to separate from the aggregate with which it is used. If exposed to frost during the time of setting, it is deteriorated, but is unaffected thereby when once it has set. It has given trouble in several cases when used under water, but appears well adapted for ordinary buildings exposed only to the air. When used as mortar the usual precautions, such as well mixing to a stiff paste, and thoroughly wetting the surfaces to be cemented, must be observed, and after the initial setting, the mortar should be kept as moist as possible to complete the process of hardening. As slag cement does not expand on setting, and from the nature of its constitution cannot "blow," it may safely be used in cases where either tendency of Portland cement would be objectionable.
—B. B.

Sixth Annual Report of the Inspector of Asphalt and Cements. Washington Government Printing Office. Fiscal Year 1891—1892.

Cements.—A large number of natural hydraulic cements was examined.

Experiments were carried out, and are recorded at length, on the effect of the experience and skill of the workman employed in gauging briquettes, and the conclusion (already well authenticated) that the personal equation is a large one, and always is in the direction of causing a skilful gauger to obtain uniformly higher breaking strains than one less accustomed to the work, was confirmed. The only point of any novelty, is the opinion recorded that natural cements are more susceptible of variation in their tensile strength than are ordinary Portland cements. Experiments were also conducted to determine the difference of results obtained in the testing room from those arrived at in actual work, and their upshot was that the latter were much lower than the former would lead one to suppose. The causes for this discrepancy are chiefly the greater amount of water necessarily used in the preparation of mortar for concrete in a suitable condition for ramming, and also the character of the sand in use, as compared with the standard quartz sand employed in testing. With briquettes preserved in moist air, the results obtained from mortar from the works were only 20 per cent. of the values given by the laboratory tests with standard quartz. This difference would diminish after the lapse of time, but in work where centres are to be drawn, the results at short intervals after use are of special importance. The falling off of strength of magnesian cements under these conditions, is not so great as that of lime cements. Another set of experiments was made on the effect of frost on cement exposed before it had time to set. All showed a deterioration, but the natural cements frequently disintegrated, whereas the imported Portland cement did not suffer to this extent.

Asphalt.—In consequence of the delivery of asphalt of inferior quality for paving purposes, the writer of the report was sent out to Trinidad to study the question of its collection and the utilisation of the various kinds obtained. There are two sorts of pitch obtained and shipped at Trinidad. The first and better is that known as "lake pitch," as it is dug from the pitch lake itself, while the other and worse is from the deposits that lie adjacent to the lake, and is called "land pitch."

The Pitch Lake.—The pitch forming the lake is not a homogeneous mass, but is composed of rounded sections which meet but do not coalesce, and form cavities and fissures at their lines of junction. It appears that there is a continuous motion of the lake, the pitch rising from the centre, flowing outwards, and rolling downwards again at the edges, where it meets another pitch mass. Any weighty object placed upon the surface gradually sinks, and holes cut in the pitch fill up in the course of a few days, the motion taking place from all sides in a manner characteristic of a fluid. Near the centre of the lake there are, at some points, patches of softer pitch, sufficiently yielding to allow a boy to sink to his knees in 20 seconds. This difference of quality is not due to the pitch being hotter than the rest of the lake, but to a difference of composition. It is more tarry and is rich in gas, composed largely of sulphuretted hydrogen and carbon dioxide. There are also present deposits of sulphur, and the water constantly associated with the pitch, is loaded with saline constituents. The evolution of the gas continues after the pitch has been removed from the lake, and in some cases suffices to burst the vessel in which it is contained. The reaction seems to result in the change of the soft pitch into the harder variety found in the rest of the lake. Owing to the removal of pitch for paving purposes, the amount taken up to the present time being rather less than one million tons, the level of the lake has sunk since it began to be worked, the most reliable estimates fixing the lowering at about one foot.

Land Pitch Deposits.—Deposits of land pitch are found between the lake and the sea coast, a distance of about three-quarters of a mile. There are several grades of land pitch, the best being known as cheese pitch, as it contains large gas cavities like those found in the lake pitch and resembles in appearance Swiss cheese. Another kind is "iron pitch," so called from its occurring in hard, compact masses, scarcely to be distinguished from refined asphalt; and yet a third is "cokey pitch," produced by the carbonisation of land pitch by fires in the scrub that grows on the slight covering of soil which overlies it. The amount of land pitch obtainable in a marketable form, varies very greatly from place to place, as much as 10,000 tons per acre being afforded by the best excavations, while others do not contain quantities that would pay to work.

Other Bituminous Deposits.—There is a certain amount of mineral oil in the neighbourhood of the lake, and attempts have been made to work it, but without commercial success, one reason being that it contains much sulphur and has a large proportion of constituents of high boiling-point (over 600° F.). Submarine bituminous springs are also found at various points on the coast. On the mainland of Venezuela there are also several pitch deposits, and one of these, at the mouth of the Orinoco, is being worked by an English company, while an effort to develop a large deposit is being made at Maturin.

Long tables of analyses of pitch are given by the author, the gist of which is appended.

LAKE PITCH.

—	Average.	Highest.	Lowest.
Water	27·85	30·65	25·77
Inorganic matter	26·38	..	..
Organic matter not bitumen	7·63	..	..
Bitumen	38·14	..	..
When calculated to dry substance:			
Inorganic matter	36·56	37·02	35·27
Organic matter not bitumen	10·57	11·75	9·95
Bitumen	52·87	53·77	51·68

F

The softening point varied from 170° to 230° F., averaging about 190° F., and the flowing point ranged between 185° and 240° F., the mean value being about 200° F. The extreme uniformity of composition, which is most prominent when the constituents are calculated on the dry substance, is very remarkable.

Soft Pitch.

	Per Cent.
Water and gas	34·10
Inorganic matter	25·05
Organic matter not bitumen	6·35
Bitumen	34·50
	100·00

The soft pitch is that obtained from the centre of the lake, and has been already referred to. When heated it froths considerably from the evolution of gas, and loses not only water and gas, but also a certain amount of light oil. It softens at a temperature of 170° F. and flows at 185° F., figures appreciably lower than those for average lake pitch. The dry substance loses 12·24 per cent. when heated for 10 hours at 400° F., as against 3·66 per cent. for lake pitch under the same conditions.

Land Pitch.

The variations of specimens obtained direct from the deposits are much greater than those observed in lake pitch, but in samples selected for commercial utilisation, the extreme specimens are absent, and greater uniformity results, although there are nevertheless larger fluctuations than in lake pitch.

——	Land Pitch (unpicked Samples).		Land Pitch (commercial Samples).		
	Highest.	Lowest.	Average.	Highest.	Lowest.
Water	39·76	0·21	27·36	31·33	23·58
Dry substance :—					
Inorganic matter	47·71	36·39	37·74	39·37	36·89
Organic matter not bitumen.	12·39	7·50	10·68	11·82	9·83
Bitumen	53·78	43·74	51·58	53·78	49·36

The difference in the proportions of these constituents from those of lake pitch is too inconsiderable to account for the marked difference in properties, and it must therefore be ascribed to the bituminous matter being different in quality. This is shown both by the divergence of the softening points, and by the behaviour of the refined bitumen obtained from the two classes of pitch to which reference is made below.

Various Forms of Pitch not of Commercial Value.

Name.	Original Substance.				Dry Substance.		
	Water.	Inorganic.	Organic not Bitumen.	Bitumen.	Inorganic.	Organic not Bitumen.	Bitumen.
Iron pitch selected	9·78	34·13	8·40	47·69	37·83	9·31	52·86
Chocolate blended	3·70	37·90	8·61	49·79	39·35	8·94	51·71
Chocolate	1·14	36·87	8·38	53·61	37·30	8·47	54·23
Sylvestre soil	35·13	38·47	18·17	8·23	59·30	8·01	12·69
Dundonald soil	7·04	80·17	11·60	1·19	86·24	12·48	12·80
Black ledge	2·27	60·24	14·54	22·95	61·64	14·88	23·48
Grey ledge	1·59	64·73	19·52	14·16	65·77	19·83	14·40

The iron pitch has been already mentioned. The chocolate variety is that which has been weathered and oxidised, and represents the exposed portions of land pitch. Those samples appearing under the head of "soil," result from the disintegration of the oxidised and rotten stuff. The last two in the table are samples from the pitch existing in reefs and shore deposits. The series viewed as a whole illustrates the nature of the change by oxidation, which causes the production of materials increasingly poor in bituminous matter. Land pitch may be taken as the first product of this change, starting from the original lake pitch.

The process of refining pitch consists in heating it in stills or boilers to a temperature sufficient to drive off the water without volatilising an appreciable quantity of the oily constituents. The melted product from which the water has been evaporated, the coarser mineral matter deposited, and the lighter organic matter, not bituminous, skimmed off, is known as refined asphalt, or locally as epuré. The softening point of the refined asphalt affords a means of ascertaining whether it has been derived from lake or land pitch, the refined lake asphalt softening at 180° to 192° F., and flowing at 189° to 210° F., while the refined land asphalt softens at 190° to 237° F., and flows at 210° to 255° F. This test alone is not quite conclusive, but taken in conjunction with others, to be mentioned later, is of considerable value. The author proposes to compare samples by determining the distance they flow down an incline under standard conditions, and thus allow of the expression of their quality in terms of a standard sample. The amount of volatile matter yielded by heating the pitch in a retort for 10 hours at 400° F., is also a criterion of its origin. Good lake pitch will lose not less than 3 per cent. by this treatment, while the loss of land pitch rarely equals this, and is below 1 per cent. in the poorer kinds.

It is well known that the bituminous matter found in Trinidad pitch is partly soluble in petroleum spirit, while entirely soluble in carbon bisulphide. The first fraction is termed petrolene and the second asphaltene. The lake pitch is richer in the former than is land pitch, and upon this fact another means of discrimination can be based. The following are some results illustrating this difference:—

Refined Lake Asphalt.

——	Percentage of Petrolene	
	In Original Asphalt.	In Total Bitumen.
Soft refined	48·36	92·32
Lake	49·01	70·03
Old refined	36·00	66·13
Still No. 1	38·65	69·97
Still No. 4	40·00	69·75

Refined Land Asphalt.

Soil	5·94	46·82
Chocolate pitch	25·17	48·90
Iron pitch	31·60	64·60
Teneriffe	33·89	64·08
Saracas	35·62	64·53
Jones point	34·73	59·61
New York	30·31	57·59

In spite of the fact that the viscosity and cementitious properties of asphalt depend largely upon the proportion of oily matter present, the addition of asphalt oil to asphalt does not endow it with the good quality of the specimens in which the oil is naturally present. This dependence of the quality of asphalt upon the ratio of the petrolene to the asphaltene, appears to hold generally, as it has been observed in the case of samples of Californian and Venezuelan origin.

The specific gravity of asphalt is a rough indication of its origin and quality, but is naturally much influenced by the percentage of ash it contains. As a rule the specific gravity of lake asphalt is below 1·39, and that of land asphalte above this limit. The specific gravity of the bituminous matter extracted from it is free from this source of error, and is higher the greater the proportion of asphaltene. Actual determinations of the specific gravity of petrolene or the portion soluble in petroleum spirit, and of asphaltene, gave the figures 1·032 and 1·142. The fraudulent addition of asphalt oil would of course upset the deductions drawn from this test. That the consideration of all the data afforded by the analysis of pitch suffices for its assignment to its true class, is shown by the results given in the following table:—

Analyses of Refined Asphalts.

Sp. gr. (77/77° F.)	1·3969	1·3988	1·3857	1·4187	1·4316	1·3771	1·4322
Softens	195° F.	197°	190°	195°	198°	183°	200°
Flows	208° F.	215°	205°	210°	210°	198°	230°
Bitumen per cent.	55·52	55·75	56·29	55·31	51·22	57·47	53·75
Organic matter not bituminous	8·96	8·06	8·05	7·84	7·78	7·05	8·01
Inorganic matter	35·52	36·19	35·66	36·85	41·00	35·48	38·24
Bitumen soluble in petroleum spirit	36·47	36·79	41·43	35·14	34·98	41·59	35·22
Per cent. of total bitumen soluble	65·68	65·99	73·60	63·53	68·27	72·37	65·52
Viscosity	Semi-adhesive.	Semi-adhesive.	Adhesive	Friable	Very friable.	Adhesive	Friable
Quality	Best land	Best land	Average lake.	Average land.	Poor land	Best lake	Average land.

In all cases the opinion of the analyst was formed before the origin of the asphalt was known to him, and proved to be correct when the source of the asphalt was disclosed.

Water accompanying the Pitch.—The water constantly associated with the pitch is highly saline, and apparently of volcanic origin. Its specific gravity at 15° C., compared with water at 15° C., is 1·017, and its reaction is strongly acid. The foliowing are the quantities of the constituents found in 1 kilo. of the water:—

	Grms.
Cl	6·7757
SO_3	5·5409
SO_2	0·0467
S_2O_7	Trace
H_2S	Trace
S	Trace
SiO_2	0·0688
B_2O_3	0·0117
I	0·0008
Br	Trace
P_2O_5	Nil
Na	6·5419
NH_4	0·4071
K	0·3391
Li	0·0271
Ca	0·5280
Mg	0·2666
Fe	0·0720
Al	Trace
Mn	Nil
Cs and Rb	Nil
Organic matter	0·4901

The mineral matter present in the pitch consists of the salts dissolved in the water accompanying it, and some clay mixed with a large proportion of silica in the form of minute sharp conchoidal fragments of quartz. The constituents soluble in acid, amount to about 17 per cent. The almost complete absence of lime is noticeable. The organic matter, other than bitumen, referred to in the analyses given above, consists partly of the débris of sticks and grass blown on to the lake from the margin, but is mainly composed of material which shows no sign of organised structure, and is apparently a by-product in the formation of the bitumen.

Conclusions drawn from these Results.—Land pitch is inferior to lake pitch in cementitious qualities, and the value of the former decreases the further it is from the lake. The two kinds can be distinguished in the refined state. The reason of the superiority of lake pitch is its higher content of viscous bituminous matter, and lower content of the more brittle asphaltene. The addition of oils toharder kinds of bitumen will not make as good material as that in which the oily constituents are naturally present. Although this difference is great, yet the element of manipulative skill is sufficient to allow of better paving being made by a skilful labourer from land pitch than by an inexperienced manipulator from lake pitch. Lake pitch might well be demanded in specifications for paving.

A comparison of Trinidad with Sicilian asphalt showed that they wear equally well, but that the former affords a better foothold for horses than the latter, as the mineral matter is sharp and siliceous instead of smooth and calcareous.

The process of manufacturing asphalt cement in a state for paving, has to be conducted at a moderate rate, as if the stills are run off too rapidly, the product is not smooth and homogeneous. Moreover, the custom of adding cold oil to the hot refined asphalt is a faulty one. The time for refining should be extended to 115 hours, and the oil run in as hot as the pumps will bear. The oil used is prepared by the Standard Oil Company, and has to be as free as possible from hard scaly, paraffin wax and light oils. The following are the analytical figures given by typical samples:—

Brand.	Flashing-Point.	Flows at	Loss at 400° F. in 10 Hours.	Character of Residue.
	° F.	° F.	Per Cent.	
Solar	420	57	2·56	Pulls long.
„	438	55	1·08	„
Baltimore (a residuum).	280	48	12·44	Soft.
Solar	438	60	0·22	Thick granular.
Baltimore.....	295	56	10·20	Soft.

The specification for these oils that is to be introduced at Washington during the ensuing fiscal year, is as follows:—"Specific gravity, 17° to 21° B.; flash-point not less than 300° F.; distillate at 400° F. for 10 hours, less than 10 per cent.; shall not cease to flow above 60° F.; shall not require more than 21 lb. per 100 of refined asphalt to produce the specified quality of cement."

The percentage of bitumen in the paving as actually laid, is as nearly as possible 10 per cent., as shown by a table, given in the original report, of analyses made of samples taken at various months of the year from the material put down by the two paving companies employed.

QUANTITY OF PITCH EXPORTED FROM TRINIDAD FROM 1888 TO SEPTEMBER 30, 1891.

—	From Pitch Lake.				From Sources other than Pitch Lake.			
	United States.		Other Countries.		United States.		Other Countries.	
	Raw.	Refined.	Raw.	Refined.	Raw.	Refined.	Raw.	Refined.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1888	24,480	8	8,290	9,303	5,020	1,915	600	1,810
1889	46,690	504	10,186	8,932	9,247	2,042	..	..
1890	38,520	..	13,221	9,760	16,460	880	..	..
1891	45,170	..	8,456	8,394	10,450	..	127	..

—B. B.

Portland Cement. Fifteenth Annual Meeting of the Association of German Cement Makers. Zeits. f. ang. Chem. 14, 1892, 423—428.

THE article contains an account of the proceedings of the Association of German Portland Cement Makers, in somewhat greater detail than that already abstracted (this Journal, 1892, 524). The following points were, however, not mentioned in the abstract referred to, or touched on but briefly. Forty-two samples of cement, made by members of the association, had been examined, of which two contained 4·5 per cent. and 6 per cent. of magnesia respectively, and three used more than 3 mgrms. of permanganate under the standard conditions for ascertaining the amount of reducing matter (sulphides) in the cement. R. Dyckerhoff had undertaken investigations to ascertain whether the addition of slag to the finished cement was detectable in cases where the cement had been made from raw materials containing slag. Samples of such raw materials, burnt in trial kilns, reduced rather more permanganate than did normal cements, and the same was true of cements made from raw materials containing slag when burnt on the large scale. The detection of subsequent addition of slag being therefore difficult by this means, the question whether slag can be recognised by elutriation or by the determination of the specific gravity, is in need of settlement. M. Meyer contributed the following figures relating to experiments with cements made from slurry containing increasing percentages of calcium carbonate, which show that as the content of lime rises the tensile strength increases, but the degree of constancy of volume diminishes,—that is, the tendency to "blow" augments.

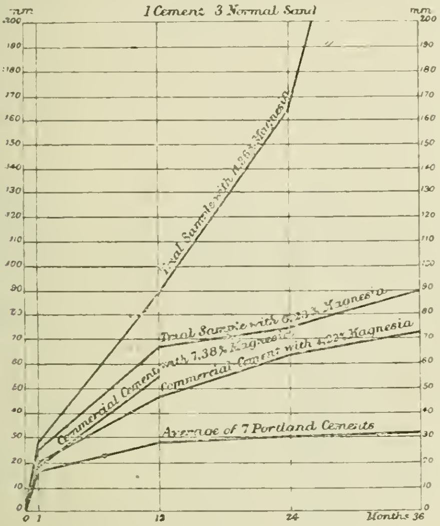
No. of Test.	Percentage of CaO.	Specific Gravity.	Compressive Strength 1 : 3 28 Days.	Expansion in $\frac{1}{200}$ mm. in Water, after						Expansion in Air after 82 Days.
				3 Days.	7 Days.	30 Days.	60 Days.	70 Days.	82 Days.	
			Kilos.							
1	75·4	3·180	175	− 1	− 1	0	− 1	− 1	+ 1	− 31
2	75·8	3·177	158	+ 8	+ 17	+ 80	+ 103	+ 118	+ 120	+ 7
3	76·5	3·176	173	+ 1	+ 2	+ 4	+ 5	+ 8	+ 9	− 40
4	76·9	3·177	185	+ 3	+ 8	+ 11	+ 25	+ 30	+ 2	− 27
5	77·5	3·183	228	+ 4	+ 8	+ 14	+ 15	+ 17	+ 18	− 34
6	77·9	3·190	235	+ 7	+ 8	+ 20	+ 22	+ 27	+ 30	+ 12
7	78·3	3·196	254	+ 19	+ 30	+ 46	+ 57	+ 69	+ 75	+ 63

R. Dyckerhoff, continuing his experiments on the effect of magnesia on cements, has represented the results of the determination of the expansion of samples with varying content of MgO in the accompanying series of curves, the significance of which is too clear to call for comment. The tensile strengths of two of the samples, those containing respectively 6·23 per cent. and 11·36 per cent. of MgO, were as follows:—

Percentage of MgO.	1 Week.	4 Weeks.	13 Weeks.	26 Weeks.	1 Year.	2 Years.	3 Years.
6·23	9·4	17·6	22·0	23·4	21·4	17·7	18·7
11·33	3·3	6·9	14·2	16·2	14·5	13·0	10·5

The tensile strength is given as usual in kilos. per sq. cm. The objectionable properties of cements rich in magnesia that are made manifest by these results are chiefly apparent when the test is carried out over considerable periods, retrogression being evident after the lapse of one year. Contradictory results were quoted by Schott, but these were only for times not exceeding nine months, and are therefore scarcely apposite. A similar remark applies to figures by Schiffner.

Expansion of Cements in which a Portion of the Lime has been Replaced by Magnesia.



The ordinates give the expansion for a rod 100 m. in length. The abscissæ represent the time in months.

Schumann's paper on the action of oils on cement has already been abstracted for this Journal (1892, 524). Some results are given of the action of two mineral waters upon cement mortar. The first was the Soden mineral water, and was found to behave like sea-water in reducing the strength of briquettes immersed in it. The water of the hot spring at Wiesbaden reduced the strength of cement mortar at an early period of immersion, but had no sensible effect upon its ultimate strength. When the test-pieces were kept at a temperature of about 55° C., the Wiesbaden water had even a favourable influence on the tensile strength.—B. B.

PATENTS.

Improvements in the Manufacture of Artificial Marble. P. A. Moreau, Meung-sur-Loire. Eng. Pat. 50, January 1, 1892.

White porous stones, such as Portland stone, are treated, either after having been carved to any desired shape, or in the form of blocks, with a solution of the sulphate of copper, iron, or zinc, prepared at a temperature of 25° to 30° C., and of a strength of 20° to 35° B., part of their surface having been previously protected by the application of a coloured varnish. The varnish is applied by spreading it over the surface of the water in streaks and spots, and dipping the stone, in a thoroughly dried condition, on to the surface of the water on which the varnish is spread. Fine lines may be obtained by dividing the varnish by projecting soapsuds upon it. The stone thus irregularly protected, is dipped into baths of the sulphates above mentioned in varying order, according to the effect to be produced, the varnish removed, the stone immersed in a bath of hot water, and then in one of sulphate of zinc to harden it, the last two operations being repeated if necessary.—B. B.

An Improvement in Burning Portland Cement. J. W. Knights, Cambridge. Eng. Pat. 4553, March 8, 1892.

Sodium chloride or potassium chloride, or a mixture of the two, is sprinkled in the proportion of 0·5 to 2 per cent. of the clinker to be produced, upon the raw material as it is loaded into the kiln, the object being to form a skin of alkaline silicate on the clinker, and prevent its "falling." The salt may be dissolved in water previous to applying it to the raw material, but must not in any case be incorporated therewith, as its action is purely superficial.—B. B.

The Production of a Cement or Glue for Joining Wood. C. W. Luther, Reval, Russia. Eng. Pat. 6104, March 29, 1892.

Sixty per cent. of air-dried casein and 40 per cent. of slaked lime are triturated together with water to a homogeneous mass; the proportion of lime may be increased, when the impermeability and solidity of the product will be increased. This cement hardens, "about an hour after preparation, into a gelatinous mass, which can be no more dissolved in water." When used in workshops it is only necessary to keep the cement in motion by means of a mixer, and to add water as it becomes thick. A joint of 1 sq. cm. made by this glue has a breaking strain of 63·5 kilos.; a similar joint of best joiners' glue breaks at 14—37 kilos.—A. G. B.

Improvements in Cements. R. Kieffert, Paris, France, and H. Thirion, Gargan, Livry, France. Eng. Pat. 14,889, August 17, 1892.

The cement, of which the composition is patented, is intended to protect surfaces of stone, plaster, wood, &c., from dampness, salt, parasites, and the like, and consists of the following ingredients, the proportions quoted being those generally suitable:—Boiled linseed oil, 10 parts; litharge, 35 parts; sifted river sand, 40 parts; lime, 10 parts; colophony, 5 parts.—B. B.

Improvements in the Production of Ornamental Stones Artificially Coloured. P. A. Moreau, Meung-sur-Loire, France. Eng. Pat. 19,395, October 28, 1892.

The patent describes the details of a process similar to that protected by Eng. Pat. 50, 1892 (see preceding abstract). The protective varnish is prepared from "a mixture of turpentine, gum thus (*sic*) and sesquioxide of iron or rouge de Prusse." It is applied in the manner described in the patent quoted above, and the stone is then immersed in baths of sulphate of iron, sulphate of copper, and sulphate of zinc in various orders, for times varying from half a minute to five minutes. It is transferred to a bath of water at a temperature of 50° to 100° C. for 30 minutes or more, and finally hardened according to the prescription in Eng. Pat. 50, 1892. The order and time of immersion vary with the nature of the stone to be treated, and the effect to be produced.—B. B.

Improved Process for Making Cement or Cement Mortar. O. Boklen, Lauffen, Germany. Eng. Pat. 19,813, November 3, 1892.

The process consists in subjecting the mortar to strong pressure, and simultaneous lateral displacement of its particles by means of rollers or obliquely moving presses, or by some equivalent mechanical device. The process is said to yield a product free from the faults common to cements prepared in the ordinary way.—B. B.

The Manufacture of Variegated or Veined Artificial Stone and Imitations of Natural Marble. P. A. Moreau, Meung-sur-Loire, France. Eng. Pat. 20,414, November 11, 1892.

Cementitious substances, such as plaster of Paris or Portland cement, are coloured in any suitable manner, and oured together into a mould so as to produce a material of ariegated aspect. A similar result may be obtained by ixing powdered chalk or Portland stone with sulphate of nc and a suitable colouring matter, making them into a aste with water, and pouring them into a mould. In ther case the resulting block may be hardened by treatent with sulphate of zinc, as described in Eng. Pat. 50, 892.—B. B.

X.—METALLURGY.

ffect of the Mechanical Condition of Aluminium on its Corrosion by Chemical Agents. A. Arche. Dingl. Polyt. Jour. 284, 255—256. Compare this Journal, 1892, 172.

HE author's experiments were conducted on the same nes as those of Rupp (this Journal, 1892, 172), and accord with them in indicating the suitability of aluminium vessels for storage of food. Attention is called to the fact that Winkler found (this Journal, 1892, 244) that aluminium has a greater durability than either silver or German silver. Experiments with sea water are in progress.

The metal experimented with was of six qualities, which had the following composition :—

Quality.	O*a*.	I*b*.	I*c*.	I*d*.	I*e*.	I*f*.
Aluminium ...	99·86	99·57	99·49	99·26	99·18	99·03
Silicon........	0·11	0·21	0·33	0·45	0·51	0·61
Iron	0·03	0·22	0·18	0·29	0·31	0·26

The following table gives the results of the observations made with these metals :—

No.	Quality.	Silicon.	Condition.	Kind of Treatment.	Duration of Test.	Weight before Experiment.	Loss of Weight.	Reaction.	Character of Liquid after Treatment.
		Per Cent.							
1	O*a*	0·11	Cast	5 per cent. acetic acid	10 days	32·1465	0·0007	..	Clear.
2	O*a*	0·11	„ hammered	„ „	„	46·2080	0·0002	..	„
3	O*a*	0·11	Cast, rolled, plates 1 cm. thick.	„ „	„	41·4436	0·0005	..	„
4	O*a*	0·11	Cast, drawn, bars 1 cm. thick.	„ „	„	21·7915	0·0005	..	„
5	O*a*	0·11	Cast, corroded with caustic soda.	„ „	„	54·6220	0·0011	Slight trace.	„
6	I*b*	0·21	Hammered field flask	Red wine, 0·5 per cent. acid.	4 days	39·7321	0·0008	..	„
7	I*b*	0·21	„ „	Coffee...............	„	39·7310	0·0011	Slight trace.	„
8	I*b*	0·21	„ „	Tea.................	„	39·7294	0·0005	..	„
9	I*b*	0·21	„ „	Water at 17°	2 days	39·7285	0·0003	..	Very slightly turbid.
10	I*c*	0·33	Stamped drinking cup	Rum................	8 days	26·1945	0·0003	..	Clear.
11	I*c*	0·33	„ „	Milk................	1 day	26·1937	0·0001	..	Slightly sour.
12	I*c*	0·33	„ „	Preserve...........	½ hour	26·1931	0·0036	Trace.	No special taste.
13	I*d*	0·45	Foil, 0·5 mm., polished	2 per cent. tartaric acid.	12 days	10·4125	0·0006	Very slight trace.	Clear.
14	I*d*	0·45	„ 0·5 mm., corroded	„ „	„	12·5384	0·0010	..	„
15	I*e*	0·51	„ 0·25 mm.	0·5 per cent. soda-ley	„	15·3440	0·0115	0·0095 Al	Turbid.
16	I*e*	0·51	„ 0·1 mm.	1 per cent. salt solution.	„	10·9120	0·0185	0·0150 Al	„
17	I*f*	0·61	Wire, 0·5 mm.........	White wine, 0·7 per cent. acid.	4 days	4·3675	0·0009	..	Clear.
18	I*f*	0·61	„ 0·75 mm........	„ „	„	4·2790	0·0007	..	„
19	I*f*	0·61	„ 0·5 mm.........	„ „	„	4·5465	0·0015	Slight trace.	„
20	I*f*	0·61	„ 0·1 mm.........	„ „	„	4·9215	0·0018	..	Turbid.

A. G. B.

Technical Importance of aluminium and its Future Applications. J. Klaudy. Mitt. Tech. Gewerbe-Museums, 1892, 89—101.

THE general effect of aluminium when used to alloy with ther metals is the increase of their ductility when small uantities are added, and of their ultimate strength when he amount employed is larger. A certain mean quantity herefore gives the most favourable results in both respects. The aluminium bronzes are the most generally useful lloys; in the next column are some figures given by Tetmajer for cast specimens.

All these bronzes are almost unaltered in air. The 8·5 per cent. alloy is that in which the increased tensile strength and the augmented extension are combined to the greatest dvantage. The 11·5 per cent. alloy represents the limit at which the addition of aluminium renders the product brittle. The so-called "steel bronze," when cast, has an elastic limit of only 6—8 kilos per sq. mm., but this can be raised by working to 24 kilos with an ultimate strength of 60 kilos and an extension of 35 per cent. This alloy has been used

Commercial Name.	Percentage of Aluminium.	Tensile Strength, Kilos per sq. mm.*	Extension on 1 dm.
			Per Cent.
Gold-bronze ..	5·5	40	64
Steel-bronze ..	8·5	50	52
Acid-bronze...	10	63·5	
..	11·5	80	0·2

* To convert kilos per sq. mm. into tons per sq. in. multiply by 0·6364.

by the Maschinenbau-Actiengesellschaft in Nüremberg for excentric straps, bearings, gear wheels and similar purposes. Nails and screws have been made from it, and it has been used for the couplings of the tubes connecting steam-heated railway coaches, Bearings made from the 5 per cent. bronze, wear better than those of gun metal containing 10 per cent. of tin. Hard rolled sheet with a high content of aluminium has been used for springs in such things as arc lamps.

Tetmajer has also tested certain cast specimens of aluminium brass.

Percentage of Aluminium.	Tensile Strength in Kilos. per sq. mm.	Extension on 1 dm.
		Per Cent.
0·25	30	61
2	48·5	30
3	61	7

The brass used contained 67 per cent. of copper and 33 per cent. of zinc. The results show that copper can bear a much larger percentage of aluminium before becoming brittle, than brass. This is also true as regards different qualities of brass, the permissible quantity of aluminium increasing with the percentage of copper.

Aluminium lends itself to the production of decorative effects as it may be given a dead white surface by the action of caustic soda, and grey tones can be produced by similar means. It may be readily spun, and all kinds of hollow goods prepared from sheet metal without a joint. The tensile strength of cast aluminium is about 10—12 kilos per sq. mm. and it has an extension of only 3 per cent. Its strength may be raised by working, and notably by rolling. It is annealed by heating and rapid cooling.

The effect of cold rolling and of annealing is shown in the following figures :—

—	Tensile Strength in Kilos per sq. mm.	Extension on 1 dm.
		Per Cent.
Section diminished to $\frac{1}{20}$ by cold rolling	23·5	4·3
„ „ $\frac{1}{80}$ „	27	4·2
Annealing and reduction of area to $\frac{1}{20}$.	10	20
„ „ $\frac{1}{80}$.	8·1	19

Attempts have been made to raise the strength of aluminium by the addition of small quantities of other metals. The following are the results with copper :—

—	Tensile Strength. Kilos. per sq. mm.	Extension on 1 dm.	—
		Per Cent.	
2·7 per cent. of copper added.	16·1	13·5	Cast.
„ „	30	3	Cold rolled.
„ „	20	19·5	Annealed, rolled.
6 per cent. of copper added.	12	5	Cast.
„ „	33	10—12	Cold, rolled.
„ „	20	„	Annealed, rolled.
2·5 per cent. copper and 2·5 per cent. cadmium added.	19	18	Cast.

When 10 per cent. of copper are used the alloy is brittle in the cast state, but loses its brittleness on working, and is fairly hard, while its specific gravity is not raised much above that of pure aluminium, being 2·9.

Aluminium is troublesome to cast, forming blow holes freely, a defect which Coehn has attempted to remedy by the addition of sodium. The electric conductivity of aluminium is only 59 per cent. of that of copper, in spite of which it might be used for field telegraph purposes on account of the saving of weight. The conductivity of aluminium bronze is too low to allow of its use for telegraph or telephone lines, for which purposes it is otherwise well suited on account of its high tensile strength. Pure aluminium, when cast, shrinks about 1·8 to 2 per cent.; the shrinkage is diminished by the addition of 8 per cent. of copper. The loss by oxidation on remelting is about 2 to 6 per cent. The problem of soldering aluminium satisfactorily is not yet completely solved. Taking the present price of aluminium at 3 fl. per kilo, it is volume for volume 164 per cent. cheaper than nickel, 11 per cent. cheaper than tin, and only 20 per cent. dearer than copper.

The Oesterreichische Alpine Montangesellschaft uses a 10 per cent. ferro-aluminium in quantities of 0·25 to 0·5 per cent. as an addition to Siemens-Martin steel of special quality. The action is a double one. The steel-bath is quieter and blow holes are almost wholly removed. The addition of ferro-aluminium is not found necessary for crucible cast steel. The addition of aluminium has also been practised by the Witkowitzer Bergbau- und Eisenhüttengewerkschaft for producing sound castings, with success. The additional cost is quite trifling. The attempt to use aluminium as a substitute for ferro-manganese in the converter or in an open hearth furnace, is rendered nugatory by the lightness of the metal causing it to float on the surface of the bath and there burn uselessly. If added to the metal in the ladle the surface becomes honeycombed in an inexplicable manner so that the use of aluminium is restricted to the removal of comparatively small evolutions of gas in place of silicon, which has long been used for quieting the metal and getting sound castings.

As regards the prevention of blowholes in copper, phosphorus appears better suited than aluminium. It is stated that according to the experience of the French navy aluminium brass containing 2 per cent. of aluminium has been found to resist the action of sea water, and to be the most suitable metal for the sheathing of ships. Nemetz has made many experiments on the suitability of aluminium for the beams of analytical balances. Rolled aluminium sheet has long been used with success, but these later experiments were with the cast metal. Pure aluminium was too weak, and the alloys containing copper had a tendency to form cracks during stamping. The best results were obtained with an alloy of aluminium containing 3 per cent. of fine silver and 2 per cent. of chemically pure copper, the casting, after being diminished in cross section about 0·2—0·3 mm. by presure, being hard and springy, free from cracks, and showing no tendency to flexure until severely overloaded. The surface could be polished with very fine emery paper and oil but with other polishing agents a rough porous appearance was produced, although the metal was really free from pores. The alloy retains its condition better than ordinary gilded beams, even after having been in use for years. When aluminium is cast a second time a certain quantity of fresh metal must be added to avoid the formation of blow-holes. Aluminium can be made into tubes by the Mannesmann process.

The future applications of aluminium depend mainly on its price. There appears reason to think that the actual cost of manufacture cannot by the present processes fall much below 1·5 fl. per kilo. The author compares the cost of its production with that of iron. He finds that the price of the raw material is eight times as great as that of iron for a given content of the metal. He calculates that the capital expenditure necessary per ton of aluminium is about 56 times as large as that requisite for an iron works. The cost of energy, even allowing the use of water power, is about three times what it would be for iron. In addition to this an expenditure of 0·15 fl. per kilo of aluminium is necessary for the carbon electrodes used. From these figures it results that aluminium must be 67 times as dear as iron without reckoning the cost of the electrodes, that is taking pig-iron at only 0·2 fl. per kilo, the manufacturing cost of aluminium would be 1·34 fl. per kilo, or with the addition of the 0·15 fl. for electrodes mentioned above, 1·49 fl.—B. B.

Progress of the Aluminium Industry. Dingl. Polyt. Jour. 1892, **284**, 253—255.

A comparison is drawn between three 10-ton displacement sailing yachts built of wood, steel, and aluminium, respectively. For the same strength the aluminium yacht will have less than half the weight of the others; this will mean a larger amount of ballast, in order that the displacement may be the same, and a corresponding lowering of the centre of gravity. Thus, in the wooden vessel the centre of gravity will be 0·43 metre, in the steel vessel 0·47 metre, and in the aluminium vessel 0·65 metre below the water line. The stability of a vessel is greater the lower the centre of gravity, and the sail area is proportional to the stability. For the three yachts in question the sail areas will be in the ratio 1:1·06:1·35, and as the speed is proportional to the square root of the sail area, this value for the three will be in the ratio 1:1·03:1·16. For the same displacement, then, the aluminium yacht is much the fastest. The ratio of cost may be approximately stated as 1:1:1·8, but from this last figure must be deducted the value which the worn out hulk of the aluminium yacht will still possess.

Great advantage as regards weight is claimed for the use of aluminium framework for the windows of railway coaches; it should also be employed for parts of sewing machines. An alloy of aluminium with 17 per cent. of copper is recommended for slide valves. For glue, gelatin and wax boiling and melting pots, aluminium has the advantage that it does not discolour the products, as do iron and copper, by forming coloured sulphides with the sulphur in the glue, &c. An alloy of aluminium with 6 per cent. of copper is employed for watch cases in the Swiss watch industry. Lithographic stones and composing sticks of aluminium have been patented. A large number of small articles such as penholders, billiard cues, &c. are made of aluminium by the Mannesmann method of tube rolling.

Aluminium bronze is being extensively used for marine and torpedo work; it has a lower specific gravity (7·7) than any other non-rusting metal (phosphor-bronze = 8·9). The "double bronze" wire for telephonic use is an aluminium core with a copper sheathing, its breaking strain is 76 kilos. per sq. mm., and its conductivity is 69 per cent. of that of copper, which is better than silicon bronze of the same strength. The 5 per cent. bronze is well fitted for the ignition tubes of gas motors on account of its resistance to oxidation at high temperatures; according to H. Schiff it is 17·6 times less oxidisable than copper, when heated in oxygen, apparently because the layer of oxide first formed does not scale, and thus protects the metal beneath. The 12 per cent. bronze has been used for some time for the needles of percussion caps.

With respect to the addition of aluminium to steel J. O. Arnold states that he has observed a temperature rise of more than 100° immediately after the addition, and is of opinion that the freedom of the casting from blow holes is due in great measure to the reduction of dissolved carbon monoxide by the aluminium. He has passed this gas over red hot aluminium and obtained alumina and carbon, and by passing carbon monoxide through a molten steel containing aluminium he has raised the carbon content from 0·30 to 0·51 per cent. The addition of aluminium is recommended for all castings which are to stand pressure, and is effected as follows:—The aluminium ingots are heated in a small ladle and some iron allowed to flow on to them; these are mixed until the mixture begins to solidify, whereupon the mass of the iron is run into the casting ladle and the aluminium alloy immediately poured in. 200 grms. of aluminium per 100 kilos. of iron are recommended. The casting is not made immediately after the addition of the ferro-aluminium, but as soon as a thin scum makes its appearance on the surface of the metal, which by this time will have cooled to orange-yellow. The reason for thus waiting is probably because the contraction of iron containing aluminium is greater than that of ordinary cast-iron, so that the more nearly the temperature approximates to the solidifying point when the casting is made, the better this will be.—A. G. B.

On the Formation of Aluminium Sulphide. A. H. Bucherer. Zeits. Ang. Chem. 1892, 483—484.

The manufacture of aluminium, based on the decomposition of sodium aluminium chloride by metallic sodium, is not able now to complete successfully with the manufacture of the same metal by the electrolytic process, and it is not likely that this state of things will change in future, and principally on account of the necessarily high price of aluminium chloride. In the electrolytic process the aluminium oxide is dissolved in molten cryolite and decomposed by means of the electric current.

The author points out the enormous cost with which the use of electricity is accompanied, when used for metallurgical reductions at so high a temperature, and the advisability therefore of finding methods by which aluminium may be obtained by means of some chemical reaction. The author has succeeded in decomposing aluminium sulphide electrolytically and has worked out a process by which this material may be cheaply produced on a large scale. Since the heat of combination of the sulphide is only one-third of that of the oxide, it is evident that it can be more easily reduced electrolytically, and that moreover its reduction chemically will offer greater facilities. When carbon and sulphur are heated with aluminium oxide to a white heat, aluminium sulphide is formed—

$$Al_2O_3 + 3\,C + 3\,S = Al_2S_3 + 3\,CO$$

This reaction is the most endothermic known, as 180,500 Cal. are absorbed. A fire-clay retort (0·6 m. × 0·3 m.) was charged with charcoal and aluminium oxide, the mixture covering the bottom to a depth of about 25 mm. At one end of the retort an earthenware pipe (0·6 m. long, 4 cm. diam.) was fixed in a slanting position, which served for the introduction of sulphur, as well as for allowing the gases to escape. The retort was heated to a white heat and sulphur was introduced at intervals of half an hour, taking care that there was always a slight excess of sulphur present. Too great an excess must be avoided on account of the danger otherwise of stopping up the tube with sublimed sulphur. The author calculates the cost of producing 1 kilo. of aluminium sulphide at 0·15 mark, allowing for the recovery of sulphur.—K. E. M.

The Extraction of Antimony by Wet Methods. C. A. Hering. Dingl. Polyt. J. **286**, 287—288.

Although antimony has hitherto been obtained by dry methods it is possible that local conditions may make the use of wet methods applicable. The author therefore gives a list of processes hitherto devised for the extraction of antimony in the wet way. These are:—

1. That of R. F. Smith, Eng. Pat. 205, January 26, 1871 (see also Ber. 1871 [15]. Finely-powdered antimony ore is dissolved in hydrochloric acid and the metal precipitated by zinc or iron and afterwards melted. The poisonous fumes given off during solution are the chief drawback to this process.

2. A method by the author (Dingl. Polyt. J. 1878, 230, 253), in which the ore is dissolved as before and precipitated either as algaroth-powder by dilution with water or as metal, by means of zinc, iron, &c., or the electric current, or as sulphide by means of sulphuretted hydrogen. The same objection applies to these methods as to the previous one.

3. J. Hargreaves and T. Robinson, Widnes, Eng. Pat. 1584 of 1881. The same as 1 and 2.

4. F. M. Lyte, London (Ger. Pat. 22,131, 1883; this Journal, 1882, 236). This process applies to lead, silver, and copper ores containing antimony rather than to pure antimony ores. The ore is roasted with salt at a high temperature, whereby antimony chloride is volatilised. The latter is condensed by means of a solution of common salt,

and the metallic antimony is precipitated from the solution by means of iron or zinc. This process is costly owing to the complex apparatus required to condense the fumes. Moreover chlorine gas escapes into the atmosphere.

5. J. Simpson and E. W. Parnell, Liverpool (Ger. Pat. 30, 1884). Finely-powdered antimony ore is extracted with solutions of alkaline or alkaline earthy sulphides. Antimony sulphide is precipitated from the clear liquor by means of hydrochloric acid. The process is not adapted for poor ores and the gases evolved are objectionable. The same process has been patented by A. W. Warwick, Battersea (this Journal, 1892, 533).

6. W. Borchers (Chem. Zeit. 1887, 1021; this Journal, 1887, 673). The ore is extracted with sodium sulphide and the solution electrolysed. The following reactions occur:—At the cathode, $Sb_2S_3 + 3\ Na_2S + 6\ H = Sb_2 + 6\ NaHS$; at the anode, $6\ NaHS + 3\ O = 3\ H_2O + 3\ Na_2S_2$. Three per cent. of common salt are added to the extracting liquor to precipitate iron sulphide and to increase the electrical conductivity of the liquor. A current density of 40—50 ampères is used for each square metre of electrode requiring an electromotive force of 2—2·5 volts. The metal is separated in a more or less compact state according to the current used, but it must be fused to render it marketable.

7. Sanderson (Ger. Pat. 54,219, 1890) has devised a process for extracting gold from the crude antimony of Lixo, Oporto. An electric current is passed between plates of the crude metal immersed in a solution of antimony chloride and common salt. The gold falls to the bottom whilst the antimony is transferred from one electrode to the other. It is, however, scaly and has to be re-melted. The process is too costly for technical use.

8. Kopp's process is the latest one brought out. The ore is dissolved in a solution of ferric chloride containing some common salt and hydrochloric acid according to the equation $2\ Fe_2Cl_6 + Sb_2S_3 = 4\ FeCl_2 + Sb_2Cl_4 + S_3$. The filtered liquid is electrolysed, with the result that antimony is separated at the negative electrode, whilst the ferrous chloride is oxidised to ferric chloride at the positive electrode. The electrodes are of lead. The liquor is heated to 50° C. and is kept in circulation. The most compact metal is obtained with a current of 50 ampères per square metre of cathode. This process seems likely to be profitable, and no noxious fumes are evolved. In a note it is stated that a patent has been obtained by Siemens and Halske for the electrolytic separation of antimony (Ger. Pat. June 28, 1892).—H. K. T.

Remarks on the Changing of the Physical Properties of Coke made in By-product Ovens.

J. J. Fronheiser. J. Franklin Inst. **135**, 1893, 34—35.

See under II., *page* 254.

The Utilisation of Blast Furnace Slag.

R. Zsigmondy. Dingl. Polyt. J. 1892, **284**, 233.

See under IX, *page* 264.

On the Optical Measurement of High Temperatures.

Le Chatelier. Dingl. Polyt. J. 1892, **286**, 43 and 63.

See under XXIII., *page* 290.

PATENTS.

Improvements in the Manufacture of Aluminium Alloys.

N. Lébédeff, St. Petersburg. Eng. Pat. 2241, February 5, 1892.

The alloys are prepared by desulphurising the sulphides of the metals to be combined with the aluminium, beneath a layer of fused clay or other silicate of alumina, the fusion being effected in a plumbago crucible or a reverberatory furnace, suitable fluxes having been added when required. The sulphides to be used are then introduced, and when melted the materials arrange themselves in two distinct layers, the sulphides being at the bottom. This lower layer is then desulphurised by maintaining the bath in a condition of fusion, with gentle agitation and in contact with carbon. Several methods of effecting this result are specified. The immediate result of either is the formation of an alloy of the desulphurised metal with aluminium.

It is recommended that an excess of sulphide should remain at the conclusion of each operation.—J. H. C.

An Improved Metallic Flux for Use in refining Iron and Steel for Casting.

R. L. Sentinella, London. Eng. Pat. 3493, February 23, 1892.

Iron or steel is heated in a crucible to a plastic condition and chloride of sodium (between 10 and 20 lb. to 1 cwt. of metal) stirred in before the metal fuses. The mixture is then raised to a higher temperature when a reaction sets up with the formation of an alloy of iron and sodium with the chlorides of iron and sodium suspended in it. This alloy is cast into ingots and used in purifying other iron from sulphur, phosphorus and silicon by adding it in the proportion of from 1 to 10 per cent. to the molten metal in either the crucible, blast furnace, or open hearth.—A. W.

Improvements in the separation of Tin from Tin Scrap.

T. Twynam, Chiswick. Eng. Pat. 3844, February 27, 1892.

The scrap is coated with a film of chloride of calcium or similar fusible salt and heated to redness. It is then cooled by plunging in water, when a scale falls which contains all the tin and leaves the iron practically clean and suitable for many metallurgical processes. The insoluble scale may be smelted direct for tin after mixing with carbon and siliceous matter; or it may be heated with sufficient acid, preferably hydrochloric, to dissolve out the iron, leaving the oxide of tin in a nearly pure state; or the tin may be recovered as a soluble stannate after fusion of the scale with alkali.

—J. H. C.

Improvements in Amalgamating the Precious Metals and their Ores and the like, and in Apparatus therefor.

T. Evans, Barmouth, and H. C. Bunkell, London. Eng. Pat. 4488, March 7, 1892.

An amalgamating apparatus is employed consisting of a circular tank, with concentric channels containing mercury, and supplied with outlet tubes formed in its bottom and a series of grated openings in its side through which the exhausted pulp passes away. The ore-pulp is introduced through a central tubular rotatory shaft, which is furnished at the bottom with distributing blades, and carries round with it a series of arms and stirrers, by which the pulp is brought in contact with the mercury and gradually forced towards the circumference.

The mercury when sufficiently charged with the precious metal is removed by means of the outlet pipes and heated in the usual manner.—J. H. C.

A Solder for Aluminium.

R. Heaton, Birmingham. Eng. Pat. 5560, March 22, 1892.

The solder is an alloy of aluminium and tin, suitable proportions being 45 parts tin to 11 parts aluminium. The metals are melted separately, poured together, and then cast into suitable strips, sheets, or ingots. No flux is required.

—J. H. C.

An Improvement or Improvements in Tinning Cast-Iron Hollow-ware.

F. Ryland, West Bromwich. Eng. Pat. 6454, April 4, 1892.

The vessel or article under treatment is cooled in the latter part of the tinning process while covered with a volatile or fixed oil, or in a mixture of the two. The volatile oil called "petroline" answers well in practice.—J. H. C.

Improvements in the Treatment of Minerals, Matts, Speiss, and other Substances containing Nickel for the separation of Copper, Nickel, and Cobalt. J. de Coppet, Paris. Eng. Pat. 4997, March 14, 1892.

In general the following six operations are employed :—

1. The iron is removed, preferably by a dry process.

2. The so-called "refined matt" is crushed and then roasted in a reverberatory furnace, to convert it partly into sulphates and partly into oxides; or chlorides may be added to convert the metals partly into chlorides.

3. The matt so treated is lixiviated at a low temperature, with the addition of sulphuric or hydrochloric acid if necessary, so as to dissolve as much copper as is equal to the chemical equivalents of the nickel and cobalt. If there is not enough copper already present an additional quantity may be added.

4. The undissolved residuum is dried, and reduced with some reducing gas or otherwise, and at a temperature not exceeding a dull red, so as to produce metallic cobalt and nickel in a crude mixed state and a pulverulent form.

5. The cupreous solution produced in the third operation is then precipitated at a low temperature by the metallic cobalt of the mixture produced in 4; the nickel at this temperature does not precipitate copper, while the cobalt does so, and itself passes into solution. The residuum of precipitated metallic copper and unattacked metallic nickel is then treated with a fresh quantity of the attacking liquor, in a heated condition. The metallic nickel now acts in its turn, precipitating more copper in the metallic state, the nickel passing into solution. Thus the complete separation of the three metals has been effected, and we have metallic (cement) copper free from nickel and cobalt; nickel as dissolved sulphate free from copper and cobalt; and cobalt as dissolved sulphate free from copper and nickel.

6. The sulphates of cobalt and nickel may be crystallised out separately, or after mixing as the double sulphate, from which the metals may be reduced by any ordinary process.

By a proper use of the foregoing methods, omitting operation 1, ferro-nickel free from copper may be readily prepared.—J. H. C.

Improvements in the Process of Treating Oxidised or Corroded Lead, and in Apparatus therefor. H. H. Lake, London. From R. W. F. Abbé, Brooklyn, U.S.A. Eng. Pat. 20,151, November 8, 1892.

The bar of lead is oxidised as usual and is then placed in a cylinder, suitably lined with porcelain or other material, revolving at a slow speed and containing loose pulverisers in the shape of pebbles, balls, or rollers. By this means the litharge is liberated from the "blue lead" or unoxidised particles, which latter become flattened by the pebbles. The material is then conveyed to the narrow end of a rotary tapered bolter or screen open at both ends, the finely powdered litharge being thus separated from the flattened particles of metallic lead, which are discharged at the wide end ready for further oxidation if desired. The advantage of this process is that the litharge and the unoxidised metal are not pressed one into the other as they are in the present method of passing the oxidised bar through rolls.—A. W.

Improvements in Methods and Processes of reducing Ores. A. J. Rossi, New York, J. MacNaughton, Albany, and W. D. Edmonds, New York, U.S.A. Eng. Pat. 21,761, November 29, 1892.

This patent relates to the smelting of titaniferous iron ores. Instead of treating titanic oxide as a base and adding large quantities of quartz, together with lime, to flux it off as silicate, the patentees utilise the titanic oxide as an acid, and in the calculation of their charges arrange for it to combine with the bases to form titanates. By this means are saved the cost of special fluxes, the amount of quartz previously used not only for fluxing the titanic oxide, but also for the other basic materials added and present, the expense of extra fuel in melting and of handling so much silicate slag, and finally the extra burden whereby the production capacity of the furnace was diminished. The best results are obtained when the ratio of oxygen in the acid (titanic and silicic) portion of the slag to the oxygen of all the bases present is between $2:1\frac{1}{2}$, and $2:2$. An example of a suitable charge is given and also the composition of its slag with three bases, but a good fusible slag can be obtained with only alumina and lime as bases, although in most cases it is advisable to add a small quantity of fixed alkali to increase the fusibility.—A. W.

An Improved Process or Method of Plating or Coating Aluminium with Tin, Zinc, or Lead, or Alloys thereof. R. Haddan, London. From L. Oliven, Berlin, Germany. Eng. Pat. 23,476, December 20, 1892.

The difficulty in coating aluminium with tin, zinc, or lead, or any mixture of these, by dipping it into the molten metal or mixture of metals, is due to the film of oxide of aluminium on the surface of that metal. The author overcomes the difficulty by brushing the aluminium, when under the surface of the molten coating metal, with a steel wire brush or other equivalent so that its surface is rubbed, scratched, or scraped, whereby the oxide is removed and an adherent coating obtained. Brushing the aluminium before dipping is insufficient as the coating is then faulty and only partially adherent.—A. W.

An Improved Process of Soldering, applicable to the Soldering of Aluminium to Aluminium or to other Metals. R. Haddan, London. From L. Oliven, Berlin, Germany. Eng. Pat. 23,477, December 20, 1892.

This is an adaptation of the principle in the preceding abstract. The surfaces of the aluminium to be soldered are warmed, dipped into the molten solder, which may be tin or any of the usual alloys of tin with lead or zinc, and scratched by suitable means while under its surface. The aluminium is then withdrawn and the two coated surfaces are pressed together and heated, with more solder if necessary. No acids, liquids, or fluxes are required and the process is suitable for soldering aluminium either to itself or to any other metal.—A. W.

Improvements in and relating to Ore Roasting Furnaces. R. Pearce, Denver, U.S.A. Eng. Pat. 23,896, December 27, 1892.

The furnace described is of a "turret-like annular" form, having one or more continuous annular hearths and a series of arms carried round so as to meet the hearth or hearths from inlet to outlet, to move the ore continuously and progressively.

Two vertical walls are built concentrically, and in the annular space between them, a short distance from the ground, is built the horizontal bed of the furnace on which the ore is roasted, and above this the roof. The fireplaces, of convenient number, are erected on the outside of the outer concentric wall and suitably connected with the inside of the furnace, while the products of combustion escape through an opening in the roof into a dust chamber, and thence to the stack. The ore is fed through another opening in the roof direct on to the bed, through which it is discharged by a suitable aperture into specially constructed cars.

In the centre common to the two walls is a revolving hollow column from which radiate horizontal arms which extend through a slot in the inner wall into the furnace to act as a stirrer and to which is fixed a rabble. The slot, which runs right round the wall, is suitably constructed against the escape of heat and gases. The revolution of the central column carries the rabble round and round over the furnace bed, raking the ore and moving it along the bed from the point of entry to the discharge. The radiating arms and stirrers can be made hollow, with outlets in the latter behind the rabbles, so that air can be forced through them directly on to the ore. Two or more beds may be arranged one above the other in the same furnace if desired. Detailed plans and descriptions are given, which show how these arrangements are carried out.—A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

A New Principle in the Electrolytic Separation of Metals. H. Freudenberg. Ber. **25**, 2492—2493.

It has been debated whether the decomposition of an electrolyte first occurs when a given voltage is used, or whether it begins at a voltage lower than that normal to its accomplishment under ordinary conditions. The latter view is supported by the fact that water is electrolysed by currents of small voltage—a fact that has been attributed by Helmholtz to convection currents. More recently Arons has sought an explanation in the different electric charges of the ions composing the electrolyte. According to this theory an innumerable multitude of compounds of various degrees of stability are present in every electrolyte, and, consequently, even the weakest electromotive force suffices to free a certain proportion of the ions.

Le Blanc's researches (Zeits. f. physik. Chem. 1892, 299) are incompatible with this belief, as he has found that there is a definite voltage requisite for the decomposition of a given electrolyte: and upon this fact and upon the considerable differences in the ease with which metallic salts are electrolysed, the author has based a method of separation. Previous processes for the electrolytic separation of metals in analysis have depended upon the behaviour of metallic salts—especially double salts—in various solutions, and upon alterations of the current density. The attainment of useful results by the latter means must often have been due to the variations in voltage that it entailed, but no clear pronouncement of this fact as illustrative of the general principle has hitherto been made. Helmholtz's convection currents do not appear to have any tangible influence on the voltage necessary for the separation of metals. Using a Leclanché cell giving 1·35 volts, the author has succeeded in separating silver from copper and bismuth, and mercury, in the mercurous state, from copper, bismuth, and arsenic, the metals being present in weak nitric acid solution. The separation takes place well, and is complete. 0·15 to 0·2 grm. of silver or mercury can be precipitated during the night. The analytical results quoted are satisfactory.—B. B.

The Alteration of the Conductivity of a Solution by the Addition of Small Quantities of a Non-Conductor. R. J. Holland. Ber. **25**, 2726, 2727.

Arrhenius' researches upon this question, which have been published while the author was at work on the same subject, dealt chiefly with cases in which the non-conducting bodies used were solvents for the salts contained in the aqueous solutions examined. The author, on the other hand, has used non-conductors which have no solvent action on the salts employed, which were dissolved in methyl alcohol at a dilution 10 to 200 times as great as that chosen by Arrhenius. The methyl alcohol was as pure as possible, and was dried by distillation over sulphate of copper. The salts experimented with were the nitrates of potassium, sodium, and lithium, pure and carefully dried. The non-conductors were pure benzene, toluene, xylene (which isomer is not stated), and oil of turpentine. Solutions $\frac{1}{100}$, $\frac{1}{1000}$, $\frac{1}{2000}$ of normal strength were prepared, and 5, 10, 15, 20 per cent. of the non-conductor added. The resistance was measured by the use of the Wheatstone bridge and telephone. The results led to the following conclusions:—

(1.) The conductivity is diminished by the addition of a non-conductor in direct proportion.

(2.) The diminution of conductivity varies according to the nature of the dissolved salt and the non-conductor. Benzene, toluene, xylene, and oil of turpentine diminish the conductivity in the order given, the last named having the greatest effect.

(3.) The molecular conductivities are expressed graphically by straight lines.

Other relations that have previously been observed with aqueous and alcoholic solutions were also found to hold in this instance, *e.g.*, the increase in conductivity with rise of temperature; the increase of molecular conductivity and the decrease of the temperature coefficient with increased dilution.—B. B.

The Use of the Electrical Current in Metallurgical Laboratories. W. Borchers. Zeits. f. ang. Chem. 1892, 133—136.

The author recommends the use of furnaces heated by the electric current in laboratories where it is available, on the ground of its convenience, rapidity, and cleanliness. He has already described the principle of the apparatus adopted by him in his book entitled "Electrometallurgie," and now gives its details of construction.

Figs. 1 and 2 show a furnace suited for roasting operations, in which KK are carbon rods, about 25—30 mm. in diameter, connected by a slender carbon rod, about 50 mm. long and 4 mm. in diameter, which is surrounded by a muffle of fireclay or magnesia, M, containing the material under treatment. In order to check radiation or to allow of the muffle being, if necessary, surrounded by powdered charcoal when it is desired to exclude air, a fireclay trough C is provided, also serving as a receptacle for open vessels which are employed when the charge is to be heated in free contact with air, and resemble the muffle M split longitudinally. The carbons KK are carried by holders HH running on the slide G, by means of which they can be brought and kept in contact by a spring or screw. The whole arrangement can readily be dismounted when cleaning is necessary, and the slide is protected from dust, &c. by the sheet-iron cover B. The leads which end in the copper plates PP are clamped, saddle-wise, on the carbons, or attached in some other suitable way to the carriers, which are mounted on an isolated stand.

Fig. 1.

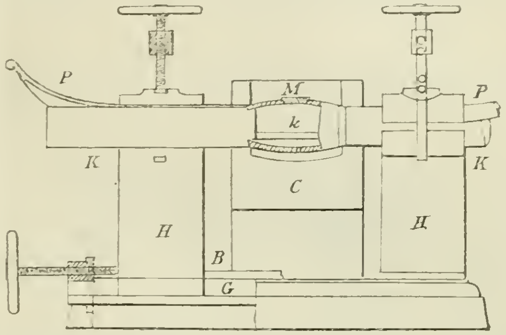
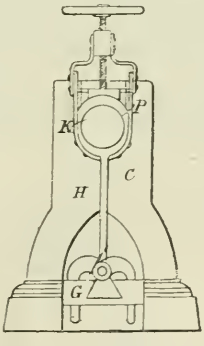


Fig. 2.



The apparatus shown in Figs. 3 and 4 is adapted for fusions and reductions where the use of an iron crucible is permissible. The crucible which is illustrated at T is held in the iron clamp Z, fastened by the key W, and serving as a conductor of the current as well as a support to the crucible. A carbon pencil, 4—6 mm. in diameter, makes connection with the crucible and a carbon rod K, which is about 30 mm. in diameter and is carried in a clamp connected with the other conductor in a manner similar to that already described for the crucible itself. C is a fireclay shield with an outer sheet-iron cover designed to protect the crucible and retain its heat; it is provided with a small opening through which the progress of the heating can be observed. The foregoing pieces of apparatus are suited for comparatively moderate temperatures. When higher temperatures are needed for the fusion or reduction of refractory substances, the furnaces illustrated in Figs. 5, and 6, and 7 may be used. The cast-iron stand for the crucible consists of a bed-plate F with side pieces B S, the latter of which is moveable, and can be brought up towards B by the wrought-iron band Z, actuated by a screw or spring, as shown in the figure. In both side-pieces a groove is cut for the reception of the small iron plate G. The crucible may be supported if necessary by the packing piece of asbestos or fireclay A. The apparatus may be made to fit crucibles of various sizes by inserting rings of gunmetal, or similar material having good conductivity, between it and the carrier, as shown at L. Another device for the same purpose is shown at Fig. 7, which differs from that already described in having a series of springs EE, made of metal strips about 5 mm. wide and 1 mm. thick, making connection with the crucible, and, at the same time, serving to support it. The working of the apparatus in either form is obvious, the only precaution necessary being to turn on the current gently and not to exceed a current density of 5 ampères per sq. mm. of the cross section of the carbon pencil imbedded in the charge. This is ample for most purposes, as when one is used of 6 ampères per sq. mm. a temperature sufficient to reduce alumina by means of carbon is attained. The author's experiments with commercial specimens of carbon pencils have shown that an electromotive force of about 0·3 of a volt is necessary to send a current of 1 ampère per sq. mm. of section of a carbon pencil 10 mm. in length. As an example of the power required for a reduction of a refractory substance, he mentions that in a case of the kind, a carbon, 4 mm. in diameter and 45 mm. in length, would be used, and would need a current of 60 ampères and 8 volts, *i.e.*, 480 watts, corresponding to an expenditure of about 0·8 of a horse power. Seeing that the continuance of the test, even with a highly refractory charge, is unlikely to exceed 15 or 20 minutes, the amount of coal used would not be greater than 0·2 or 0·3 kilo. The cost of the carbon pencil, of which 5 cm. at most would be used, would be negligibly small, while the crucible itself would suffer considerably less than with the usual modes of heating.

—B. B.

Fig. 3.

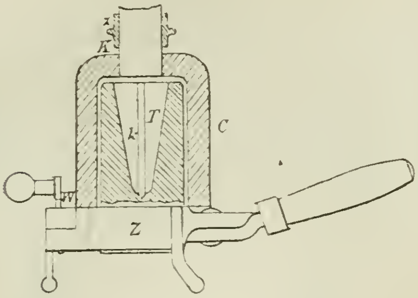


Fig. 4.

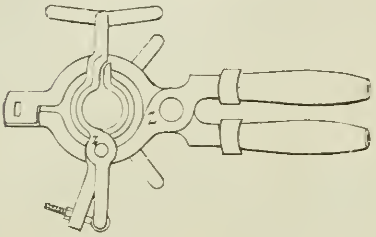


Fig. 5.

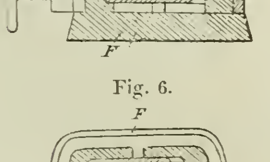


Fig. 6.

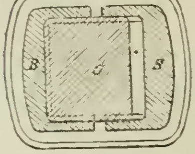
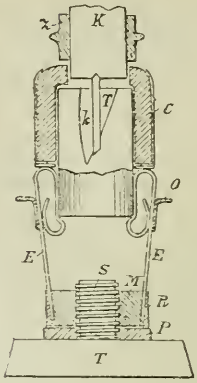


Fig. 7.



PATENTS.

Improvements in or Connected with the Manufacture or Production of Chloride of Zinc and Alkaline or Alkaline Earth Sulphates, and of Zinc and Chlorine, by Electrolysis of Solutions thereof. T. Parker, A. E. Robinson, and C. H. Parker, Wolverhampton. Eng. Pat. 982, January 18, 1892.

Chloride of zinc and sulphate of an alkali, or of an alkaline earth, are produced by roasting sulphide of zinc or zinc blende together with the chloride of an alkali or of an alkaline earth. These salts are then made into a cold saturated solution, which preferably contains the salts in molecular proportions, and the solution is electrolysed with the production of zinc and chlorine.

Lead or silver remain behind as insoluble chlorides. Zinc cathodes and anodes of carbon or of chromium phosphide answer well, and 10 amperes per sq. ft. of anode surface is a suitable current density.—G. H. R.

Improvements in Electrical Batteries. F. M. A. Laurent Cély and E. Finot, Paris, France. Eng. Pat. 4190, March 3, 1892.

The positive element or plate of this battery consists of a frame of lead with openings in it, into which is compressed a paste composed of peroxide of lead together with 4 per cent. more or less of litharge and sulphuric acid, or in lieu of the latter a concentrated solution of sodium or magnesium sulphate. Washing the plates with acidulated water removes the soda or magnesia set free, and gives a high porosity to the peroxide. The negative element is zinc, and the E.M.F. 2·45 volts.—G. H. R.

Improvements in Electric Batteries. S. W. Maquay, London. Eng. Pat. 4768, March 10, 1892.

According to this invention the zinc plates are attached to screw plugs, or caps, adapted when in place to hold the plates in the battery cell while preventing the escape of any liquid. When the battery is not in use the plates are removed from the cells, and secured in suitable cavities attached to or forming part of the battery.—G. H. R.

Improvements in Secondary Batteries and Accumulators. P. Germain, Auxerre, France. Eng. Pat. 8987, May 12, 1892.

Each positive electrode consists of three plates of lead or lead alloy placed one against the other, and united into a solid block by bolts passing through their corners. The two outer plates consist of an external frame with internal divisions shaped so as to prevent the active material filling them, from falling to the outside of the plates. The third plate consists of a combination of vertical and horizontal bars, the space between the bars being the same as that occupied by the divisions of the two outer plates. These bars are so disposed that they divide the pastils of the outer plates into equal parts, and prevent them from falling inwards. The space between the bars is not usually filled with active material, but forms a set of chambers in which the electrolyte can circulate. The pastils are formed by moulding in the cold a mixture composed of 90 per cent. of oxides of lead, and 10 per cent. of a compound called calcareous aluminous alkaline cement which is claimed to give cohesiveness and porosity.—G. H. R.

Improvements in or Relating to the Electrolytical Decomposition of Metallic Salts, and in Apparatus therefor. C. Kellner, Vienna, Austria. Eng. Pat. 17,169, September 26, 1892. Second Edition.

This invention relates to the use in the electrolytic decomposition of metallic salts of a mercury cathode for the purpose of obtaining metals in the solid or metallic state, or in the form of hydrates. It also relates to apparatus whereby the use of mercury for this purpose on an industrial scale is rendered practicable. The mercury employed as a cathode is in the form of a vertical thin layer, and acts as an intermediary between the electrolyte (which is separated therefrom by the partition wall), and the water, or mercury or acid or other body flowing in contact therewith, as it takes up through the partition wall in a metallic state the metal separated as a cation, and constantly gives it up to the water or to the other body employed according to the product required. When water is employed, it forms a hydrate with the metal; whilst when mercury is employed an amalgam is produced from which the metal can be separated by a second electrolysis, by employing as the anode of a second cell the metal which separates at the mercury cathode, the said second cell being arranged in the decomposing cell, and its cathode being electrically connected with the mercury. The metallic compound is formed in the secondary cell on short circuiting much more quickly than the separation of the metal at the mercury cathode, so that the secondary cell never reaches its full electromotive force, but by including the secondary cells in the circuit of the source of electricity, as for example a dynamo, it is possible to employ a weaker main current, or a weaker machine, because the current generated in the secondary cells flows in the same direction as the main current, and therefore strengthens the latter.—G. H. R.

Improvements in Glass for Secondary Batteries or Accumulators. H. Kroeker, Berlin. Eng. Pat. 22,639, December 9, 1892.

See under VIII., *page* 264.

Improvements in Secondary Battery Plates or Elements, and in the Process of Preparing the Same. P. M. Justice, London. From W. W. Griscom, Haverford, U.S.A. Eng. Pat. 22,987, December 14, 1892.

The plates are in the form of grids forming a group of frames of comparatively thick material, and these frames consist of a series of thin sheets or stripes of metal enclosed within the framework, and forming an integral part of it. Forced lead, that is lead which has been forced in a semi-fluid condition into dies or moulds, is the material preferably employed in the construction of the plates, which are first boiled in an aqueous solution containing 2 per cent. of ammonium nitrate, and then formed by electrolysis in the usual way in a bath of dilute sulphuric acid.—G. H. R.

Improvements in and relating to Secondary or Storage Batteries. J. Y. Johnson, London. From A. M. Michel, Paris, France. Eng. Pat. 23,232. Dec. 16, 1892.

This invention relates to the lead zinc type of cells. The lead used in the construction of these plates is in a honey-combed condition, produced by dissolving zinc out of an alloy of lead and zinc which has been disintegrated by physical or mechanical means. The alloy is preferably composed of ninety-six parts of lead and four parts of zinc, by weight, and after reduction to a granular state it is treated with sulphuric acid, and subsequently washed to eliminate the zinc sulphate formed. The honey-combed lead thus produced is compressed by pressure (which should not exceed 50 kilos. per square centimetre), into skeleton supports, or the briquettes may be placed in moulds and the frame or support formed round them by pouring in molten lead.

The negative plates are composed of an alloy containing one part of zinc to three or four parts by weight of mercury which is spread over and squeezed into meshes of a support made of metallic wire netting or gauze, or a skeleton or open work frame of any suitable or convenient form. In using accumulator plates made according to this invention it is found expedient to cover the plates with a wrapper or envelope of parchment paper held in place by rubber bands or other suitable means.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Viscosimeter. E. Engler, Zeits. ang. Chem. 1892, 725—727.

See under XXIII, page 291.

PATENTS.

Improvements in Solidifying Animal, Vegetable, and Mineral Oils, and Volatile and Inflammable Fluids. W. S. Chenhall, and W. F. T. Chenhall, Eastville, Bristol. Eng. Pat. 952, January 18th, 1892.

The oils are solidified according to this patent, by means of resin soaps.—J. L.

Improvements in or appertaining to Solid Lubricants and Bearings therefor. C. H. Ridsdale, Guisboro', Yorkshire. Eng. Pat. 3239, February 19th, 1892.

The inventor wishes to replace fluid lubricants by hard solid lubricating substances and proposes to use them in the form of pencils, bars, sticks, &c., which are to be inserted into holes in the bearings.—J. L.

Improvements relating to the Manufacture of Soap. H. H. Lake, London. From G. Schicht, Aussig on the Elbe, Austria. Eng. Pat. 22,039, December 1st, 1892.

The inventor produces hard potash soap and potash-soda soap by allowing hot fat to run in a thin stream into a concentrated solution of the alkalis heated previously to 135° C.—J. L.

Improvements in the Manufacture of Soap. P. Zacharias and J. Grünwald, Berlin, Germany. Eng. Pat. 22,605. December 9th, 1892.

The "improvement" claimed consists in incorporating with ordinary soap for the purpose of manufacturing hard transparent soap a mixture consisting of: (1) a weak solution of magnesium chloride, in which starch is "dissolved;" (2) potash or soda, and hydrate of lime; (3) glycerin; and (4) a solution of borax and potash, in order to "clarify the compound."—J. L.

Improvements in Petroleum or Naphtha Soap, and in the Method of and Apparatus for Producing the same. S. Stanton, London. From E. W. Stanton, Colwyn, Pennsylvania, U.S.A. Eng. Pat. 22,681. December 10th, 1892.

This specification contains eight claims for the manufacture of a resin soap highly impregnated with petroleum. This soap stock may also be used for mixing with ordinary soap. An apparatus is claimed for mixing the resin, petroleum and caustic potash or caustic soda.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Aniline Pigments. Papier Zeit. **17**, 2286.

The aniline pigments are particularly valuable for chromo lithography, for which purpose the aniline dyes themselves cannot be used, owing to their solubility in water. For the purpose of paper-staining the aniline pigments are prepared in the paste form, and the nature and quality of these pigments depend very much upon the mineral "base" or medium upon which the lake is deposited. Blanc-fixe, barytes, china-clay, red lead, starch, barium carbonate and calcium carbonate are the bases mostly employed, upon which the aniline dyes are precipitated by means of suitable precipitants. For pigments for lithographic purposes alumina hydrate is the base generally employed. The aniline dyes are dissolved in water, and it is advisable to filter these solutions before adding them to the bases. The acid dyes, such as Ponceau 2 R, are precipitated by means of barium chloride, whilst for the weak acid dyes like eosin, lead acetate is used. The basic dyes are precipitated by means of tannin and tartar emetic. The fastest of these pigments are those obtained with the alizarin dyes. As they are insoluble in water it is necessary to dissolve them in sodium carbonate; alum, chrome-alum, or nitrate of iron being used as precipitants. A very fine madder lake is obtained by dissolving 700 grms. of sulphate of alumina in 2,000 cc. of water and precipitating with 400 grms. of soda ash, dissolved in 1,000 cc. of water. The precipitate is washed with water five or six times. Then 300 grms. of alizarin (20 per cent. paste), 150 grms. of Turkey-red oil, and 30 grms. of tannin are added, and the mixture is heated to 70° C. for half an hour. Another 200 grms. of Turkey-red oil are added and the whole boiled for 75 minutes. The pigment is then carefully washed and dried. In preparing this pigment, the solutions must be guarded from contact with iron. In drying lake pigments the temperature ought never to exceed 60° C.—C. O. W.

Celluloid Varnishes. Papier Zeit. **17**, 2,138.

These varnishes are prepared by dissolving colourless celluloid in a mixture of strong alcohol and ether. The price of celluloid being, however, very high as yet, a cheaper way of preparing these varnishes is proposed, and consists in dissolving absolutely dry gun-cotton in a mixture of three or four times its weight of ether with from three to six times its weight of very strong alcohol. After a few days standing, the solution is separated from a small quantity of an insoluble sediment and a quantity of camphor amounting to from 25 to 30 per cent. of the original weight of the gun-cotton is added to it. An excellent celluloid varnish is obtained in this manner.—C. O. W.

Antichrome Pigments. Papier Zeit. **17**, 1835.

In view of the fugitiveness of the chrome pigments the author recommends for the purpose of dyeing paper yellow the use of Mikado yellow 6 G. For use in paper-staining he suggests a preparation obtained by precipitating Mikado yellow upon a base of alumina hydrate with common salt.
—C. O. W.

PATENT.

Improvements in Ornamented India-rubber Waterproofed Fabrics and in the Mode of Producing the same. G. C. Mandleberg, Manchester. Eng. Pat. 6879, April 9, 1892.

See under V., *page* 261.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Sumach. Dingl. Polyt. J. 1892, **286**, 71.

The best kinds of sumach which occur in commerce and are used for tanning and dyeing, come from Sicily. It has recently been shown that the amount of tannin contained in the leaves is different at different stages of the growth, and is greatest when the leaves have just reached their fullest development. The colour imparted to the leather during the process of tanning also depends on the stage at which the sumach is collected. For example, if it is gathered too late it imparts a yellow colour, which is due to quercitin present in the wood as well as in the root-bark of the shrub. It is not always possible to judge from the colour of the sumach itself what colour it will impart to the leather tanned by it. Thus a green colour which is exhibited by dry sumach arises from the chlorophyll present in the leaves; this is quite insoluble in water and therefore cannot dye the leather. Young leaves especially, show the green colour; whereas leaves which are ripe or over-ripe contain yellowish or brownish colouring-matters. These latter are also formed in young leaves if they are exposed in a moist state to bright sunshine; or if they are stored in a moist state, in which case fermentation ensues. The colour of sumach and the proportion of tannin contained are affected by admixture with foreign substances, which are either added intentionally or are introduced by careless treatment. Of all the kinds of sumach found in commerce only the Sicilian undergoes a proper and suitable treatment, the natural result being that it is more highly valued than any other.—D. E. J.

Absorption of Tannin by Hide. Von Schröder and J. Pässler. Dingl. Polyt. Jour. 1892, **284**, 256—261 and 283—286.

To ascertain whether the quantity of tannin absorbed by hide is a function of the strength of the liquor, 5 grms. of air-dried hide powder (= 4·115 grms. of dry, ash-free hide substance, containing 17·82 per cent. N) were shaken in a flask several times during one day, with a solution of 2 grms. of air-dried tannin (= 1·742 grms. of dry, ash-free tannic acid) in 500 cc. of water. At the end of the day the mixture was filtered; 100 cc. of the filtrate were dried at 100°, and the residue was weighed to determine the tannin left in solution; the powder was pressed, washed with 100 cc. of water, dried at 100°, and "Kjeldahled" to determine its nitrogen. The absorption of tannin was thus estimated in two ways, which gave fairly concordant results. Similar experiments with increasing quantities of tannin were made, and the whole series was repeated with the slight alteration that instead of washing the tanned hide, it was merely pressed, and the water left in it was determined; a correction was then made for the amount of tannin left by the evaporation of this water.

The mean results are embodied in the following table, wherein the numbers are calculated on the dry, ash-free materials and on the nitrogen determinations:—

——	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Tannin in 500 cc., grms.	1·7424	2·6136	4·3560	8·7120	13·0680	17·4240	21·7800	26·1360	30·4920
Nitrogen in tanned hide powder, per cent.	13·34	12·02	10·56	10·01	10·31	11·05	11·78	11·76	11·76
Tannin absorbed by 100 parts of hide powder	33·50	48·10	68·60	77·90	72·70	61·30	51·30	51·50	51·50
100 parts of tanned hide powder contained— Hide	74·90	67·50	59·30	56·20	57·90	62·00	66·10	66·00	66·00
Tannin	25·10	32·50	40·70	43·80	42·10	38·00	33·90	34·00	34·00

The general conclusion to be drawn from this table is that the quantity of tannin absorbed by hide from a liquor increases with the strength of the liquor up to a certain point (iv.), after which it decreases, but soon reaches a minimum (vii.), beyond which there is no variation. An explanation is to be sought for in the fact that the tannin is more quickly absorbed in a stronger liquor, and the surface of the hide soon gets tanned sufficiently to protect the interior. The maximum absorption occurs in a liquor of about 2 per cent. strength, when 100 parts of hide absorb some 78 parts of tannin; the "constant minimum" first occurs when the liquor is 5 per cent., when 100 parts of hide absorb some 51·5 parts of tannin. The practice of the tan-yards, where the hides are first handled in very weak liquors, and then laid away in layers of increasing strength, the strongest of which is from 1—2 per cent., is fully justified by these observations. But still further justification was obtained by another series of experiments, in which the hide powder was treated with successively stronger liquors, when it was found that in order to obtain the maximum absorption of tannin it is necessary to begin with a weak liquor, which must be strengthened as the tanning proceeds. The maximum absorption obtainable was practically equivalent to the original weight of the hide; that is, the leather when fully tanned contains equal weights of hide substance and tannin.

In determining the percentage of nitrogen in leather, for the purpose of judging the extent to which it has been tanned, the results of analyses must be calculated on the pure leather; that is, the carbon bisulphide extract, water, and ash must be deducted from the weight of leather taken. When this is done the nitrogen content of thoroughly-tanned leather should be 8·9—9·1 per cent.

Some experiments on sheep's skin confirmed the above results obtained with hide powder.

In conclusion, the authors state their opinion that the absorption of tannin by hide is a physical process. This is in agreement with Knapp (Dingl. Polyt. J. 1858, **149**, 305, 378), but contrary to Müntz, who regards the process as a chemical one (Ann. Phys. Chim. [4], **20**, 309).—A. G. B.

Theory of Tanning. F. Knapp. Dingl. Polyt. J. **286**, 93.

This paper is for the most part a criticism of a recent communication from V. Schröder and J. Pässler (*ibid* **284**, 256, 283). These authors, investigating the mode in which tannin is taken up from solution by skins, came to the general conclusion that the quantity combined is proportional to the concentration of the solution. At the same time they noticed the anomalous result, that when this concentration exceeded a certain limit (13 grms. of tannin to 500 cc.) the proportion became less. It is now pointed out that these results are no doubt based upon erroneous observations. It has been already shown by Reimer (*ibid.* **205**, 143; **248**, 358, 457) that in chemical tanning with alum and salt, the solution within the skin at the conclusion of the operation has a very different composition from that without. When this fact is not allowed for, he estimated in three experiments 13·3, 19·7, and 35·2 per cent. of the theoretical quantity of sulphuric acid in a sulphate of alumina tanning bath. But when allowed for, the corresponding numbers obtained were respectively 91·4, 96·6, 93·5 per cent. of the theoretical.

In the investigations above mentioned, no allowance having been made for this fact, the results are so far untrustworthy.

The author agrees with V. Schöder and J. Pässler that the combination of tannin and the skin substance cannot, on the evidence of its dependence upon concentration of the tanning solution, be in any sense regarded as the result of chemical reaction, but is a physical phenomenon.—C. F. C.

PATENTS.

An Improved Process for Treating Skins and Hides. J. W. R. and A. Pullman, London. Eng. Pat. 4783, March 10, 1892.

The removal of the oil or grease which has been used in preparing or dressing the skins, is conveniently effected by the use of some solvent such as benzine; but it has been found that the quality of the skins so treated has become deteriorated. Another practice has been to expose the skins to a temperature below 32° F. after they have been first saturated with a solution of soap, the effect of the freezing being to render the skins very soft and supple. The claim in this patent is for the combination of these processes; the degreased skins are saturated with a solution either of soap or of rock ammonia, or with water only, and frozen.

—A.G.B.

The Production of a Cement or Glue for Joining Wood. C. W. Luther, Reval, Russia. Eng. Pat. 6194, March 29, 1892.

See under IX., *page* 269.

XV.—MANURES, Etc.

PATENT.

Improvements relating to the Disinfection of Cesspools and the Utilisation of the Disinfected Matter. V. J. C. Boulengier, Gand, Belgium. Eng. Pat. 17,815, October 6, 1892.

The emptied cesspool is provided with a layer of filamentous vegetable matter (such as heath, peat, &c.) or with one or more of the following absorbents:—detritus of wool, linen, hemp, or cotton, dried tanner's bark, sawdust, &c. A fresh layer is added periodically until the cesspool is full. The product is dry and inodorous. Full cesspools can be disinfected by adding one of the above absorbents or by precipitating with alumina, calcium compounds, &c., whereby the fæcal matter is deodorised and the supernatant liquid decolourised. According to the process employed, the manuer will contain from 2 to 8 per cent. of nitrogen.
—N. H. J. M.

XVI.—SUGAR, STARCH, GUM, Etc.

Investigation of the Muddy Dregs from the Manufacture of Starch. O. Reinke. Zeits. f. Spiritus-ind., 1891, 332; through Dingl. Polyt. J. **285**, 211.

The author estimates the starch in these dregs by four different methods: (1.) 3 grms. of the well mixed mass are inverted with hydrochloric acid (15 cc.) for a period of 2½ hours; the solution is then neutralised, made up to 250 cc., and the sugar estimated by means of Fehling's solution. (2.) 3 grms. are boiled under a pressure of 3½ atmospheres with 1 per cent. lactic acid (25 cc.) and water (30 cc.). The solution is then made up to 250 cc., 200 cc. are filtered off, and inverted with hydrochloric acid (15 cc.), and the sugar estimated as in (1). (3.) 5 grms. are treated at 62° C., with malt extract prepared in the cold, and after filtering, the filtrate inverted with hydrochloric acid (15 cc.), and the sugar estimated as in (1). (4.) The residue on the filter in the last experiment is washed, dried, weighed, and incinerated, and again weighed. A sample tested in this way gave by (1) 54·8 per cent. of starch; by (2), 55·2 per cent. of starch; and by (3), 53·7 per cent. of starch; whilst the residue not dissolved by diastase was found by (4) to have the composition:—*Water* = 14·24 per cent.; *Ash* = 18·79 per cent.; and *Fibre and other insoluble organic substances* = 58·29 per cent. Other samples investigated in the same way gave the under-mentioned results:—

Water.	Ash.	Fibre and other Insoluble Organic Substances.	Difference: Starch and other Soluble Organic Substances.	Pure Starch: Estimated in the Diastase Filtrate.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
12·42	27·76	20·86	38·96	38·02
15·15	8·51	6·97	69·37	..
45·86	1·46	5·56	47·12	..
43·47	1·06	5·93	49·54	..
14·56	14·57	11·32	59·55	56·34
11·82	19·44	28·47	40·27	..
15·36	15·16	6·23	63·25	59·54

The author considers the high-pressure method (2) to be the surest and most convenient; he draws attention to the extraordinary divergence in composition of different samples of the dregs. Two samples were found by the high-pressure method (2) to have the following composition:—

Water.	Starch.	Ash.	Fibre, &c.
Per Cent.	Per Cent.	Per Cent.	Per Cent.
55·06	18·49	16·69	9·76
18·15	65·48	5·75	10·62

The abstractor points out in a note that the composition of these dregs is entirely conditioned by the appliances of the factory and the mode of working. Careless working and a badly-appointed factory tend to increase the amount of starch in the dregs, although in working with putrid, frozen, or unripe potatoes, a loss of starch in this way can scarcely be avoided.—A. R. L.

Pulp Drying. Saare. Dingl. Polyt. J. 1892, **285**, 212; from Zeits. f. Spiritus-ind. (See last abstract.)

There is attached to the factory a small subsidiary building, divided into four chambers, the floors of which slope towards the centre, and drain into a common gutter running longitudinally. The pulp drops, or is pumped, on to plaited wicker-work, which is somewhat raised from the floor. Each chamber suffices for one day's work, so that the pulp may be run on for four days. When the wicker-work is clogged, it may be rendered fit for use again by beating.
—A. R. L.

Drying of Maize Pulp. Dingl. Polyt. J. 1892, **285**, 212.

In the American Grape Sugar Company's factory, Buffalo, maize pulp is pumped on to an endless wire net, 60 inches in width, and thereby transferred between two pairs of rubber rollers, and pressed. Selwig and Lange's cylindrical presses also serve for this purpose. The pulp is dried in Herseys Brothers' granulators. These consist of cylinders of sheet iron 25—30 ft. long and 6 ft. in diameter, placed upon rollers at a slight inclination, and rotating about their axes 6—8 times per minute. There is furnished within the cylinders a system of tubes heated by steam, and the material to be dried is continually upheaved and caused to fall on the heated tubes by means of strips of sheet iron riveted to the inner walls of the cylinders at an angle of about 30°. The apparatus may be used for potato pulp when this material is previously dried and pressed to such an extent that it may be rubbed in the hand.—A. R. L.

Sago or Palm Starch. A. Dubosc. Dingl. Polyt. J. 1892, **285**, 213; from La féculerie.

Sago or palm starch is obtained from the *Sagus farinifera*, a species of palm growing in the Molucca and Philippine Islands, and in New Guinea. A not inconsiderable quantity is now imported into France and Italy, mainly from the cause that potato starch has reached so high a price. As it yields a transparent paste, it has quite superseded potato starch in England as a glaze; and in France it has long been used for the same purpose for the so-called Normandy fabrics. It forms white, rose-coloured, or brownish granules (0·3—0·8 μ), which under the microscope are seen to be ovate, the hilum, which is generally situated at the narrow side of the granule, being often circular, but sometimes jagged. The granules show a black cross when viewed by polarised light, the hilum forming the middle portion. Granulated sago starch comes into commerce as tapioca-sago, which is reddish, and contains soluble starch; granulated sago, which does not yield a paste; and Molucca sago, which yields a stiff paste. It may be purchased in powder, both in an impure state and as washed starch. A single sago-palm yields about 600 kilos. of starch, containing 12 per cent. of water. Sago starch is the raw material from which the granulated product is manufactured; this industry is carried on in India, and at Singapore, where

20,000,000 kilos. are annually produced by Chinese manufacturers. Purified sago starch is made chiefly in Malacca. The annual import into England is 16,000,000 kilos.; London is the chief market. This product, which was almost exclusively confined to the island of Portland, has died out years ago.—A. R. L.

On the Indications obtained with the Hydrostatic Potato Balance. Saare. Zeits. f. Spiritus-ind. Ergänzungsheft, 1891, 19.

According to the tables constructed for the hydrostatic potato balance, an average amount of 5·8 per cent. deducted from the percentage of total dry substance in the potatoes, gives the amount of starch. The author finds that this number is in many cases too high; thus, on adding together the percentages of extraneous matter, and soluble matter other than starch, a value varying between 3·8 and 5·8 is obtained.—A. R. L.

Determination of Matters other than Starch in Potatoes. Saare. Zeits. f. Spiritus-ind, 1891, 18.

The potatoes are dried, ground to powder, and heated with water under a pressure of three atmospheres. The saccharification is then effected by malt extract, and the insoluble residue taken as extraneous matter.—A. R. L.

The Formation of Starch from Formaldehyde. T. Bokorny. Ber. d. deuts. bot. Ges. 1891, **9**, 103.

To put to the test von Baeyer's hypothesis that the carbonic anhydride which is absorbed by the chlorophyll cells is first reduced to formaldehyde, which subsequently undergoes condensation into carbohydrates, the author has conducted the following experiments. A variety of algæ (Spirogyræ) were rendered free from starch by employing nutritive solutions free from potassium salts and containing an excess of nitrate, the assimilation of carbonic anhydride being prevented by keeping the plants in an atmosphere free from that gas. They were, under these conditions, supplied with formaldehyde, but these experiments led to negative results on account of the toxic nature of this compound; when methylal (which in the presence of water decomposes into formaldehyde and methyl alcohol) is employed, the formation of starch was observed: here, however, the starch may have been formed from the methyl alcohol. Subsequent experiments were made with the compound of formaldehyde with monosodium sulphite, which readily breaks up into its components. Solutions of disodium phosphate were also added to convert the monosodium sulphite, which acts deleteriously, into the disodium sulphite. In this way large quantities of starch were formed at the end of six days.
—A. R. L.

The Affinity of Starch for Water, and the Rise in Temperature which accompanies its Combination with the Same. F. Ullik. Zeits. f. d. gesammt. Brauw. 1891, 565.

Potato starch, which, when dried at 120° C., was found to contain 12·1 per cent. of water, was weighed out in quantities corresponding with 20 grms. of the air-dried substance, and mixed with an equal weight of water, when the following increments in temperature were observed:—

	Increase of Temperature.
(1) Anhydrous starch (dried at 120° C.)	13·8° C.
(2) Starch dried at 90° C.	12·0° C.
(3) Starch dried over concentrated sulphuric acid	8·8° C.
(4) Air-dried starch	3·0° C.

The gain of water which these products showed were (2), 0·85 per cent.; (3), 2·6 per cent.; (4), 12·1 per cent. The author finds that starch which has been exposed in an atmosphere saturated with moisture at a temperature of 16°—20° C. contains about 37 per cent. of water, and that no rise of temperature is produced on mixing the product with water.

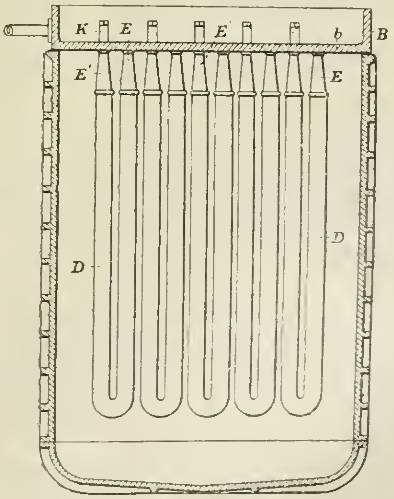
A mixture of wheat gluten dried at 100° C., and water (2 parts by weight) exhibited a rise in temperature of 8° C. Anhydrous maltose (18 grms.) mixed with water (30 grms.) gave a rise of 5° C.; whilst very pure dextrin, prepared from beer, showed when mixed with an equal weight of water a rise of 8° C.

The combined water was estimated by adding a known weight of the starch to a standard concentrated aqueous solution of an indifferent compound, noting the alteration in concentration, and calculating therefrom the water which has combined with the starch. Since a solution of common salt forms a paste with starch at the ordinary temperature, it cannot be employed for this purpose. Experiments with solutions of sucrose showed that anhydrous starch took up 18·98—19·1 per cent., whilst air-dried starch combined with 23·75—24·58 per cent. of water. The author considers Schultze's petroleum method to be impracticable.—A. R. L.

PATENTS.

Improvements in and Appertaining to Apparatus for Filtering Saccharine or other Liquors, and Method of Working the Same. T. O. Easton, A. Watt, and J. Buchanan, jun., Liverpool. Eng. Pat. 4911, March 12, 1892.

The main feature of this invention consists in the bag-filtering device shown in the accompanying sketch. The filtering-bags D are twice the ordinary length, but are each looped up in the form of a U, and are incased in the usual form of sheath, at each end of which is fastened the so-called nozzles or bottles E E¹, which latter are attached to the bottom of the shallow liquor-tank B. There is joined to each alternate bottle a tube K, which projects above the level of the liquor in the tank B. By this means the liquor descends that half of the looped bag which is not in connection with the tube K, and ascends the other half, driving out the air as it does so; the bags are consequently filled more rapidly than are the ordinary kind—closed at one end. The tendency for the slimy matter, which retards filtration, to deposit on the down-half of the bag E, and at the bottom, leaving the up-portion of the bag E¹ comparatively clean, allows a larger quantity of the liquor to filter through in a given time than in the ordinary process.



Apparatus for filtering Saccharine or other Liquors.

Bags open at both ends, the latter being connected by means of bottles to a common horizontal pipe, may also be arranged in a group in such a manner that there are one or more inlet bags for liquor, the remainder of the bags forming a set of upward filters.

The patentees claim the invention of the filters above described, their arrangement side by side, together with means for hoisting up the top of the filters with all the bags attached, and shifting them over the other filters to the washing tank; as also means for catching the drip, and emptying the bags while they are suspended.—A. R. L.

Improvements in or Relating to Refining Sugar. W. P. Thompson, Liverpool. From F. Soxhlet, Munich, Germany. Eng. Pat. 21,217, November 22, 1892.

A raw sugar solution of say 60°—63° Brix. is prepared at the ordinary temperature, and, after treatment with lime, is filtered in a press through a thin layer of calcined silicious material (infusorial earth), which, it is urged, is impervious to microbes. The liquor may likewise be filtered through a sludge of wood sawdust and silicious material. The claims are: that the liquor is kept at the ordinary temperature until it is introduced into the pan, and the employment of the above-named filtering media. —A. R. L.

Improvements in the Treatment of Raw Sugar for Purifying and Drying the Same. W. P. Thompson, Liverpool. From F. Schiaffino, Sampierdarena, Italy. Eng. Pat. 21,939, November 30, 1892.

Raw sugar is intimately mixed with a quantity, proportionate to the amount of moisture it contains, of wheat flour or starch, or with wood sawdust, cork, bran, or the like. It is claimed that these substances absorb the impurities adhering to the surface of the sugar crystals, and render them "almost absolutely pure and dry." The sugar crystals are next separated by sieves or by fans, the residue (sawdust, &c.) being washed in a centrifugal machine or in a filter-press, preferably the former, to separate the molasses and to cleanse it for a subsequent operation.—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

On the so-called Iso-Arabonic Acid. C. Scheibler and H. Mittelmeier. Ber. **25**, 1964—1966.

Ballo (Ber. **22**, 750; this Journal, 1890, 474) described the formation of an acid by the reduction of tartaric acid by ferrous sulphate, the calcium salt of which is isomeric with calcium arabonate. The authors have repeated Ballo's experiments and find that this calcium salt is totally different from calcium arabonate, and closely resembles calcium tartrate, and is probably formed from the tartrate by the loss of the elements of water.—A. L. S.

The Action of Yeast on Cane Sugar. J. O'Sullivan. Trans. Inst. Brewing, **6**, 67—82.

A series of experiments are described which prove that the whole of the cane sugar in solution may be inverted by yeast, whilst very little is fermented; and that large proportions of cane sugar may be inverted whilst none is fermented.

Experiments on the partial fermentation of cane sugar show that in the first stages dextrose is fermented in larger proportions than levulose.

The concentration does not influence the amount of sugar inverted in a given time with the same quantity of yeast. A. J. Brown (this Journal, 1892, 257) has shown that fermentation by yeast also follows this law.—A. L. S.

The Viticultural Industry in Cyprus. Board of Trade Journal, March 1893, 283—286.

A report has recently been prepared as the results of a personal inspection by M. P. Mouillefert, Professor at the National School at Grignons, on the subject of the vineyards of Cyprus. Amongst other information given by M. Mouillefert in his report is the following:—

M. Mouillefert states that an examination of the vineyards of the villages named above, and which represent the greatest part of the vine-growing country of the island, shows that the chief diseases by which they are attacked are *oïdium*, *anthracnose*, *pourridié*, *septosporium fuckelli*, *cuscute*, *cochylis*, and the larva of an insect which appears in the spring, stated to be the *zygene* of the vine—*zygæna ampelophaga* (Bayle).

He gives a short description of these diseases and the means of combatting them.

In that portion of his report, treating generally of the methods adopted in the cultivation of the vine in Cyprus, M. Mouillefert remarks that by its situation, its broken surface, its general incline, running from 0, or sea level, to an altitude of over 6,000 ft., the island of Cyprus offers the most varied and favourable conditions for the cultivation of the vine.

This cultivation is, even at the present day, of real importance, not only from its area, which covers almost 145,090 deunums (100 deunums = 2·47 acres), but also from the value of the produce it yields, which exceeds 3,500,000 francs, and affords a livelihood to over 10,000 families.

This branch of produce, however, is far from being in the condition it should be. Firstly, the method of cultivation, and secondly, the manufacture of the wine, fall far short of what they should be, and this is owing to the ignorance and the poverty of the people.

While bearing in mind the various circumstances which have brought about the present state of things, M. Mouillefert points out what the vine-grower should and what he should not do with a view to the improvement of his methods of vine cultivation.

The island possesses two excellent kinds of vines for growing on a large scale: the *mavro* and the *xynesteri*, to which might be added, if care were taken to protect it from the *oïdium*, the *ophthalmou*. The former is peculiarly suited to a rich, moist soil, the latter to a dry calcareous, or an argilo-marly soil.

As regards the manufacture of wine in Cyprus, M. Mouillefert states:—

"If the cultivation of the vine as carried out leaves much to be desired, especially in the matter of pruning, the system followed in the manufacture of wine is, perhaps still more defective. The table wines are not only bad, as a rule, but they are very liable to go bad when made, and yet they can be made not only good but even excellent, varied as are the climate and soil of the island. To improve these wines the following steps must be taken.

"The vintage is often gathered too late, resulting in a useless waste of grapes. Moreover, sufficient care is not bestowed on the picking of the bunches—they are all collected together regardless of their quality, with the result that the rotten, mildewy, and worm, or *cochylis*, eaten grapes give a disagreeable taste to, and often spoil, the wine, and the small unripe bunches detract from its quality.

"The vintage should be gathered in two instalments, the damaged and only partially ripe bunches found on the upper part of the branches being gathered first, and then the better bunches. The grapes thus gathered should be dealt with separately so as to obtain two classes of wine, the one of inferior quality, but still fit for use, and the other of a better quality and of a value to compensate to a great extent for the inferiority of the former kind.

"The grapes are trodden in Cyprus, and, as is well known, the fermentation takes place in jars or chatties of porous earth, of a capacity of two or three hectolitres, which are of necessity tarred inside to counteract the porous nature of the jar. The houses in which the fermentation takes place are of almost the same temperature as the surrounding air, with the result that in the warmer parts of the island, where the temperature inside the houses when the grapes are thrown into the vat often exceeds 25° C., the fermentation is at first very rapid or disturbed, and the temperature of the liquor or must quickly exceeds 30° and even 35° C. The great quantity of carbonic acid thrown off will then destroy the wine yeast, and the fermentation is arrested before all the sugar of the grape can be turned into alcohol, and from this will result a wine charged with sugar and liable to a second fermentation, by which it may possibly be spoilt.

"In the colder parts of the island, on the other hand, it is often the case that when the vintage is gathered the temperature is very low, with the result, for a contrary reason, that the fermentation will again be bad, or it will be necessary, in order to charge the wine with tannin so as to preserve it better, to leave it too long with the lees, from which it may happen that the wine will be rough and sharp. The wine also loses in quality from the use of gypsum, intended to assist in preserving it against the changes of temperature to which it is exposed. The wine, in short, acquires from the tarring of the jars a flavour distasteful to the European palate, and its exportation is therefore necessarily curtailed. It is certainly true that wine made in old jars, in which the tar has been gradually absorbed by repeated fermentations, does not taste of tar, but this will be so only in the case of jars which have been in use for at least 30 or 40 years—it were better by far to use jars glazed on the inside. During the summer the wine in jars not properly closed will often, being in contact with the air, turn into vinegar, and this to such an extent that in certain villages I have been unable to obtain a single sample of wine which was fit to drink.

"And now, briefly, that is what should be done—

"1. The places in which wine is made and stored should be kept at a level temperature varying only between 19° and 20° C., and never, even in exceptional circumstances, exceeding 29·6°; and this can be done by building partly underground and making the walls of the building very thick, say 3 ft. Within and throughout the entire circumference of these walls, at say a distance of 1 or 2 millimetres, a second wall, 1 ft. thick, should be constructed and the building covered with a sloping roof, with a thick vaulted ceiling of stone, or, better still, of hollow bricks. Within these buildings the wine should be made and stored, and they will in the warmer parts of the island preserve it from the great heat and from the cold in the hill districts, and in this way the period of fermentation, always one of danger, can be curtailed.

"2. The fermentation jars, those at least which have been tarred, should be replaced by wooden vats, similar to those in use in Europe, or in the warmer parts of the island, by tuns similar to those used throughout the south of France and in Algeria. Presses less primitive than those in use in Cyprus should be used, since they leave in the lees a very large quantity of wine. The wine should, when drawn off from the lees, be kept in tuns or in small wooden casks. In short, to speak quite plainly, no good wine destined for ordinary consumption can be obtained with jars.

"In view of the fact that considerable capital will be required to carry out these radical changes on which depends the future of Cyprus, as far as the vines are concerned, and of the fact that the vine cultivators of the island are not, as a rule, rich, I can only suggest that, to obtain the objects required, syndicates to encourage the cultivation of the vine and the making of wine, be formed of the existence of which societies the practical proof would appear in the form of buildings and wine-making machinery on modern principles, and it would be to these syndicates that the cultivator would sell his grapes. These societies would be analogous to the sugar syndicates in Europe, which buy from the farmers the beet root from which, for the want of the necessary material, they are unable to extract the sugar, and the societies would, without difficulty, find in Europe and in other parts of the world outlets for their produce—a thing which the Cypriot proprietor cannot as a rule hope to do.

"A society of this kind has already been formed, that of Messrs. Williamson. I have inspected the premises at Peripedia, and I entertain lively hopes that the venture will be crowned with success and the example of the society followed. If this be so the cultivation of the vine in Cyprus will really improve, and the prosperity of the island, which might become the vineyard of Great Britain, will be assured."

The Use of Stop-Cocks containing Lead. C. Engler and G. Rupp. Dingl. Polyt. J. 1892, **284**, 300—301.

See under XVIII., page 284.

PATENTS.

Improvements in or Relating to Apparatus for Treating and Bottling Fermented Malt Liquor. J. H. Kersenbrock, Columbus, Nebraska, U.S.A. Eng. Pat. 14,786, August 16, 1892.

The beer passes from the cask first through a tube placed in a water-bath, which is kept sufficiently hot to Pasteurise the beer, thence through a pipe immersed in cold water or brine, to cool the beer, and flows into a receiver, from which the bottling takes place.—A. L. S.

Improvements in the Method of and Apparatus for Distilling Mash for the purpose of Obtaining Highly-concentrated Fusel-Oil and Purified Alcohol. R. Ilges, Cöln-Bayenthal, Germany. Eng. Pat. 17,927, October 7, 1892.

The hot singlings from the rectifier of a still are led into a cooler; by means of a regulator controlled by the temperature of the singlings; the water supply of the cooler is controlled so that the temperature in the cooler corresponds to the boiling point of a mixture containing 17—20 per cent. alcohol. At this temperature the fusel oil rises to the surface and is conducted away. The heavier liquid from the cooler, containing alcohol and water, passes into a distilling column of the usual kind, and heated by steam. The alcoholic vapours from this pass into the rectifier of the still.—A. L. S.

Process and Apparatus for Ageing or Ripening Wines, Spirits, and other Liquors. T. R. Timby, Washington, U.S.A. Eng. Pat. 20,071, November 8, 1892.

It is believed that long voyages improve the condition of wines and spirits and accelerate their ripening. The inventor proposes to build a circular railway on which trucks shall run containing the wines and spirits to be stored. The rails are notched and the trucks are without springs so as to subject the liquors to the greatest possible agitation. The railway is to be contained in a store, the temperature of which can be varied considerably.—A. L. S.

Improvements in the Manufacture of Malt Liquor. A. Kerschbaum, Budweis, Bohemia, and F. J. Zwick, B. Strassnicky, and R. Schmeidel, Vienna, Austria. Eng. Pat. 20,317, November 10, 1892.

Malt is mashed with cold water, heated to 50° C., and the temperature subsequently raised to 70° C. The wort is concentrated in vacuo, fermented at 15°—20° C. with pure yeast, and sterilised air blown through the fermenting liquid. After five days the beer is racked into the store casks, and in about six or eight weeks it is ready for consumption.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Starch Bread. Zuntz and Magnus—Lewy. Archiv. f. Physiol. 1891, **49**, 438.

The object of this investigation was to ascertain whether the addition of starch to bread exerts any deleterious effect on its digestibility and assimilability; also whether skim-

milk can with advantage be added to such bread without nauseating its taste. The experiments show that even foods very poor in albuminoids are assimilated in the human alimentary canal, and that starch-meal may, up to a certain limit, be added to bread without rendering it indigestible. However, as shown by Munk and Rosenheim, this limit must not be exceeded. No injurious influence on the digestive organs through alcohol was observed.
—A. R. L.

Experiments with Bread and Biscuits. M. Balland. Comptes. Rend. 1892, **115**, 665—667.

The temperature of the inner portion of a loaf immediately after taking it from the oven is between 97° and 100° C., but never exceeds this even when the baking is prolonged; it only cools down to the surrounding temperature after 5—6 hours. The crumb contains 38—49 per cent. of water and the crust 16—25 per cent. The amount of water contained in the crumb varies according to that taken up by the dough; a few minutes more or less in the oven exerts an influence only on the percentage of water in the crust. To determine the amount of water in a loaf it is advisable to divide it into two or four equal sections, and take one of these for the estimation. The amount of moisture contained in a loaf varies according to its form: thus a round loaf weighing 1,500 grms. was found to contain 39 per cent. of water, and a similar one weighing 750 grms., made of the same dough, 35 per cent.; whilst a long loaf only contained 33—34 per cent. of moisture. The water contained in the army biscuits varies, according to the season of the year, from 11 to 14 per cent.; it is equally disseminated throughout the entire mass. Bread, taken out of the oven, and placed in a dry, sufficiently-ventilated place, loses moisture slowly until it contains only 11—14 per cent., the quantity present in wheat and flour. To attain this condition a loaf of 750 grms. weight takes 40 days, whilst long loaves weighing 100 grms. attain it in 8—10 days. Bread thus dried contains about the same quantity of moisture as the army biscuits, and may be kept just as long. Loaves dried in this manner are said to be superior to army biscuits and are strongly recommended as substitutes for them.—A. R. L.

On the Estimation of Fats in Bread. M. Weibull. Zeits. ang. Chem. 1892, 450.

See under XXIII., *page* 294.

PATENTS.

Improvements in Ovens for Baking Bread, Biscuits, and the like. E. Naylor, Bradford. Eng. Pat. 1040, January 19, 1892.

The object of this invention is to economise fuel and to obtain a more perfect control of the temperature of bakers' ovens. The external portion of the oven is preferably constructed of brickwork lined with fire-brick, and square or rectangular in form, the furnace being arranged either transversely or lengthwise, with firing-doors at one or both ends, or at the sides, as may be convenient. A heating-chamber, including the furnace, extends under nearly the whole of the oven, and a similar chamber is arranged immediately above the oven. Another oven may be built above this, being surmounted in its turn by a third chamber. The three heating-chambers are connected end to end by means of flues, and each chamber is provided with a number of transverse partitions, branching alternately from the opposite sides, so that the products of combustion are compelled to take a zigzag course through them. If desired the chambers may be divided into halves by transverse or lateral walls, and the flues and dampers so arranged that either half of the oven may be heated alone. By means of other dampers the two ovens may be heated separately or simultaneously. An air-chamber in immediate connexion with the furnace is provided to carry off surplus heat in case the lowest oven becomes too hot. The lower oven being the hottest is preferable for baking biscuits, &c., and is provided for the purpose with an endless chain operated by sprocket wheels fixed outside the ends of the oven and driven by external power. Trays to carry the biscuits are pivoted to the chain. The upper oven is more suitable for baking bread.—H. T. P.

Improvements in Soda and other Mineral Waters and the Mode of Preparing Same. A. W. Orr and F. H. Orr, Dublin. Eng. Pat. 2817, February 13, 1892.

Mineral waters may be thoroughly saturated with carbonic acid by generating the gas in the waters themselves. This end may be attained, for instance, by the decomposition of a sodium bicarbonate solution with hydrochloric acid in a closed vessel, from which, for purposes of a better absorption of the evolved gas, the air is exhausted before adding the acid.—H. A.

Improved Means for Preserving Eggs. G. Farquhar and R. North, London. Eng. Pat. 15,128, August 23, 1892.

The eggs are dipped into a strong, warm solution of gelatine, allowed to dry, and wrapped in thin paper. The hard film of gelatine is said to completely protect the eggs from all injurious external influences, so that they may be stored for a long time, shipped, &c., without deterioration.
—H. T. P.

An Improved Process for Treating Salt for Medicinal and Dietetic Purposes. W. T. Thorp, Glossop. Eng. Pat. 20,070, November 8, 1892.

The object of this invention is the production of cheap and palatable preparations, suitable for use in medicine or as dietetic articles of food, &c. The desired ingredients are dissolved along with salt, the solution slowly evaporated to dryness during constant stirring, and sieved. As an example an alkaline salt suitable for dairy purposes may be made by the following formula:—

	Parts.
Salt	70
Sodium carbonate	15
Sodium-potassium tartrate	10
Sodium phosphate (desicc.)	5
Oil of celery	A sufficiency to be added after sieving.

—H. A.

A New or Improved Process for the Manufacture of Bread and the like with Extract of Malt. W. Paterson, Glasgow. Eng. Pat. 21,488, November 25, 1892.

Any suitable meal or flour is made into a paste with warm water, and sufficient boiling water then stirred in to raise the temperature to 190° F. When cooled to 150° F., a quantity of malt-extract (preferably prepared by the inventor's process; Eng. Pat. 6337, 1890; this Journal, 1890, 961) equal in weight to about one-fifth of the flour employed is added, and the mixture gradually heated to 165° F., about one-half to three-quarters of an hour being consumed in the operation. The temperature may then be raised to 175° F. or more, in order to kill the diastase, or the mass may be cooled at once. In either case the mixture is incorporated with a sufficient quantity of dough, whether in the fermented, partially fermented, or unfermented state, and made into bread, biscuits, &c., in the usual way.

Instead of the above malt-extract, any other kind of malt extract, or an infusion of malt, or ground malt, may be employed.—H. T. P.

(*B.*)—SANITARY CHEMISTRY.

The Use of Stop-Cocks made of Alloys of Lead. C. Engler and G. Rupp. Dingl. Polyt. J. 1892, **284**, 300—301.

According to the German law, no vessel to be used for the preparation or storing of any article of food or drink must contain more than 10 per cent. of lead. By one of the clauses, however, this regulation is limited to those portions of the apparatus which come into direct communication with the contents; and for this reason a large number of stop-cocks are still employed, which are fitted with a metallic plug, the lead in which often rises far above the legal limit. The plugs are made of an alloy of tin and lead, and work in a wooden casing. The authors have examined 33 of such cocks and find the percentage of lead to vary from 3·1 to 93·8, the average being 46·5.

To observe the action of liquids on these alloys, they prepared large flasks containing from 6 to 10 litres, fitted at the bottom with an aperture into which the cocks were fixed. The flasks were filled with brandy (containing 0·0768 per cent. of acetic acid), wine (with 0·65 per cent. of tartaric acid), and vinegar (4 per cent.), and they were emptied after various intervals and the lead estimated as metal. Three different cocks were tested, containing—I., 33·0; II., 51·9; and III., 86·5 per cent. of lead respectively, the results being given in the tables:—

BRANDY.

—	After 1 Hour.	6 Hours.	12 Hours.	24 Hours.
I.	Traces	Traces	Considerable traces.	Considerable traces.
II.	„	„	0·00032	0·0055
III.	„	0·00034	0·00068	0·0061

WINE.

I.	0·00164	0·00216	0·00205	0·00274
II.	0·00274	0·00339	0·00290	0·00342
III.	0·00205	0·00240	0·00243	0·00340

VINEGAR.

I.	0·0018	0·0027	0·0048	0·0041
II.	0·0044	0·0034	0·0042	0·0056
III.	0·0072	0·0055	0·0075	0·0052

—F. H. L.

Contributions to our Knowledge of Carbon Bisulphide Poisoning. Alex. Westberg. Inaug. Dissert. Dorpat. 1891. Zeits. Anal. Chem. 31 [4], 484—486.

THE author shows that carbon bisulphide, however it finds its way into the body, according to the amount and duration of action, is capable of decomposing the blood, a decomposition which finds its expression in the formation of methæmoglobin, with destruction of the blood corpuscles. The latter is demonstrable by microscopic examination.

The xanthic acid, which in the body decomposes into carbon bisulphide and alcohol, exerts no specially powerful action on the blood, that action being commensurate with the amounts of carbon bisulphide set free.

In most cases of carbon bisulphide poisoning, especially in chronic cases, the substances can be detected in the blood. For this purpose 12 to 15 cc. of the blood to be examined, immediately taken from the veins, are introduced into a distillation flask, at once mixed with half its weight of distilled water, and distilled in vacuô, with continual passage of a stream of carbonic acid or hydrogen. As receiver, a pair of test-tubes united together (A. W. Hofmann's method) were used, each being half filled with caustic soda solution, on the surface of which was a layer of an ethereal solution of triethylphosphine.

The precipitates obtained after filtering through asbestos and drying in vacuô were too small for weighing, and so the amount as representing the carbon bisulphide was judged by the appearance of the precipitates (this Journal, 1893, 293).—J. C. C.

Physiological Action of Sulphuretted Hydrogen. K. B. Lehmann. Arch. Hyg. 14, 135.

THE highest endurable percentage of sulphuretted hydrogen in the air is 0·01 per cent. if it be breathed for any considerable time, and 0·02—0·03 per cent. for periods not exceeding two hours. 0·1 per cent. proves rapidly fatal.

—B. B.

Lead Poisoning among Glass Polishers. Engineering and Mining Journal.

At the town of Baccarat, in the east of France, a great glass-making centre, there have been many cases of lead poisoning among the polishers of crystal glass. It is stated that at one works no fewer than 39 out of the 200 polishers have suffered from lead poisoning. In some cases repeated attacks have occurred in the same individual. One case ended in death and seventeen operatives were obliged to leave the business. The polishing is done with so called "tin ashes," which consists of lead stannate, prepared by calcining three parts of lead with one of tin. The polishing is done wet, but a portion of the powder dries and forms a dust which is inhaled by the workmen. Of course, attempts were made to find some efficient substitute for "tin ashes." Metastannic acid, prepared by acting on granulated tin with strong nitric acid and a gentle heat, was first tried, but was found to be unsuitable alone. It was therefore mixed with half its weight of tin ashes, and this mixture has given satisfaction both as a polisher and on account of its freedom from danger. It contains only 20 per cent. of lead as compared with 61 per cent. in the tin ashes.

PATENTS.

Improvements relating to the Treatment of Sewage and other Refuse, and to Apparatus therefor. A. Levieux, Brussels. Eng. Pat. 1567, January 26, 1892.

THE heat produced by the burning of town refuse is employed in the distillation of sewage, for the production of ammonia, tar, animal black, and lighting gas, and for the production of lime and cement. The apparatus consists of an improved blast-lime furnace placed between four furnaces for incinerating sewage, the waste heat of which passes into the furnace charged with limestone, with inferior fuel, or town refuse, &c. The cost of heating the lime furnace is low, and the ashes may be used for the introduction of lime into the retorts containing animal matter, or, when suitable, for making mortar. The large quantity of lighting gas produced from the animal waste may be used for lighting the works or for heating the retorts.

The interior of the lime furnace is provided with inclined grates, which are of use in obviating the caking together of the materials, which may, moreover, be introduced when quite wet. There is also a drying chamber provided with inclined grates in which the sewage may be dried, partly by draining and partly by means of hot air, before being introduced into the retorts. The advantages claimed are the much reduced cost of the incineration of town refuse, and the production of large amounts of animal black, ammonia, tar, and lighting gas by the destruction of animal matter.—N. H. J. M.

A New and Improved Method for the Purification of Sewage and Waste Water from Manufacturing Processes. H. Grimshaw, Manchester. Eng. Pat. 6731, April 8, 1892.

OXIDE of iron obtained in the manufacture of zinc chloride or that obtained as a by-product in the manufacture of aniline, is mixed with about an equal amount of quicklime and some water, and ground in an ordinary mortar mill. The mixture is added, preferably after having been kept for a few days, to sewage in the proportion of a ton to a million gallons. When the water is alkaline a part of the lime may be omitted, and when there is much iron and aluminium compounds present, acid may be added before treating with the iron and lime mixture. To effect the removal of organic nitrogen, the water, after being allowed to subside and run off, is treated with a little ferric chloride or sulphate, or with acid and sodium nitrate. The oxides of iron may also be mixed with gravel or coke, &c., and used as a filter. —N. H. J. M.

Improved Apparatus for Sterilising Water. D. Grove, Berlin, Germany. Eng. Pat. 20,568, November 14, 1892.

By means of this apparatus water is sterilised by being boiled; the boiled water is then passed through a pipe which encircles the greater part of the inlet pipe, and is thus soon cooled and suitable for drinking. At the same time the inflowing water becomes heated before entering the heating body where it is boiled. By means of a disc mounted on the spindle of the gas tap, having an opening corresponding with the water tap (situated just below the gas tap), the water tap can only be opened after the gas tap has been opened. There is also an arrangement by means of which the boiling water can be drawn off if required.—N. H. J. M.

(*C.*)—DISINFECTANTS.

PATENT.

An Improved Insecticide and Anticryptogamic Composition for the Treatment of Plants. S. Pitt, Sutton. From Schlœsing Frères, Marseilles. Eng. Pat. 20,785, November 16, 1892.

Tobacco liquor (1 to 5 per cent.) is added to the purifying matters from gasworks, after the removal of cyanides; copper sulphate (8 to 10 per cent.) may also be added. Suitable gasworks matter is such as contains 25—30 per cent. of finely-divided sulphur with ferric oxide and tarry matter. The mixture is dried at a low heat and triturated very finely.—N. H. J. M.

XIX.—PAPER, PASTEBOARD, Etc.

The Chemistry of the Sulphite Process of Wood-boiling. A. Harpf. Dingl. Polyt. J. **286**, 84, 112.

This paper contains the results of an extended series of observations on the conduct of the Mitscherlich process.

A. *Preparation of the Solution.*—This part of the author's work has already been published, for the most part, in the Papierzeitung, Nos. 76 and 78, 1891, and Nos. 53, 54, 56, 57, 1892 (this Journal, 1892, 452).

B. *The "Boiling" Process.*—This almost resumes the contents of previous publications, viz., Nos. 66, 68, 70, 72, 74, 80, 1891, and 28, 38, 39, 1892. The author's statistics are given in tabular form, and are further illustrated by diagrams. His views on the chemistry of the process are chiefly confined to a study of the changes in the distribution of the inorganic constituents of the boiling solutions, and he appears to be unaware of the theoretical work which is being done from the point of view of the organic constituents of the wood, which undergo solution in the process. At the conclusion, however, he briefly notices the work of Lindsey and Tollens. Zeits. ang. Chem. **5**, 1892 (see also this Journal, 1892, 835, and 1893, 287).—C. F. C.

Japanese Papers. G. Lauboeck. Mitt. K. K. tech. Gew. Mus. Wien. 1893, 11.

The author has investigated samples of hand-made and machine-made paper supplied by the Fuji Paper Co., Lim., of Fujigori, and made from indigenous bast fibres.

The investigations comprised six specimens; four were made from the Mitsumata fibre (*Edgeworthia papyrifera*), and in this group the machine-made specimen is included, one from the Kodsu fibre (*Broussonetia pap.*) and one from the Gampi fibre (*Wiegströmia canescens*).

The following are the manufacturing details of the papers:—

Specimen No. 1.—*Machine-made.*—Raw fibre boiled with caustic soda. Paper made from unbleached pulp sized with 1·5 per cent. of resin and 2 per cent. of alum.

. *Hand-made.*—Boiled with soda, but unbleached.

3. *Hand-made.*—Boiled with lime and unbleached. It is to be noted that the ash in this paper amounted in consequence to 8·1 per cent.

4. *Hand-made.*—Particulars not given.

5. *Hand-made.*—Boiled with soda and bleached with bleaching-powder solution.

6. *Hand-made.* — Boiled and bleached. This paper weighed only 5·7 grms. per square metre.

The subjoined table contains the results (mean numbers) of the author's determinations:—

No. of Specimen.	Breaking strain in kilos. (*a*)	Breaking strain in kilos. (*b*)	Percentage elongation at fracture. (*a*)	Percentage elongation at fracture. (*b*)	Breaking strain expressed as length of paper in metres. (*a*)	Breaking strain in metres of paper. (*b*)	Breaking strain, mean number in metres of paper.	Mean percentage elongation at fracture.	Breaking strain calculated for dry weight in metres of paper.	Weight of paper per m² in grms.	Thickness of paper in mm.	Ash in percentage in dry weight (100°).	Hygroscopic moisture per cent.	Raw Material.
1.	14·10	15·48	1·78	2·00	7,149	8,375	7,762	1·89	8,446	127·3	0·174	2·7	8·1	Mitsumata.
2.	3·30	1·64	2·20	2·62	8,366	4,123	6,245	2·41	6,766	26·4	0·065	2·1	7·7	Kodzu.
3.	1·56	1·00	1·54	2·00	6,296	3,536	4,916	1·77	5,349	17·7	0·044	8·1	8·1	Mitsumata.
4.	1·44	1·00	1·56	1·90	8,787	6,102	7.445	1·73	8,145	10·9	0·020	1·3	8·6	Gampi.
5.	2·30	1·34	2·48	2·78	8.519	4,395	6,457	2·63	7,119	19·2	0·046	1·8	9·3	Mitsumata.
6.	..	..	..	..	..	..	..	..	..	5·7	0·025	2·9	8·0	Mitsumata.

Of the above, No. 1 is machine-made, Nos. 2—6 inclusive are hand-made papers.

(*a*) and (*b*) refer to the two "dimensions" of the paper in the directions of which the strips are cut for the tests.

With regard to the Mitsumata bast, it is to be noted that the ultimate fibres are long (10 mm. average) and slender (0·007 to 0·024 mm. diameter); the extremities are rounded, with a tendency to bifurcation.

The strengths of these papers are comparatively high; and these pulps, worked by European methods, would evidently give exceptional products.—C. F. C.

Sulphite Wood-Pulp Liquor. J. B. Lindsey and B. Tollens. Inaugural dissertation, Göttingen, 1891. Zeits. f. ang. Chem. 1892, 154—158.

The liquor experimented with was prepared by the Ritter-Kellner process. It was yellow and almost clear, and when fresh smelt slightly of sulphurous acid, the quantity of which was increased by heating with dilute sulphuric acid. It had a specific gravity of 1·055, decolorised iodine solution, and strongly reduced Fehling's solution on warming—a result not to be ascribed to the sulphurous acid present, as this has no such action in alkaline solution. Phenylhydrazin acetate gave a fairly copious yellow turbidity, which became darker on standing and finally separated as a dark, tarry mass. A precipitate of barium sulphate was produced on adding barium chloride to the wood-pulp solution after the addition of hydrochloric acid; lead acetate gave a dense yellow precipitate, leaving the filtrate clear and colourless. A solution of gelatin gave a grey precipitate which cohered in clots on stirring.

Seeing that, according to Wehmer and Tollens, the formation of levulinic acid on heating organic substances with hydrochloric acid is a certain indication of the presence of hexacarbohydrates, the fact that only a small quantity of the silver salt could be obtained from sulphite liquor goes to show that lignin does not fall into this class of bodies. A trace, at most, of dextrose was found by the saccharic acid reaction of Gans and Tollens. The presence of a small quantity of galactose or galactan was recognised by the formation of mucic acid. Mannose was detected by the formation of its hydrazone, which melted at 187° C., and was further identified by its ultimate analysis and behaviour on polarisation. The quantity obtained was 3·4 grms. of the hydrazone from 500 cc. of the liquor, which was increased to 5 grms. when inversion had been previously performed. Pentoses were recognised by means of the furfurol reaction, furfuramid melting at 114° C. being ultimately obtained. On evaporating the liquor to a syrup, adding alcohol, and boiling, a considerable amount of gummy matter separated out. After this had been removed and the filtrate hydrolysed with sulphuric acid, and again freed from residual gummy matter, the final alcoholic extract had an odour of vanillin, and gave the phloroglucin reaction for vanillin; the presence of xylose was negatived by the spectroscopic examination of the alcoholic solution of the phloroglucin precipitate. It therefore appears certain that vanilla, or some closely analogous body, must be present in sulphite liquor, although it has not been isolated in the crystalline state.

An experiment was made to ascertain the capability of the liquor of fermenting. The sulphite was decomposed by a slight excess of sulphuric acid, and fermentation effected by fresh yeast, with the addition of a small amount of nutritive material derived from the same yeast. From 1 litre of the liquid thus treated 0·456 per cent. of alcohol by volume, was obtained. This was increased when previous hydrolysis with sulphuric acid had been resorted to, to 0·675 per cent. Therefore, out of a total amount of solid matter of 9·46 per cent., not more than about 1·2 per cent. consists of fermentable carbohydrates.

The cause of the yellow precipitate with lead acetate (*v. s.*) was investigated. A portion of the fluid from which sulphuric acid had been eliminated by means of baryta water was precipitated with lead acetate, and the precipitate analysed. It had a composition of which the organic portion was expressed by the formula $C_{25}H_{30}O_{12}$ or $C_{26}H_{32}O_{12}$.

The crude lead precipitate was decomposed with sulphuric acid, and the excess of acid removed by digestion with a second portion of the precipitate, and the resulting solution, which gave no reaction with phloroglucin, concentrated and diluted with alcohol. A grey flocculent precipitate was produced, which, after purification by means of alcohol and ether and drying over sulphuric acid, gave results corresponding to the formula $C_{26}H_{30}SO_{12}$ or $C_{24}H_{24}(CH_3)_2SO_{12}$. The filtrate from this grey body yielded on evaporation to dryness a substance of the formula—

$$C_{24}H_{24}(CH_3)_2SO_{12} + 1\tfrac{1}{2}\ H_2O$$

which reduced Fehling's solution. A substance was also precipitated from the original sulphite liquor by hydrochloric acid, to which was assigned the formula $C_{26}H_{30}SO_{10}$, and a brominated derivative was also obtained $C_{26}H_{25}Br_4SO_{11}$. The authors deduce from these observations that the gummy material from which the above sulphur-containing bodies are formed has the composition $C_{24}H_{21}(CH_3)_2O_{12}$ or $C_{21}H_{26}(CH_3)_2O_{12}$, assuming that the sulphur is not in direct union with oxygen. Should the contrary be true, and the sulphur be present as a sulphonic group, the above formula would be reduced by two or three atoms of oxygen. According to Mitscherlich, sulphite liquor contains tannin, a supposition upheld by its behaviour with gelatin, hide powder, and lead acetate; but opposed to this is the absence of the reaction with iron salts and the divergence in composition noted above. Nevertheless, if it be assumed that the sulphur is present as a sulphonic group in the substance capable of precipitating gelatin, a resemblance to the bodies prepared from sundry phenols by Schiff, which he termed "sulphurised tannins," becomes apparent, as they also fail to give the iron reaction.—B. B.

Liquid Sulphurous Acid. K. Barth. Papier Zeit. **17**, 1918.

See under VII., *page* 262.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Dissociation of Barium Peroxide. H. Le Chatelier Comptes. Rend. 1892, **115**, 654—656.

According to the author, the dissociation of barium peroxide is a much less simple phenomenon than might *à priori* be supposed. It requires the presence of water vapour, and a fused mixture of barium hydroxide (2 parts) and barium peroxide (1 part) appears to be the intermediary substance in the decomposition. The fused mixture is formed when moist air is passed over baryta at 20°; it only solidifies at 450°. Barium peroxide is prepared by heating the more or less hydrated peroxide in a current of pure, dry oxygen until no more water is given off. The product contains the minimum quantity of moisture which is necessary for the absorption of oxygen. The observed pressures are much higher at the commencement than at the end of the decomposition. The limiting pressure of the dissociation has a value which is theoretically infinite when the product is saturated with oxygen and no baryta is present. The pressure diminishes, however, as the decomposition proceeds, until sufficient anhydrous baryta is formed that a portion remains in the solid state; it then becomes constant until all the barium peroxide exists in solution in the fused mixture, when it gradually decreases, and reaches its vanishing point when the decomposition is complete. The importance of the degree of decomposition compatible with the maintenance of a constant pressure is the more considerable the less the quantity of water present in the mass, but at the same time a state of equilibrium is established more and more slowly. The period of constant pressure disappears when the proportion of water reaches a certain limit, which varies inversely as the temperature, being equal to 10 per cent. at 450°. The mass is then completely fused. The pressure of the water vapour contained in the oxygen exerts no influence on the pressure of the oxygen itself, provided barium monoxide and dioxide are present in the free state; it is, however, of considerable importance in the manufacture of oxygen from barium peroxide. If the tension of the water contained in the air employed for regenerating the peroxide has not exactly the right value, there will be a fixation or elimination of water. and consequently a change in the proportion of fusible matters. If this diminishes too much the fixation of oxygen is impossible; if it increases too much all the barium peroxide fuses and is rendered unavailable.

A. R. L.

A New Process for the Preparation of Acetylene. L. Maquenne. Compt. Rend. 1892, **115**, 558—561.

When a mixture of barium carbonate (26·5 grms.), magnesium powder (10·5 grms.), and charcoal (4 grms.), contained in an iron bottle of 700 cc. capacity, furnished with a tube 2 cm. in internal diameter and 30 cm. in length, is heated in a Perrot's furnace for four minutes, the following reaction occurs :—

$$BaCO_3 + 3\,Mg + C = BaC_2 + 3\,MgO$$

The tube is then closed, and the bottle rapidly cooled by sprinkling it with water. The amorphous, grey, friable product yields acetylene on treatment with water or with other hydroxylated compounds, due to the presence of barium carbide BaC_2 (see Comp. Rend. **114**, 361). 100 grms. of the above-described product, furnish 5200—5400 cc. of acetylene, containing 2—3 per cent. of hydrogen. By employing calcium or strontium carbonates instead of barium carbonate, the yield of acetylene was much less. (See this Journal, 1893, 178).—A. R. L.

Oil of Cinnamon. J. Weber. Arch. Pharm. **230**, 241.

The oil from the leaves consists chiefly of eugenol, together with smaller quantities of a terpene and cinnamic aldehyde. Pinene and cineol do not appear to be present. The oil from the root, as commercially designated, also has eugenol as its main constitutent, and in addition safrol and benzaldehyde in small quantity ; it also contains a larger proportion of terpenes.—B. B.

The Action of Hydriodic Acid on Cinchonidine. G. Neumann. Monatsh. Chem. 1892, **13**, 651—662.

Cinchonidine takes up 1 mol. of hydriodic acid to form the hydriodide $C_{14}H_{22}N_2O.HI$. This body when decomposed does not yield cinchonidine, but an isomeric base, and the product obtained is a different one according to whether caustic potash or silver nitrate is employed in the decomposition.—C. A. K.

Some Decompositions of Cinchonine. G. Pum. Monatsh. Chem. 1892, **13**, 676—690.

The hydriodic acid addition products of cinchonine, β-cinchonine, and iso-cinchonine, undergo varying decompositions according to the reagents employed. Cinchonine tri-hydriodide, $C_{19}H_{22}N_2O.3\,HI$, with alcoholic caustic potash yields cinchonine and iso-cinchonine ; with silver nitrate β-cinchonine and iso-cinchonine are formed. β-cinchonine tri-hydriodide forms β-cinchonine and iso-cinchonine, both with alcoholic caustic potash and with nitrate of silver. The tri-hydriodide of iso-cinchonine is decomposed into γ-cinchonine and iso-cinchonine by alcoholic potash. The tri-hydriodides of these four bases are so much alike in all their properties, beyond their decomposition products, that they must be regarded as identical, whilst of the three isomeric bases, cinchonine, iso-cinchonine, and β-cinchonine, the first appears to be the least, the last the most stable.

—C. A. K.

Laudanine. G. Goldschmiedt. Monatsh. Chem. 1892, **13**, 691—696.

The author finds that pure laudanine is optically inactive, in opposition to Hesse's statement that it is active, whilst some of its salts are not. With ferric chloride an emerald-green coloration is produced. Analysis points to the formula $C_{20}H_{25}NO_4$, thus confirming the experiments of Hesse. Laudanine contains three methoxy-groups and one hydroxy-group, and is isomeric, but not identical with tetrahydropapaverine. On oxidation with potassium permanganate, meta-hemipinic acid is formed.—C. A. K.

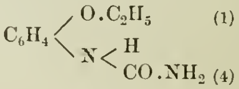
Volumetric Estimation of the Alkaloids. L. Barthe. Compt. Rend. 1892, **115**, 512.

See under XXIII., *page* 294.

PATENTS.

Improvements in the Manufacture of Para-phenetol Carbamide and Para-anisol Carbamide and their Amido-derivates. J. Berlinerblau, Sosnowice, Russian Poland. Eng. Pat. 1808, January 29, 1892.

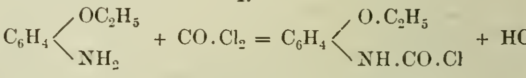
The patentee first prepared para-phenetol carbamide—



$$C_6H_4\left<\begin{array}{l}O.C_2H_5 \quad (1)\\ N\left<\begin{array}{l}H\\ CO.NH_2 \quad (4)\end{array}\right.\end{array}\right.$$

by the action of potassium cyanide on para-phenetidine hydrochloride. This body has an extremely sweet taste and is inocuous when taken internally, thus being capable of utilisation as a substitute for sugar. Owing to the poisonous character of the potassium cyanide employed, however, the manufacture of the carbamide from this source was without value. The present process for the preparation of the same body is based upon the action of carbonyl chloride on 1·4 phenetidine in benzene solution. Intermediate products are formed which are decomposed by ammonia with the formation of the carbamide. The following equations illustrate the changes that occur:—

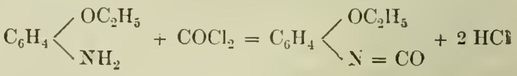
I.



$$C_6H_4\left<\begin{array}{l}OC_2H_5\\ NH_2\end{array}\right. + CO.Cl_2 = C_6H_4\left<\begin{array}{l}O.C_2H_5\\ NH.CO.Cl\end{array}\right. + HCl$$

1:4 *Phenetidine carbonyl chloride.*

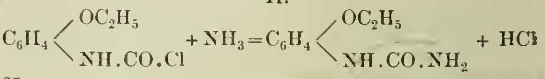
or—



$$C_6H_4\left<\begin{array}{l}OC_2H_5\\ NH_2\end{array}\right. + COCl_2 = C_6H_4\left<\begin{array}{l}OC_2H_5\\ N = CO\end{array}\right. + 2\,HCl$$

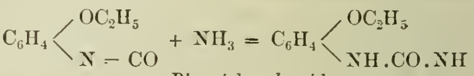
1:4 *Phenetolisocyanate.*

II.



$$C_6H_4\left<\begin{array}{l}OC_2H_5\\ NH.CO.Cl\end{array}\right. + NH_3 = C_6H_4\left<\begin{array}{l}OC_2H_5\\ NH.CO.NH_2\end{array}\right. + HCl$$

or—



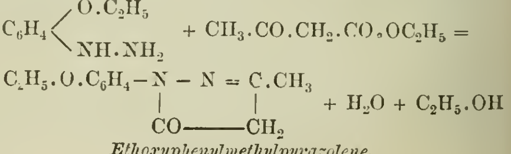
$$C_6H_4\left<\begin{array}{l}OC_2H_5\\ N - CO\end{array}\right. + NH_3 = C_6H_4\left<\begin{array}{l}OC_2H_5\\ NH.CO.NH\end{array}\right.$$

Phenetol carbamide.

Phenetol carbamide forms white needles, melting at 160° C., which dissolve readily in hot water, but with difficulty in cold. The corresponding methoxy-compound is similarly prepared from anisidine. This also possesses a sweet taste, as do the amido-compounds prepared from both the carbamides by the reduction of their mono-nitro-derivatives.—C. A. K.

*Manufacture of Ethoxyphenylmethylpyrazolone and of Para-ethoxy-*1 *Phenyl* 2 : 3, *dimethyl-*5 *pyrazolone.* O. Imray, London. From Die Farbwerke vormals Meister, Lucius, and Brüning, Hoechst-am-Main, Germany. Eng. Pat. 2617, February 10, 1892.

Para-phenetidine when diazotised and then reduced with stannous chloride in alcoholic solution, is converted into para-ethoxy-phenyl hydrazine, which may be recrystallised from ether and melts at 74° C. The hydrazine condenses with acetyl-acetic ester on heating to form ethoxyphenylmethylpyrazolone according to the equation—



$$C_6H_4\left<\begin{array}{l}O.C_2H_5\\ NH.NH_2\end{array}\right. + CH_3.CO.CH_2.CO.OC_2H_5 =$$

$$\begin{array}{l}C_2H_5.O.C_6H_4-N - N = C.CH_3\\ \qquad\qquad\qquad\quad | \qquad\quad\; |\\ \qquad\qquad\qquad\; CO\text{———}CH_2\end{array} + H_2O + C_2H_5.OH$$

Ethoxyphenylmethylpyrazolene.

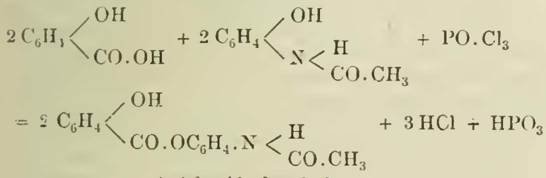
The product recrystallised from alcohol forms compact crystals melting at 147° C.; they dissolve both in acids and in alkalis, and give a blue coloration with ferric chloride. When heated with methyl iodide in presence of methyl alcohol to 100° C., para-ethoxy-1 phenyl-2:3 dimethyl-5 pyrazolone is obtained, being precipitated from the products of the reaction by caustic soda, as a thick oil. It is purified by extraction with benzene, from which it separates in compact crystals melting at 89 C., readily soluble in water, alcohol, and benzene, but with difficulty in ether. With ferric chloride a red solution results, whilst nitrous acid forms a blue-green solution from which crystals of the nitroso-body are rapidly deposited.—C. A. K.

"An Antipyretic and Anti-Neuralgic Chinolin" Derivative and Processes for the Production of the Same. A. Bang, Leeds. From G. Adolf Dahl, Barmen, Prussia. Eng. Pat. 3147, February 18, 1892.

Orthohydroxy-ethyl-ana-amido-quinoline hydrochloride, previously patented as an antipyretic and antineuralgic (this Journal, 1892, 59), is converted into ortho-hydroxy-ethyl-ana-monobenzoylamidoquinoline when boiled with benzoyl chloride. The new base forms small yellow crystals, difficultly soluble in water, more readily in alcohol, which melt at 206° C. It is also obtained by the action of benzoyl chloride in presence of caustic soda on the free hydroxyethylamido-quinoline. The product thus got is purified by recrystallisation from alcohol. It is valuable for therapeutic purposes both as an antipyretic and as an anti-neuralgic.—C. A. K.

Improvements in the Manufacture and Production of Pharmaceutical Compounds. B. Willcox, Lincoln's Inn Fields, Middlesex. From Farbenfabriken vormals Friedrich Bayer and Co., Elberfeld, Germany. Eng. Pat. 3435, February 22, 1892.

The invention relates to a new process for preparing the acetyl-amido-phenyl salt of salicylic acid or of analogous hydroxy-carboxylic acids described in the specification 11,883, July 11, 1891 (this Journal, 1892, 708). Instead of starting from the nitro-phenyl salt of salicylic acid, acetyl-para-amido-phenol is heated for 1—2 hours to 120°—130° C. with salicylic acid in the presence of phosphorus oxychloride or other dehydrating agent. The product of the reaction is treated with water, when the acetyl compound remains behind and can be purified by recrystallisation from alcohol. It is advantageous to effect the reaction in benzene solution. The following equation represents the change :—



$$2\,C_6H_4\left<\begin{matrix}OH\\CO.OH\end{matrix}\right. + 2\,C_6H_4\left<\begin{matrix}OH\\N\left<\begin{matrix}H\\CO.CH_3\end{matrix}\right.\end{matrix}\right. + PO.Cl_3$$

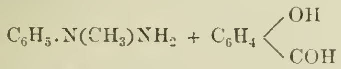
$$= 2\,C_6H_4\left<\begin{matrix}OH\\CO.OC_6H_4.N\left<\begin{matrix}H\\CO.CH_3\end{matrix}\right.\end{matrix}\right. + 3\,HCl + HPO_3$$

Acetylamidophenylsalicylate.

—C. A. K.

Manufacture of a New Compound Resulting from the Reaction of α-Methyl-phenyl hydrazine and Salicylaldehyde. J. Roos. Frankfort-on-the-Maine, Germany. Eng. Pat. 3698, February 25, 1892.

Salicylaldehyde reacts readily with unsymmetrical α-methyl-phenyl hydrazine, a molecule of water being eliminated according to the equation—



$$C_6H_5.N(CH_3)NH_2 + C_6H_4\left<\begin{matrix}OH\\COH\end{matrix}\right.$$

$$= C_6H_5.N(CH_3)N{=}CH.C_6H_4.OH + H_2O$$

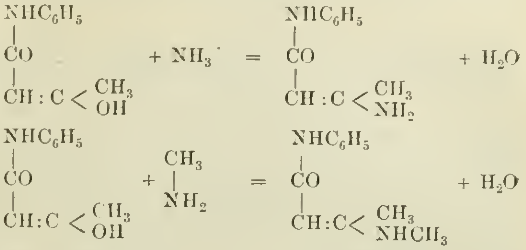
Salicylaldehyde α-methylphenylhydrazone.

The reaction takes place either directly or may be effected in a solvent such as methyl or ethyl alcohol; no heating is required. The new compound, to which the name of "antalgine" is given, forms white laminated crystals, which melt at 73° C. It is insoluble in water, soluble in alcohol, ether, &c., and is decomposed on boiling with hydrochloric acid (concentrated). It is useful for therapeutic purposes.

—C. A. K.

Manufacture of Beta-Amido Crotonic Anilide and of Beta-Methyl-Amido Crotonic Anilide. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 4406, March 5, 1892.

By the action of ammonia or methylamine on acetylacetic anilide, β-amido-crotonic anilide or its methyl derivative are readily prepared according to the equations—



$$\begin{matrix}NHC_6H_5\\|\\CO\\|\\CH:C\left<\begin{matrix}CH_3\\OH\end{matrix}\right.\end{matrix} + NH_3 = \begin{matrix}NHC_6H_5\\|\\CO\\|\\CH:C\left<\begin{matrix}CH_3\\NH_2\end{matrix}\right.\end{matrix} + H_2O$$

$$\begin{matrix}NHC_6H_5\\|\\CO\\|\\CH:C\left<\begin{matrix}CH_3\\OH\end{matrix}\right.\end{matrix} + \begin{matrix}CH_3\\|\\NH_2\end{matrix} = \begin{matrix}NHC_6H_5\\|\\CO\\|\\CH:C\left<\begin{matrix}CH_3\\NHCH_3\end{matrix}\right.\end{matrix} + H_2O$$

These anilides are to be employed as raw materials for the production of medicinal products. Under certain conditions when oxidised they yield pyrazolone derivatives. In order to produce the anilides, about one part by weight of acetylacetic anilide is dissolved in 10 times its weight of water, heated, and an excess of ammonia gradually added. When the whole of the acetylacetic anilide has dissolved, the solution is allow to cool, and on standing it deposits a substance of somewhat similar appearance, which is β-amido-crotonic anilide. This crystallises from alcohol in white needles melting at 144°—145° C., and is almost insoluble in water; it is easily soluble in hydrochloric acid. The β-methyl-amido-crotonic anilide is formed in a similar manner from acetyl-acetic anilide and methylamine, and crystallises from hot alcohol in white crystals melting at 140°—144° C. It dissolves in water with difficulty.—T. A. L.

New or Improved Apparatus for the Production of Ozone by Means of Phosphorus. C. R. Poulsen. Horsens, Denmark. Eng. Pat. 14,862, August 17, 1892.

The phosphorus is held in a glass cup fixed at the end of glass rod and placed in a 10 per cent. solution of sulphuric acid, which is contained in a wide-mouthed bottle provided with a glass cap, through which the free end of the glass rod projects. A perforated glass or porcelain plate is fixed below the neck of the bottle, through which the ozone escapes, whilst the phosphorous acid formed simultaneously is kept back. The bottle is filled to about one-half its volume with the dilute acid, to which a little potassium permanganate is added to oxidise the phosphorous acid. The apparatus is designed for inhaling of ozone in cases of tuberculosis and other diseases of the chest.

—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

A Process for Developing Photographic Images. J. Hauff, Feuerbach, Stuttgart, Germany. Eng. Pat. 4498, March 7, 1892.

Ortho-para-diamido phenol, when mixed with only a small quantity of sodium carbonate, for use as a photographic developer, acts so powerfully that the unexposed silver haloid is reduced, thus causing fog. The developer can be successfully employed without the addition of carbonated or of caustic alkalis, by simply dissolving it in water, in which it is very soluble, with the addition of an alkaline sulphite. Dilute mineral acids act as restrainers and can be used instead of the bromides or chlorides of the alkalis. The proportion of sulphite to the salt of ortho-para-diamido phenol recommended is 10 to 1. The solution remains colourless on keeping, and does not stain the gelatine of the plates. For portraits the following developer answers well:—0·45 grm. diamido-phenol hydrochloride, 4·5 grms. sodium sulphite, and 60 cc. water. A few drops of a 10 per cent. solution of potassium bromide or a few cc. of a 10 per cent. solution of sulphuric acid, strengthened with an alkaline sulphite, is used as the restrainer.—C. A. K.

Improvements in or appertaining to Printing Plates or Blocks formed by Photographic Means. J. Hines, Southport. Eng. Pat. 5008, March 14, 1892.

A metallic plate, preferably of stereotype metal, is coated with gelatin by brushing it over with a warm solution of gelatin in glacial acetic acid; the plate is then sensitised and allowed to dry. After exposure under a negative it is developed in a bath of hot sulphate of iron, which causes those parts of the plate which have not been acted upon by light to shrink, leaving the rest of the picture raised; when dry the plate is screwed on to a wooden block and is ready for the printer. Methods of preparing the negative so as to produce an engraved effect are described.—J. C. C.

An Improved Dish or Case for use in Photographic Development or other Process. H. Rayner, Leeds. Eng. Pat. 22,633, December 9, 1892.

This consists in an outer frame of tinned iron or other sheet metal, varnished or japanned, enclosing an inner dish of non-actinic glass, which has a projecting lip at one corner, a vertical wall or screen being placed at the entrance of the lip to prevent any actinic light entering the dish. A sliding cover of non-actinic glass covers the dish, and the lip is also closed by a hinged lid. The dish is intended for developing in ordinary light.—J. C. C.

Improvements in or relating to Packs or Series of Sheets with Notched Edges, more particularly applicable to Packs of the Flexible Sensitised Films in Photographic Usage. J. T. Clarke, Boston, Mass., U.S.A. Eng. Pat. 23,315, December 19, 1892.

This invention relates to improvements in packs of films, as described in Eng. Pat. 11,891 of 1890. In the new pack each individual sheet or film is identical in outline, the differentiation between the sheets of odd and even number depending on an alternate reversal of the ends of the sheets. This is effected by designing the outline of the sheets so that the notches correspond alternately with the projections when the alternate sheets are reversed as regards top and bottom.—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in the Manufacture of Explosives. C. O. Lundholm and J. Sayers, Stevenston. Eng. Pat. 6448, April 4, 1892.

This invention comprises some operations which are described in previous patents—Nobel, 1471 of 1888 and 9361 of 1889; also Lundholm and Sayers, 10,376, 12,338, 13,486 of 1889 (this Journal, 214, 1889; 764, 893, 1890).

The object of the invention is to produce explosives consisting of mixtures of nitroglycerin and the various nitro-derivatives of the aromatic series with the various nitrocelluloses, &c., by effecting the mixing in the wet state. The nitrocellulose is kept in suspension in water, which is agitated in any suitable way, and then the nitroglycerin or nitro-compound is injected; the combined bodies are then separated from the suspending medium by filtration and pressure, and worked between rollers till nearly dry. After this the explosive is treated in a kneading machine with acetone or other solvent until complete gelatinisation has taken place, when it can be rolled or pressed into suitable forms and the solvent driven off by heat.—W. M.

Process of and Apparatus for Treating Vegetable Fibres, or Fibrous Substances for Producing Sheets, Roofing and Wall Felts, Matches, Torches, and the like. P. Jensen, London. From E. Steimer, Karlsruhe, and M. Ziegler, Nachterstadt, Germany. Eng. Pat. 18,572, October 17, 1892.

See under V., page 261.

Improvements in the Manufacture of Explosives. O. Imray, London. From J. Storer, Sydney, N.S.W. Eng. Pat. 23,377, December 19, 1892.

This invention consists in the employment of kerosene shale as a substitute for other carbonaceous matter, along with oxidising agents such as chlorates or nitrates, both being finely ground separately and then mixed together. Suitable proportions are one of shale to five of potassium chlorate.—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

On the Optical Measurement of High Temperatures. Le Chatelier. Dingl. Polyt. J. 1892, **286**, 43—47 and 63—66.

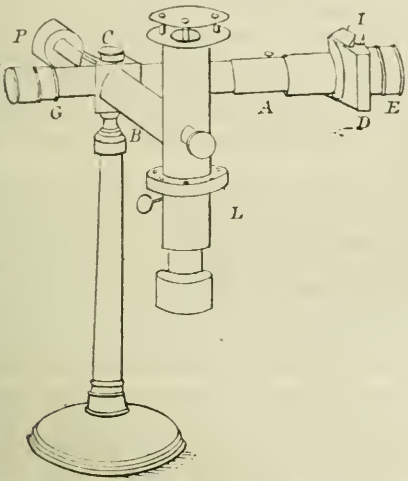
The author has investigated and published the conditions under which exact measurements of high temperatures can be made by thermo-electric methods. The rapid adoption of his electrical pyrometer has shown that methods of measuring high temperatures are urgently required in industrial operations; but it must be admitted that delicate electrical apparatus cannot well be entrusted to workmen. The author has been urged to devise a method suitable for industrial purposes, and his investigations have led him to the conclusion that optical methods alone provide a satisfactory solution of the problem. They do not depend upon the properties of special thermometric substances, nor do they require any rigid connection between the furnace and the instrument used for measuring its temperature.

Methods depending on the change of colour in the light emitted by a surface at various temperatures, cannot well be accurate. Violle has shown that the ratio between the intensities of the rays $\lambda = 656$ (red) and $\lambda = 482$ (blue) changes in the proportion of 1 : 4·5 for an interval of temperature of 700°. Now in practice the error in measuring such a change cannot be less than 10 per cent., which would correspond to an error of 50°. In many industrial operations, *e.g.*, the hardening of steel and the manufacture of chlorine by the Deacon process, such an error could by no means be neglected. On the other hand, the ratio between the absolute intensities of the radiation of any particular wave-length—*e.g.*, red—for the same interval of temperature (1000°—1700°) is measured by the ratio 1 : 300. Between 600° and 1800° the ratio amounts to 1 : 1,000,000. Obviously a pyrometric method depending on the absolute intensities of radiation from a surface at various temperatures, admits of considerable accuracy. The surface chosen should be a black one, such as that of oxidised iron.

It is scarcely possible to measure intensities which vary between such wide limits as 1 and 1,000,000 without making use of absorption glasses; these may be placed behind one another, and the smaller changes of intensity between the application of successive glasses may be measured by means of a Nicol prism or an iris-diaphragm. The latter method is found to be both practical and satisfactory. It is absolutely necessary to work with a monochromatic light; this must be red light, for red glass is the only one which transmits monochromatic light, and is the only one which can be applied for measuring low temperatures.

All the adjustments which are required in a pyrometric photometer are found to be practically provided in Cornu's photometer; the author had therefore only to modify this photometer slightly, as shown in Fig. 1, so as to make it suitable for furnace work. Several standards of light were tested. The amyl-acetate lamp was found to give satisfactory results when special precautions were taken, but for practical purposes a small lamp L burning petroleum ether is recommended as giving a steadier light. This is protected from draughts by a chimney. The red glass is placed in front of the eye-piece G, and the dark absorption glasses are placed at E in front of the iris-diaphragm D. Some difficulty was experienced in finding an absorption glass which did not appreciably alter the colour of the red light. A glass of special composition was made, coloured by oxide of iron and copper, with a slight admixture of oxides of manganese and nickel. This was found to answer admirably. The radiating surface is viewed directly: the lamp-flame is seen by reflection from the mirror, which must be adjusted so that the observer sees both sources of light at the same time. The lamp must be lit 10 minutes before any experiments are made, and its flame must then be kept at a constant height. The mirror must be adjusted so that its edge bisects the flame.

Fig. 1



Cornu's Photometer, with Microscope.

In making a measurement the observer looks at the radiating object through the tube in such a way that its image is bisected by the edge of the mirror, and thus brought into contact with the image of the flame. The iris-diaphragm is now adjusted until the intensities are equal, and similar observation is then made with a normal amyl-acetate lamp in the place of the radiating object and at the same distance. If n and n^1 are the apertures of the iris-diaphragm in the two cases, the intensity of radiation from the surface of the object compared with that of the normal lamp is given by—

$$I = \left(\frac{n^1}{n}\right)^2.$$

Generally, however, the object and the lamp will not be at equal distances: if f is the focal distance of the image of the object, and f^1 that of the lamp, then—

$$I = \left(\frac{n^1}{n}\right)^2 \left(\frac{f}{f^1}\right)^2.$$

If it is found necessary to use an absorption glass its absorption coefficient must first be determined. This can be done by pointing the tube at a surface of suitable brightness and adjusting the iris-diaphragm so as to admit equal amounts of light before and after the absorption glass is introduced. If N and N¹ are the apertures of the iris-diaphragm of the two cases, the absorption coefficient is—

$$K = \left(\frac{N^1}{N}\right)^2.$$

Hence if absorption glasses have to be used in any comparison the intensity is—

$$I = \left(\frac{n^1}{n}\right)^2 \left(\frac{f}{f^1}\right)^2 \left(\frac{1}{K}\right)^p$$

With the above instrument the author has measured the emissive powers of various substances for red rays at 1300° with the following results:—

Substance.	Emissive Power.
Fe_3O_4	1
Palladium	0·6
Platinum, matt surface	0·4
Polished platinum	0·25
Magnesium oxide	0·1

The author has graduated this optical pyrometer by comparison with one of his thermo-elements, the junction of which was covered with Fe_3O_4. He finds that the results of the observations can be expressed by the equation—

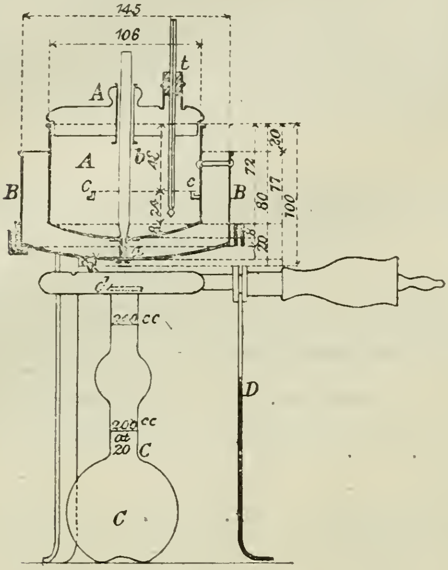
$$I = 10^{6·7} \,.\, T - \frac{3210}{T}$$

Similar sets of observations were made with junctions covered with platinum and palladium respectively. For the full data we must refer to the original paper. Some of the results obtained by the author flatly contradict estimates of temperatures obtained by other methods, and he expresses a hope that their publication will provoke further inquiry. The following may be given as examples of temperatures measured by his optical and thermo-electric pyrometers.

Melting-points:—Hard steel, 1410°; soft steel, 1475°; medium steel, 1455°. The temperature of a Bessemer converter at the end of the operation, 1580°. Siemens' furnace for illuminating gas, heated by coke:—Top, 1190°; bottom, 1045°; retorts in the same furnace, 875°—950°. The temperature of various porcelain furnaces (Sèvres, Bayeux, &c.) were found to be about 1370°. (The temperatures usually accepted are:—2000° for steel, 1800° for porcelain, and 1200° for illuminating gas.) Temperature of an incandescent electric lamp at normal voltage, 1800° if much over-run it may rise to 2100°. Temperature of the hottest part of the carbon in an arc lamp, 4100°; this is independent of the nature of the lamp and the strength of the current. The negative carbon is not so hot (3000°). Applying an extrapolation formula to certain observations of the radiation from the sun, the author deduces 7600° as the effective temperature.—D. E. J.

Rules for the Correct Construction and Use of the Engler Viscosimeter. C. Engler. Zeits. ang. Chem. 1892, 725—727.

Various complaints of discordant results obtained with Engler's viscosimeter having been raised, the author asserts that all the apparatus made according to his instructions are free from the defects complained of. To obviate further complaints, he publishes a description of the latest form of his viscosimeter, which has been designed in conjunction with the officials of the Charlottenburg Mechanisch-Technische Versuchsanstalt. The dimensions indicated in the accompanying sketch must be rigidly adhered to, if accurate and concordant results are to be obtained.



The vessel A is made of sheet brass, the inside of which should be gold-plated for very accurate determinations. The efflux-tube *a* must be exactly 20 mm. long. and of a diameter of 2·9 mm. at the top and 2·8 mm. at the bottom; the plug *b* of the efflux-tube should be made of hard wood, or, better still, of platinum. The three pointers *c* serve the double purpose of indicating whether the apparatus is level and marking the exact volume of 240 cc. The vessel A is jacketed, vessel B serving as a receiver for mineral oil, which may be heated up to 150° C. All the other features of the viscosimeter will be easily gathered from a glance at the diagram.

The author repeatedly lays stress on the necessity of strictly adhering to the measures given if correct observations are to be expected, and he goes on to say that the results complained of had been obtained with apparatus made by a Berlin firm.

Finally he gives the following instructions for testing the apparatus itself and oils by means of it:—

Clean A with ether or petroleum ether, and rinse out afterwards with alcohol and water, measure, by means of the flask C, 240 cc. of water and pour it into A, which should be filled up to the level pointers *c*. Heat the mineral oil in B, if necessary, to 20° C., and wait until the water in A has attained the same temperature. In the meantime dry flask C and place it under the efflux-tube. Draw the plug and carefully note the time (by means of a chronometer) occupied in filling the flask C to the 200 cc. mark. It is most important that the water in A should be completely at rest before the stop is drawn. The time required should be 51 to 53 seconds for a good apparatus, and repeated observations should not differ by more than 0·5 of a second. If an oil is to be examined, every trace of moisture should be removed from A, whereupon A is rinsed out with the oil under examination, and filled with it. The oil may be heated to any desired temperature. Supposing 53 seconds have been found for water at 20° C., and 276 seconds for the oil, the quotient $\frac{276}{53} = 5{\cdot}2$ will represent the specific viscosity of the oil.

—J. L.

INORGANIC CHEMISTRY.—QUANTITATIVE.

On the Estimation of Sulphur in Burnt Pyrites. G. Lunge. Zeits. ang. Chem. 1892, 447—449.

After an examination of the chief methods for estimating sulphur in burnt pyrites, Lunge came to the conclusion that Watson's method was the simplest, quickest, and most accurate. This method (see this Journal, 1888, 305) consists in heating the burnt ore with a known weight of sodium bicarbonate and titrating with standard acid the quantity of alkali that has not been converted into sulphate. But it was found that the method did not receive adoption in the copper works where the cupreous pyrites residues were worked up, as it failed to give sufficiently concordant results. Lunge has therefore made a careful investigation of the method with a view to determine the exact conditions for obtaining correct results by this method. The chief source of error was found to be due to the fact that in filtering the solution of the heated mass, finely-divided particles of iron or copper oxide pass through the filter, which particles during the titration use up acid and so lead to too low a percentage of sulphur being found. The author has succeeded in overcoming this difficulty by extracting the fusion with a concentrated neutral solution of sodium chloride. When this is done a perfectly clear filtrate is obtained.

Lunge's modified method is as follows:—3·2 grms. of the burnt ore and 2 grms. of bicarbonate of known strength are intimately mixed in a nickel crucible that is capable of holding about 20 grms. of the mixture (38 mm. wide at the top and 30 mm. deep). A thick nickel crucible is better for the purpose than a platinum one, as in the latter the portion of the mixture at the bottom is apt to fuse before the whole mass has become heated throughout, which does not happen with a nickel crucible. The crucible is first heated for from 10 to 15 minutes in such a way that only the tip of the flame touches its bottom, and next, it is heated for 15 minutes with a larger flame until the whole mass is raised to a red heat. In a nickel crucible the mass does not readily fuse, but fusion must be absolutely avoided. The crucible must be covered during the whole operation, or loss will occur by the projection of particles by the issuing stream of carbonic acid; and the contents of the crucible must not be stirred whilst being heated. After cooling, the crucible is put into a porcelain dish. If the operation of heating has been properly carried out, the mass will be black and porous; if the heat has not been great enough it will be brownish-red, and if too strongly heated it forms a black, glassy cake that is difficultly soluble. It is extracted by boiling with water, then a quantity of sodium chloride solution (which, if necessary, has been accurately neutralised with hydrochloric acid, using methyl-orange as indicator) is added, and the liquid is poured on to a filter moistened with sodium chloride solution. If the first portion of the filtrate is of a greenish-yellow colour it is returned to the filter again. Usually a clear solution is at once obtained, tinged faintly yellow by the methyl-orange. The extraction by boiling is repeated several times, the residue washed with dilute sodium chloride solution, and the total filtrate titrated with one-fifth normal hydrochloric acid. Analyses are given which show a very satisfactory result.

Lunge also mentions that in estimating the sulphur in pyrites, and more especially in burnt pyrites, by the method of oxidation with nitric acid and final precipitation as barium sulphate, the method of dissolving the ore previously recommended by him, viz., in a mixture of 3 vols. of nitric acid of sp. gr. 1·4, and 1 vol. of hydrochloric acid of sp. gr. 1·16, is not reliable, as when the ore contains FeS sulphuretted hydrogen may be evolved. It is therefore best to oxidise first with nitric acid alone and afterwards to add a few drops of hydrochloric acid. The nitric acid must then be expelled by repeated evaporation to dryness with hydrochloric acid.—H. S. P.

Methods for Estimating Small Quantities of Carbon Bisulphide. Alex. Westberg. Zeits. Anal. Chem. **31**, [4]—485—486. (This Journal, 1893, 285.)

The carbon bisulphide used in these experiments was first distilled from quicklime (from marble). The distillate was separately shaken up with roughly pulverised potassium permanganate (5 grms. per litre), metallic mercury, and mercuric sulphate (25 grms. per litre), and finally distilled repeatedly at a temperature not exceeding 60° C., from pure fat. Thus treated, the commercial carbon bisulphide lost its bad smell, and was obtained as a liquid possessing an agreeable ethereal odour. It was preserved, with exclusion of air.

Sulphocyanide method.—If carbon bisulphide be mixed with five times its volume of alcoholic ammonia, and the mixture be heated for a short time, there remains on evaporation of the liquid, a residue of sulphocyanide of ammonium. The addition of a few drops of neutralised ferric chloride (excess of acid)—then gives rise to the well-known red coloration. By this method 0·00105 grm. of CS_2 could be detected; *i.e.* 0·21 grm. of a 0·5 per cent. solution of carbon bisulphide, gave the red coloration.

Ammonium Molybdate method.—A known quantity of carbon bisulphide is treated with a few drops of an 8 per cent. alcoholic potash solution and evaporated on a watch-glass in the exsiccator over sulphuric acid and caustic potash, in vacuô. There remains behind a residue of potassium xanthate, which on addition of ammonium molybdate and sulphuric acid, is coloured red. What the red-coloured substance is, no one as yet knows.

By this method 0·0006674 grm. of CS_2 was recognised.

Hofmann's Method (Tri-ethylphosphine).—An ethereal solution containing a known quantity of carbon bisulphide, was added to an ethereal solution of tri-ethylphosphine. As the limit of delicacy of the reaction, the just appreciable separation of a red crystalline precipitate was taken. The precipitate, of course, consists of the double compound $P(C_2H_5)_3.CS_2$.

By this reaction 0·0005434 grm. of CS_2 could be detected.

Other Methods of Detection.—The blackening of an alcoholic solution of lead acetate by carbon bisulphide; the yellow precipitate produced by potassium xanthate rendered acid with acetic acid, in a cupric acetate solution; the yellowish brown precipitate produced by potassium xanthate in an ammoniacal nickel solution, and also the blackish brown precipitate of a cobalt solution with potassium xanthate,—are given as alternative, but less delicate, methods. They (the latter tests) cannot be employed in detecting carbon bisulphide in the blood.

—J. C. C.

Determination of Chromium and Manganese in Steel. L. Schneider. Oesterr. Zeits. Bergh, 1892, 235.

Two grms. of steel are dissolved in 100 cc. of dilute sulphuric acid (1:10). Then the iron is oxidised by 5 cc. of concentrated nitric acid and boiled a short time, until brown vapours cease to come off. About 5 grms. of lead peroxide are now added to the boiling solution, and the boiling continued for about $\frac{1}{4}$ hour, the solution is then filtered and the filtrate rendered ammonical and boiled again for a short time. The permanganate that has been formed is thus quickly and completely decomposed and the liquid above the precipitate of ferric hydrate appears a clear yellow in the presence of chromium. If the quantity of chromium be so small that the yellow colour is not definite, the ammoniacal liquid is filtered and then acidified with sulphuric acid, when even traces of chromium cause a distinct yellow colour in the solution. If 0·1 per cent. of chromium be present, the colour is evident in the ammoniacal solution, which need not then be filtered, but sulphuric acid may be added to it direct until all the ferric hydrate together with the oxide of manganese dissolves. But if the oxide of manganese does not completely dissolve, as will be seen by the slightly brown turbidity, the liquid must be filtered. The clear solution is now diluted to 1 litre, and the chromic acid determined by adding excess of ferrous ammonium sulphate and titrating the excess with potassium permanganate solution. In oxidising chrome iron the boiling with sulphuric acid must be continued for about 1 hour, and the addition of the lead peroxide must be several times repeated.

To estimate the manganese 2 grms. of steel are dissolved in 200 cc. of dilute sulphuric acid (1:2) and oxidised with 5 cc. of nitric acid, and then digested for $\frac{1}{4}$ of an hour with peroxide of lead as above. Lead peroxide is then again added and the liquid cooled, during vigorous agitation. Both the chromium and manganese are oxidised—the chromium to chromic acid and the manganese to permanganic acid. The solution is then filtered through asbestos and diluted to one litre and excess of ferrous ammonium sulphate added, and the excess titrated with potassium permanganate solution. This gives the quantity of ferrous iron oxidised by the combined acids and deducting from this the quantity that is oxidised by the chromium present as determined by the method above described the amount of ferrous oxide equivalent to the manganese present is obtained.—H. S. P.

The determination of Phosphorus in steel and iron. R. Zimmermann, Stahleisen, 1892, 524.

This is a method for estimating the phosphorus after precipitating as ammonium-phospho-molybdate, use being made of the usual formula for reckoning the weight of a precipitate by the method of specific gravities, viz.:—

$$X = \frac{S}{S - s}(G - g)$$

Where S is the specific gravity of the precipitate *s* the specific gravity of the liquid, G the weight of the specific gravity bottle + the liquid, + the precipitate, and *g* the weight of the sp. gr. bottle, + the liquid.

The weight *g*, varies with the temperature. If a liquid of known sp. gr. be therefore used it is only necessary to make a table of the weight of the bottle + the liquid within the range of the various temperatures likely to occur in practice, in order by merely taking the temperature of the liquid and referring to the table, to be able to tell the weight *g*.

The specific gravity of the ammonium-phospho-molybdate precipitate, according to E. E. Merz, is S = 3·252, and it contains 1·73 per cent. of phosphorus.

The operation is carried out as follows:—The phosphorus is precipitated as ammonium phospho-molybdate, and the precipitate is allowed to settle for 15 to 20 minutes and the clear liquid is then syphoned off or carefully poured off and the precipitate transferred to a small filter paper and washed with dilute nitric acid of sp. gr. 1·002 from a wash-bottle. After washing, the precipitate is then rinsed off the paper into a specific gravity bottle, and the bottle is filled up with nitric acid of sp. gr., 1·002. After closing the bottle and drying it, the whole is weighed and gives the weight G. The temperature of the liquid in the bottle is then taken and a reference to the table gives the weight *g* of the bottle + liquid at that temperature.

The weight of the precipitate is therefore

$$X = \frac{3{\cdot}252}{3{\cdot}252 - 1{\cdot}002}(G - g)$$

and the percentage of phosphorus when 5 grms. of steel or iron has been taken

$$\frac{3{\cdot}252}{3{\cdot}252 - 1{\cdot}002}(G - g)\frac{1{\cdot}73}{5}$$

or very nearly 0·50(G − *g*).—H. S. P.

ORGANIC CHEMISTRY.—QUALITATIVE.

Process for Determining the Purity of Cocoa-nut Oil and of Palm Oil. E. Milliau. Comptes rend. 1892, **115**, 517—518.

The author has devised the following scheme to detect the adulteration of these oils with others:—

First Operation:—Twenty cc. of the sample are shaken for one minute in a graduated tube with 40 cc. of alcohol of

90°, when the oil, deprived of its free fatty acids, sinks to the bottom. Alcohol of 95° then absorbs a certain quantity of neutral fatty matters, and the oil dissolves 15—20 per cent. of alcohol. The solvent power of the oil diminishes sensibly in the presence of insoluble oils, whilst that of the alcohol increases in the presence of oils, soluble in alcohol of 95°,—castor oil, resin oil, &c., which latter can then be readily characterised by their physical and chemical properties.

Second Operation.—Five cc. of cocoa-nut oil, previously washed with alcohol of 95°, are treated in a graduated tube with 10 cc. of absolute alcohol, and the mixture placed on the water bath at 30°—31° C.: it is now shaken for 30 seconds and replaced on the water-bath. Pure cocoa-nut oil dissolves completely under these conditions, whilst when contaminated with oils insoluble in alcohol, such as earth-nut, sesame, cotton-seed, and maize oils, it does not sensibly dissolve, but falls to the bottom of the tube. Cocoa-nut oil containing 20 per cent. of palm-oil separates, but when the percentage is below this a turbid emulsion results. Palm oil is tested in the same manner, only with 20 cc. instead of 10 cc. of absolute alcohol. Five cc. of palm oil containing 20 per cent. and upwards of cocoa-nut oil is soluble in 15 cc. of absolute alcohol, whilst, under these circumstances, the pure oil forms a turbid emulsion.

The purity of cocoa-nut and palm oil cakes is determined by extracting the fats and treating them in the manner above described.—A. R. L.

ORGANIC CHEMISTRY.—QUANTITATIVE.

On the Estimation af Fats in Bread. M. Weibull. Zeits. ang. Chem. 1892, 450—451.

The author found that in his own experience, as also in all published analyses, the fat in bread was less than in the meal from which it was made. He finds that this is due to errors of analysis arising from the fact that in baking, the fat particles become so surrounded by dextrin and starch that they were not extracted by ether. To overcome this obstacle he finely powders from 1 to 3 grms. (according to the size of the Soxhlet's extractor) of the bread and pours over it in a small beaker 15—20 cc. of water acidulated with 10 drops of dilute sulphuric acid. The liquid is then boiled for at least an hour, and during this time it is frequently stirred with a glass rod. It is afterwards neutralised with powdered marble, and the pasty mass is then spread upon absorbent paper as in the estimation of fat in milk, the part adhering to the beaker being removed with cotton-wool free from fat. The paper is dried at 100° for two to three hours and then placed in the extractor and extracted for eight hours with water-free ether. At the end of this time all the fat is extracted. If the ether contain water some grape sugar is also extracted. By working in this way results were obtained which showed that the whole of the fat in the meal was retained by and could be extracted from the bread. A sample of rye-bread (made from rye-meal and milk containing 1·47 per cent. of fat) yielded by this process 1·49, 1·47, and 1·43 per cent. of fat.—H. S. P.

Analysis of Mixtures of Ammonia and Methylamines. H. Quantin. Comptes Rend., 1892, **115**, 561—562.

To separate the methylamines from ammonia the crude mixture is distilled with milk of lime, and the distillate collected in water, moist magnesium phosphate is then added when, in the presence of much methylamine, the ammonia will be precipitated in 24 hours. The filtrate yields on distillation with milk of lime the methylamines free from ammonia. The following scheme is put forward to determine the relative amounts of ammonia and the methylamines present in a mixture. The total alkalinity is determined and calculated as ammonia, the necessary amount of sodium phosphate and magnesium sulphate to precipitate the ammonia, on this calculation, being then added in the presence of an excess of the purified methylamine. The ammonia is then estimated in the precipitate, and its amount deducted from the total alkalinity, the difference will then be equivalent to the methylamines present. A determinate weight of the methylamines purified as above, is then transformed into platinochloride, and the latter washed repeatedly with absolute alcohol, which dissolves the platinochloride of trimethylamine. The relative amount of methylamine and dimethylamine is deduced from the weights of the platinochlorides insoluble in alcohol, and that of the platinum left on igniting them.—A. R. L.

Volumetric Estimation of the Alkaloids. L. Barthe. Comptes Rend., 1892, **115**, 512—514.

A weight in grms. corresponding to $\frac{1}{1000}$ of the equivalent of the alkaloid or of either of its salts is introduced into a flask together with $\frac{N}{10}$ sulphuric acid (10 cc. for a salt, or 20 cc. for the base); neutral alcohol of 90° (20 cc.) is added, and 3 or 4 drops of an alcoholic solution of phenolphthaleïn. The solution is titrated with $\frac{N}{10}$ potash; the amount of the latter required to produce the red tint is equivalent to the whole of the free and combined acid in the solution. When the free alkaloid is soluble in dilute alcohol, a clear solution results; when otherwise, the base is precipitated. A similar titration is now conducted using litmus as indicator. The number of cc. of $\frac{N}{10}$ potash required to produce the blue colour corresponds in this case to the free acid only, consequently the difference between the two titrations gives the number of cc. equivalent to the combined acid. The amount of the base is obtained by multiplying this difference by $\frac{1}{1000}$ of the equivalent of the alkaloid. The method is available for all the better known alkaloids.—A. R. L.

ANALYTICAL AND SCIENTIFIC NOTES.

On the Volatility of Silicic Acid. E. Cramer. Zeits. ang. Chem., 1892, 484—486.

Experiments are described which prove that the presence of steam greatly facilitates the volatilisation of silicic acid. Over 2·5 grms. of silicic acid (quartz) were completely evaporated in a lightly covered graphite crucible, placed in a furnace (similar to Deville's) at a temperature at which platinum boiled. No evaporation could be observed on lowering the temperature to considerably above that of the melting point of cast iron, although Jeffy has shown that in presence of steam evaporation takes place at the melting point of cast iron. The presence of steam in blast-furnaces explains why sublimed crystalline silicic acid is found there notwithstanding that the temperature in such furnaces does not nearly reach that of an oxygen-fed blowpipe-flame, in which silicic acid cannot be volatilised. Sublimates of silica have also been observed in a stone-ware kiln, when steam was introduced, although the temperature was only the same as that of melting cast iron.

The author mentions casually that platinum evaporates in the vacuum of the incandescent lamps when the tension of the electric current is increased inordinately. The metallic vapours then cover the glass with a thin grey film.
—K. E. M.

The Action of Certain Gases and Vapours upon Copper and the "Noble" Metals. G. Neumann, Monatsh. Chem. 1892, 40 48.

(1.) *Action of Hydrogen, Carbonic Anhydride, and Alcohol Vapour upon Copper.*—It has long been recognised that copper has the property of absorbing hydrogen when heated in that gas, and it has been stated by Thudichum and Hake (Jahres bericht f. Chem. **29**, 1876, 966), that it can be driven out by a stream of carbonic anhydride at a red heat, a statement confirmed by Vortmann (Anleitung z. Chem. Analyse org. Stoffe, 1889, 49). The author's results run counter to these assertions.

A roll of copper gauze, weighing 29 grms. was heated in a combustion tube in a stream of hydrogen. The hydrogen was then expelled by a stream of purified carbonic acid, the latter gas being finally displaced by nitrogen. The tube containing the copper was then connected with one filled with copper oxide and provided with absorption tubes. When these ceased to gain weight pure oxygen was led through both tubes, which were again heated, and the water and carbonic anhydride formed, collected, and weighed. Four experiments were made, the time during which the gases were passed being varied, and in all cases the absorption tubes gained in weight, the quantity of water, even in the case when least was produced being as much as 4 mgrms., and that of the carbonic anhydride 5·5 mgrms. These numbers were obtained when the heating was continued for three hours in hydrogen, and for an equal period in carbonic anhydride. It therefore appears that the whole of the hydrogen is not expelled by the carbonic anhydride, although its quantity is diminished by prolongation of the treatment. As it is now the practice in some laboratories to reduce copper intended for organic analysis with alcohol, similar experiments were conducted with this substance. The gauze was heated in a blowpipe flame and quenched in purified, recently distilled alcohol. Hydrogen and carbonic anhydride were, however, invariably recognised. The elimination of the former was most nearly complete when the spiral was dried by heating to a temperature of 222° C.; that of the carbonic anhydride, however, was best effected by drawing the dried spiral through the flame of a Bunsen burner. An experiment was also made by reducing the copper in purified coal-gas Hydrogen and carbonic anhydride were still recognised. Complete purification of copper for organic analysis does not therefore appear to be practicable, as doubt has been cast on the method prescribed by Hempel (Zeits. Anal. Chem. 1878, **17**, 414), and the use of silver, as shown by Calberla, does not suffice to decompose nitric oxide completely. Further research is therefore necessary.

(2.) *Action of Oxygen on the "Noble" Metals.* The mode of experiment was in all cases the same. The metals were ignited for several hours in pure oxygen, and when the absorption tubes had ceased to gain in weight, the metal was allowed to cool in the gas and the latter expelled by pure nitrogen, which in its turn was driven out by hydrogen, the metal being heated and the water that was formed collected. The tube was finally refilled with nitrogen and the absorption tube with air. A blank experiment was also made, and no formation of water observed.

(*a.*) *Silver.*—Two experiments showed an absorption of 4·09 and 5·43 volumes of oxygen. These results confirm those of Graham, who found an absorption of 0·745—7·4 volumes according to the state of aggregation of the metal.

(*b.*) *Gold.*—This metal was found to absorb 32·78 and 48·49 volumes of oxygen in two experiments conducted in the manner described above. This runs counter to Graham's results, who found gold remarkably indifferent to the action of oxygen. This discrepancy may depend upon the fact that the temperatures used were different. Graham does not give the temperatures, even approximately, while that employed by the author was about 450° C.

(*c.*) *Platinum.*—A conflict of evidence exists concerning platinum. The author, in two experiments found that it absorbed 63·14 and 77·14 volumes of oxygen.

(*d.*) *Palladium.*—The author found that palladium absorbed 7·33 per cent. of oxygen corresponding to the formation of the suboxide Pd_2O, which contains 6·99 per cent.

The temperature used in these experiments was approximately measured by heating a piece of combustion tube of about the same size as the tube containing the metal, closed at one end and drawn out to a capillary tube at the other, in a manner similar to that used in the actual experiment, sealing it, and when cool opening under water, the volume of the water drawn in serving as a measure of the temperature to which it had been exposed. Two experiments gave the figures 491° C. and 454° C., a result which was confirmed by the fact that zinc (m. p. 412°—433° C.) melted easily, and antimony (m. p. 432°—450° C.) just fused in the neighbourhood of the tube in which the experiment was being conducted.—B. B.

Fusion of Calcium Carbonate. H. Le Chatelier. Compt. Rend. 1892, **115**, 817—820.

If the experiments of Hall on this subject, published at the end of the last century, be correct, calcium carbonate fuses at a temperature between the melting point of silver and that of gold, say 1050°. According to the author's investigations into the dissociation of calcium carbonate, this temperature corresponds to a dissociation tension of 8·7 atmospheres. Heretofore attempts to repeat Hall's experiment have failed, mainly, in the author's opinion, because the iron vessel was itself heated in order to heat the calcium carbonate; the liberated carbon dioxide would be reduced by the hot iron to carbon monoxide, which would much increase the total pressure without attaining the dissociation tension of the calcium carbonate.

Chemically pure calcium carbonate, in impalpable powder, was submitted to a pressure of 1000 kilos. per sq. cm. in a steel cylinder by means of two steel pistons, and heated by an incandescent platinum coil. The calcium carbonate within the platinum spiral was fused to a white translucent substance, separated by a sharp line of demarcation from the surrounding portion, which was merely agglomerated by the pressure. Crystals of 0·1 mm. diameter, *i.e.*, 1,000 times greater than the original particles of calcium carbonate, were also noticed. The insertion of a filament of gold in the cylinder proved that the temperature necessary was below the melting point of gold. A photograph shows the resemblance of the fused calcium carbonate to certain natural marbles.—A. G. B.

Deleterious Effect of Soda Dust and Ammonia on Plants. M. Bömer, E. Haselhoff, and J. König. Landw. Jahrb. **21**, 407.

These are most injurious to potatoes and clover, while wheat, oats, and rye are more affected than barley. Fruit trees are more sensitive than other trees. Cherry and plum trees suffer when the air contains 70 to 86 mgrms. of ammonia per cubic metre; the oak on the other hand can stand as much as 240 mgrms.—B. B.

The Temperature of the Maximum Density of Mixtures of Alcohol and Water. L. De Coppet. Comptes Rend. 1892, **115**, 652—653.

The author's experiments were made with solutions containing from 0·1 grm. to 17 grms. of alcohol in 100 grms. of water. The results show that although the weight of alcohol present is proportional to the lowering of the freezing-point (Blagden's law), it is not proportional to the lowering of the point of maximum density; and *a fortiori* in the case of dilute solutions, where, instead of a fall, there is an actual rise in the temperature of maximum density.—A. R. L.

Erratum.—This Journal (1893) page 184, col. 1, line 16 from bottom, erase the word "of" before "alcohol." Ibid., line 19 from bottom, for "1877" read "1887."

New Books.

Handbuch der Chemischen Technologie, von Dr. Ferdinand Fischer. (Zugleich **14**, völlig umgearbeitete Auflage von R. von Wagner's Handbuch der Chemischen Technologie.) Leipzig: Verlag von Otto Wigand, 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. M. 15. or 15*s.*

Large 8vo. volume in paper cover, containing Preface, Table of Contents, text covering 1140 pages, and the Alphabetical Index of Subject-Matter and Names. The pages of the work are illustrated with 716 engravings. The work actually represents the 14th edition of R. von Wagner's Handbook of Chemical Technology, and the author points out in his Preface that owing to the gigantic strides of chemical technology since the issue of the 13th edition, the work has been to him like one undertaken entirely *de novo.* The following Subjects are treated of in the text:—I. Technology of Fuel.—Fuel and its applications. Gasification and Combustion. Furnace arrangements. Illuminating Gas. Petroleum. Paraffin Oil Industry. Illumination. Electric Lighting. II. Metallurgy.—Generalities. Iron. Manganese. Cobalt. Nickel. Copper. Lead. Silver. Gold. Platinum. Zinc. Bismuth. Antimony. Arsenic. Mercury. Zinc. Cadmium. Sodium and Potassium. Aluminium. Magnesium. III. Chemical Industries.—Water and Ice. Sulphur. Bisulphide of Carbon. Sulphurous Acid. Sulphuric Acid. Ammonia and Ammonium Compounds. Sodium Chloride. Potash Salts. Soda. Chlorine, Chloride of Lime, and Chlorates. Bromine. Iodine. Nitric Acid and Nitrates. Phosphates and Manures. Phosphorus and Matches. Explosives. Boric Acid and Borax. Aluminium Compounds. Ultramarine. Tin, Arsenic, and Antimony Compounds. Gold, Silver, and Mercury Compounds. Copper Compounds. Zinc and Cadmium Compounds. Lead Compounds. Chromium Compounds. Manganese Compounds. Iron Compounds, including Ferrocyanides, &c. Oxygen, &c. Statistics. IV. Chemical Industries, Organic.—Alcohols and Ethers. Organic Acids. Coal-tar. Colours and Dyes. Coal-tar Medicaments, Alkaloids, &c. V. Glass, Earthenware, Cements, and Mortars. VI. Food Stuffs. VII. Textile Fibres. Including Dyeing and Calico Printing. VIII. Other Organic Chemical Branches. IX. Mechanical Engineering in Connection with the Chemical Factory.

Report on Mineral Industries in the United States at the Eleventh Census, 1890. David T. Day. (Department of the Interior.) Washington, D.C.: Government Printing Office. 1892.

Quarto volume, bound in black cloth and containing Table of Contents, List of Illustrations, Letters of Transmittal, Introduction of 16 pages, and Text covering 806 pages. The work closes with an Alphabetical Index of a most complete kind.

The text is illustrated with maps and engravings to the number of 56. In the Introduction is given the scope and general subject of the report, which consists actually of an investigation to show the position of the mineral industries, among the various forms of industrial activity in the United States. It shows the extent of these industries measured by the quantity and value of the minerals produced, by the amount of capital at stake in the various mining enterprises, and more especially by the extent to which they afford a means of livelihood to the people of the United States. Each branch of mineral industry is investigated and written upon by a special expert.

Iron Ores (John Birkinbine). Gold and Silver (R. P. Rothwell). Copper (C. Kirchhoff). Lead and Zinc (C. Kirchhoff). Mercury (J. B. Randol). Tin, Nickel and Cobalt, Aluminium (R. L. Packford). Manganese (J. D. Weeks). Chromic Iron Ore, Antimony (E. W. Parker). Platinum and Iridium, Coal (J. H. Jones). Petroleum (J. D. Weeks). Natural Gas (J. D. Weeks). Asphaltum (E. W. Parker). Ozokerite (E. W. Parker). Stones (W. C. Day). Precious Stones (G. F. Kunz). Phosphate Rock (E. Willis). Marl (J. Middleton). Gypsum (E. W. Parker). Infusorial Earth (E. W. Parker). Corundum (E. W. Parker). Millstones (E. W. Parker). Whetstones (E. W. Parker). Mica (L. J. Childs). Asbestos, Graphite, Soapstone, Barytes, Ochre and Metallic Paint, Fluorspar, Lithographic Stone, Sulphur, Pyrites (all by E. W. Parker). Mineral Waters (A. C. Peale).

Special schedules are given for the collection of statistics relating to mineral industries.

Our Secret Friends and Foes. By Percy F. Frankland, Ph.D., F.R.S. London: Society for Promoting Christian Knowledge, Northumberland Avenue, W.C. Brighton: 135, North Street. New York: E. and J. B. Young & Co. 1893. Price 2*s.* 6*d.*

Small 8vo. volume, bound in cloth, and forming an expansion of lectures delivered before popular audiences in London, Edinburgh, and elsewhere. It commences with a frontispiece, title-page, and dedication. Then follow the Preface, Contents, List of Illustrations, numbering 48, and subject-matter. The work concludes with a chart showing the number of colonies obtained from 1 cubic centimetre of water by gelatin-plate cultivation.

The object of this little book is clearly and concisely set forth in the Preface as being "A means of making the general reader more intimately acquainted with the recently-discovered world of life, commonly known as germs or micro-organisms, these daily attracting more and more public attention, as a knowledge of their remarkable powers for good and evil, becomes more widely diffused." The work is divided into six chapters, devoted as follows:—I. Introduction. II. Micro-organisms in Air. III. Micro-organisms in Water. IV. Useful Micro-organisms. V. Malignant Micro-organisms. VI. The Theory and Practice of Prevention in Disease.

Soap Manufacture. A Practical Treatise on the Fabrication of Hard and Soft Soaps, and Analytical Methods for the Determination of their Chemical Composition, together with a Short Account of the Materials employed. By W. Lawrence Gadd, F.I.C., F.C.S. London: George Bell and Sons, York Street, Covent Garden. 1893. 5*s.* And New York.

This little book is set forth as a practical treatise for teachers and students, to meet the requirements of the City and Guilds of London Institute Examinations. It is a small 8vo. volume, containing Preface, Table of Contents, List of Illustrations, numbering 33, and Text covering 218 pages. An Alphabetical Index closes the work.

The following branches are treated of in their respective chapters:—I. Introduction. II. Fatty Acids. III. Materials. IV. Water. V. Manufacture of Soap. VI. Stamping and Packing. VII. Special Soaps. VIII. Toilet Soaps. IX. Perfumes. X. Glycerin Recovery. XI. Analysis.

Mineral Resources of the United States. Calendar Years 1889 and 1890. David T. Day, Chief of Division of Mining Statistics and Technology. Washington: Government Printing Office. 1892. 50 cents.

Octavo volume, bound in black cloth, and containing Table of Contents, Introduction, Summary, Text covering 535 pages, and a most copious and exhaustive Index for the Reports of 1882, 1883-4, 1885, 1886, 1887, 1888, and 1889-90, extending from pages 537 to 651, and finally an Alphabetical Index of the present volume.

The matter treated of comprises the following subjects:—Iron; Gold and Silver; Copper; Lead; Zinc; Mercury; Aluminium; Tin; Nickel and Cobalt; Manganese; Chromic Iron Ore; Antimony; Platinum; Coal; Petroleum; Natural Gas; Stone; Pottery; Precious Stones; Fertilizers; Buhrstones; Corundum and Emery; Grindstones; Infusorial Earth; Oilstones, &c.; Cement; Gypsum; Fluorspar; Mica; Soapstone; Asphaltum; Salt; Bromine; Borax; Graphite; Mineral Paints; Barytes; Asbestos; Sulphur; Pyrites; Lithographic Stone; Mineral Waters.

Chemisch-technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1892. Erstes Halbjahr. Zweite Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder. Schönebergerstrasse 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

This issue forms the second for the first half-year of 1892, and contains pages 157 to 314, in which the following subjects or branches are treated of:—Foodstuffs; Paper; Photography; Residuals, Manures, Disinfectants, &c., Soaps. Explosives and Detonators. Preparation and Purification of Chemicals. Chemical Analysis, Apparatus, Machinery, Electrotechnology. Thermotechnology. Adulteration of Trade Products. New Books

Technisch-Chemisches Jahrbuch, 1891—1892. Ein Bericht über die Fortschritte auf dem Gebiete der Chemischen Technologie. Herausgegeben von Dr. Rudolf Biedermann. Vierzehnter Jahrgang. Mit 236 in der Text gedruckten Illustrationen. Berlin: Carl Hermann's Verlag. 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. M. 12, or, 12*s.*

This useful Year-book of Chemical Technology is now in its 14th year. It takes the form of a substantial 8vo volume bound in cloth, and containing, besides the Table of Contents and list of Journals utilised, subject-matter covering 542 pages, List of New Books on Physics, Chemistry, Chemical Technology and Mineralogy, Geology and Mining, covering 21 pages, and closing with Indexes of subject-matter and names of Authors. The text is illustrated with 236 engravings. Following the indexes and closing the work is a most useful register of all the patents taken out during the year, arranged under their appropriate headings and so paged that the abstracts to which they relate are easily found and turned up in the text.

The subjects treated of are:—I. The Alkali Metals, Magnesium and Aluminium. II. Gold and Silver. III. Copper. IV. Lead. V. Zinc. VI. Tin. VII. Nickel and Cobalt, Manganese, Chromium, and Platinum. VIII. Iron. IX. Chlorine and Hydrochloric Acid. X. Sulphuric Acid. XI. Hydrogen, Oxygen, Ozone, Nitric Acid. XII. Soda. XIII. Potash Salts. XIV. Ammonia. XV. Alkaline Earths. XVI. Glass. XVII. Earthenware. XVIII. Cement. XIX. Artificial Stone. XX. Explosives. XXI. Illuminants. XXII. Heating Materials. XXIII. Sugar. XXIV. Starch and Dextrin. XXV. Wine. XXVI. Beer. XXVII. Spirits. XXVIII. Fats, Soaps, &c. XXIX. Water. XXX. Foodstuffs. XXXI. Manures. XXXII. Tanning Materials. XXXIII. Organic Acids. XXXIV. Alkaloids. XXXV. Colouring Matters. XXXVI. Textiles, Dyeing and Printing. XXXVII. Paper. XXXVIII. Photography. XXXIX. Glue and other Adhesives. XL. Apparatus. XLI. Reviews of Books.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(*From the Board of Trade Journal.*)

Argentine Republic.

Under the new Customs law for 1893, the under-mentioned duties are applicable in respect of the following articles:—

Vegetable oils, 12 cents per kilogramme.

Patent medicines for sheep, 12·50 dols. per ton.

Stearine, 14 cents per kilogramme.

Wax matches, 80 cents per kilogramme.

Wooden matches, 40 cents per kilogramme.

Glycerine under 30 degrees, for native industries exclusively, 2 cents per kilogramme.

Colombia.

According to a law recently passed by the Colombian Congress—

All pharmaceutical specialities, including wines, gums, pills, pomades, elixirs, pastelles, &c., &c., and all patented medicines, are to pay double the rates levied hitherto.

United States.

Customs Decisions.

Manufactures of paper-pulp made in imitation of Lincrusta Walton wall-paper, having a burlap foundation with an embossed facing of paper-pulp saturated with an oleaginous substance, used as panelling for carriages and as wall-paper for large rooms, is dutiable at 35 per cent. under paragraph 461.

Merchandise known as "Tonka-bean crystals," a powder that falls from the Tonka bean in handling and transporting the beans, and contains largely the aromatic principle of the bean, is dutiable at 10 per cent. under section 4, new tariff.

Muriate of apomorphia is dutiable at 25 per cent. under paragraph 76, new tariff.

New South Wales.

Customs Tariff.

In the statement of the rates of Customs duty leviable in New South Wales, published at pp. 186–94 of the *Board of Trade Journal* for February, soda crystals are mentioned as being subject to a duty of 40*s.* per ton, and are also included in the list of articles which are exempted from duty. With reference to this article, a communication, dated the 24th February, has been received at the Board of Trade from the Agent-General for New South Wales to the effect that, on communication with his Government, he is informed that soda crystals are admitted to the colony free of duty.

Turkey.

The Entry of English Patent Medicines.

A communication, dated the 13th February, has been received at the Board of Trade from the Privy Council Office, transmitting copy of a letter from the Foreign Office (together with its enclosure) on the subject of the entry of English patent medicines into Turkey.

The Foreign Office letter contains a list communicated by a local chemist to Her Majesty's Ambassador at Constantinople, of English patent medicines, the entry of which into Turkey is alleged to have been prohibited since September 1891, on the ground that the contents of these medicines are not known to the Ottoman Customs.

It is stated that certain similar medicines from the United States are allowed to enter Turkey upon their contents being made known to the proper authorities through the United States Legation. It is suggested that the proprietors of any English proprietary medicines, by adopting a course similar to that pursued on behalf of United States medicines, might further the sale of their goods in Turkey.

The list in question may be seen by those interested at the Commercial Department, Board of Trade, Whitehall Gardens, London, S.W.

GENERAL TRADE NOTES.

The Camphor Trade of Formosa.

According to the United States Minister at Peking, the report of the Customs Commissioner at Tamsui (Mr. F. Hirth) for the year 1891, contains the statement of some interesting facts relating to the camphor trade in the island of Formosa.

There were exported from Formosa to Hong Kong in 1891 16,353 piculs of camphor (a picul is 133⅓ pounds avoirdupois), of which the value was 253,575 haikwan taels (the haikwan tael is worth 1·20 dols. in American gold). The total export was 16,760·96 piculs, valued at 259,871 haikwan taels. This is a large increase over former years. The product in 1890 was 100,833 piculs.

Unfortunately, one of the causes of this great production is the destruction of the camphor trees by the persons engaged in the trade. They are said to hew down the trees remorselessly. This extraordinary increase in the production of camphor is also alleged to be greatly due to the extensive use of the article in the manufacture of smokeless powder. Less expensive ingredients of this new invention have, it is said, been now discovered, but camphor is evidently still used in its manufacture.

Under new regulations the purchasers of camphor are not allowed to approach the stills for fear of injury from the savages; but four markets have been selected, viz., in Taipei, Tokoham, and Sakko-k'eng, and in Chung-lu, or middle district, Chipchipkoi and Tohchay, whither all produce is to be taken for sale. The provincial Government holds that the camphor forests, having been reclaimed by warfare from the savages and brought under cultivation at Government expense, are the property of the Crown. The Government might utilise these forests under its own administration. If it does not choose to do so, Chinese settlers must abide by the regulations made by the Government.

The Commissioner states that as long as Japan camphor is high Formosa can compete, but if the former is reduced in price the Formosa trade would cease, unless the tax were reduced. Formosa camphor cannot be refined to the proper hardness without adding Japan camphor. The cause of this peculiarity has not been discovered.

The great quantity of oil and moisture contained in the Formosa camphor keeps the prices 5 per cent. lower than those of the Japan gum.

Camphor is the chief ingredient of celluloid. As is well known, also, it is extensively used in the materia medica of Europe and America. It is to be hoped that the new regulations above mentioned will have a beneficial effect on the production of this important article.—*Board of Trade Journal.*

Economic Condition of Bolivia.

The *Moniteur des Intérêts Matériels* for the 23rd February publishes the following extracts bearing upon the subject of Bolivian industries, from a report presented to the National Congress by the Minister of Finance and Industry:—

The production of silver in Bolivia, instead of diminishing, is rapidly increasing; in 1890 it was about 1,200,000 marcs, and in 1891, 1,403,345 marcs, of which 792,279 marcs were produced by the Huanchaca Company of Bolivia, and 157,234 marcs by the Aullagas Company.

The price of copper varies from 43*l.* 10*s.* to 46*l.* 10*s.* per ton. Its production in 1890 was 45,993 quintals, and in 1891, 63,731 quintals.

Tin, the demand for which is daily increasing, owing to industrial competion, exceeds the anticipation of the miners, principally in the Oruro Department. More than 100,000 quintals are annually exported.

The working of bismuth, coal, sulphur, and other substances is still very limited, but the production of silver is rapidly increasing.

The rubber industry is in a flourishing condition in the northern department of Beni. In 1890 the production of india-rubber reached the figure of 382,087 kilos. and 490,937 kilos. in 1891, of which 269,466 kilos. correspond to the second half-year, and represent an official value of 179,556 bolivars and a Customs revenue of 17,800 bolivars. These figures refer only to the Custom-house of Villa-Bella, and only represent therefore a portion of the working. The immensity of these territories makes supervision impossible and facilitates smuggling, which is carried on with impunity. Measures have recently been proposed with the object of putting a stop to these fraudulent practices.

Manufacture of Paper from Sugar-Cane.

It is stated to be a well-established fact that the stalks of the sugar-cane can be utilised for making paper of the best quality, and the *Journal de la Chambre de Commerce de Constantinople* expresses astonishment that at the present time, in face of the very large production of sugar, which results in the constant depreciation in value of this product, and *per contra* of the increasing use of paper, this industry has not yet been put to practical purpose, which would enable the sugar-planters to get a better return from their plantations.

The fibres of the sugar-cane give a paper of superior quality, and the mechanical or chemical manipulation required in this industry is of the simplest. In fact, the sugar contained in the stalks aids towards removing the silicates.

It is stated that a citizen of New Orleans, Mr. Walter P. Forbes by name, is exhibiting in that town a dozen samples of white paper made from the sugar-cane, of remarkable beauty. The best quality of this paper costs less than 1*d.* per pound.

Now estimating that 1,100,000 lb. of sugar-cane produce 22,000 lb. of paper at rather less than 1*d.* per lb., it is seen that a surplus value of nearly 100*l.* is to be drawn from the sugar-cane.

Discovery of a New Mineral in Colombia.

The *Journal des Mines* for the 2nd February announces that a new mineral, the properties of which bear some resemblance to those of asbestos, has recently been discovered in the form of immense deposits in Colombia.

The mineral in question is amber-coloured, it is transparent and non-combustible.

Experiments have been carried out at Bogota, which tend to prove that the new substance can be used in the manufacture of bank notes.

The Future of Platinum.

The fact that one of the great electric light companies has introduced a lamp that contains no platinum, the use of which has been heretofore considered indispensable, makes pertinent the query: What will be the future of this metal?

Since the introduction of the incandescent electric lamp in 1880, the consumption of platinum, not only in the United States, but also in Europe, has increased rapidly, although improvements made from time to time have greatly reduced the amount used in each lamp. In 1886–7 the Edison 16-C.P. lamp contained one grain, and the Sawyer-Mann lamp two grains; at present the Edison lamp contains but one-seventh of a grain, and the new Sawyer-Mann lamp none at all. In England the Edison-Berliner lamp, and in Germany the Siemens-Halske lamp, have likewise had the amount of platinum reduced to a minimum, owing, as in this country, to the use of a shorter wire of a smaller diameter. Notwithstanding this, however, the gross amount of platinum used in this country and Europe in the manufacture of electric lamps has steadily increased from nothing in 1880 to about 55,000 oz. in 1892. If the new Sawyer-Mann lamp should prove to be a success, of which, however, there is yet no proof, it might eventually replace all the other kinds of lamps now in use, and consequently this particular demand for platinum would cease.

On the other hand, however, it is to be observed that all the manufacturers of incandescent lamps have large plants already established, and that the amount of platinum used per lamp has been reduced to a minimum, so much so that its value forms less than 5 per cent. of the value of the lamp. Consequently it is quite probable that platinum will continue to be used in electric lamps, and that the amount so used will continue to increase with the growth of the industry.

There are, moreover, two other uses for platinum, which are even more important than its use in electric lighting, namely, the construction of stills for the concentration of sulphuric acid and the wires by which artificial teeth are firmly fastened to a plate. The amount used for stills varies widely from year to year, being greatly dependent upon the number of new plants started each year, but it has been estimated that the average amount so used during the last few years is about 80,000 oz. The manufacture of sulphuric acid is bound to increase, and although glass concentrating vessels are now being used to some extent, it is believed that this industry will continue to supply a constantly increasing demand for platinum.

For dental purposes platinum will always continue to be used, being the only metal which possesses the required properties of infusibility, ductility, and strength. In the United States 35,000 oz. and in England 25,000 oz. are annually used in this industry, and this amount will probably increase at the rate of 2 or 3 per cent. per annum.

The other uses of platinum, such as chemists' crucibles, jewellery, plating, &c., consume about 20,000 oz. annually, making the entire consumption about 215,000 oz. or 6,680 kilos. Of this amount from 30 to 40 per cent. is old or scrap platinum, which leaves from 4,000 to 4,676 kilos. to be annually supplied by the mines.

For many years the Siberian Urals have supplied the greater part (92 per cent.) of all the platinum used in the world, but it is questionable whether its output can be maintained at its present high level for many years. According to the official statistics of the Russian Department of Mines, the output of platinum in that country reached its maximum, 4,400 kilos., in 1887, following which it dropped to 2,700 kilos., and so remained until 1891, when, owing to the abnormally high price of the metal, the production amounted to 4,226 kilos. Many of the old placers are now worked out, and it is believed that the above figure represents the maximum possible output of the country. If, then, the demand should continue to increase, as seems possible, it will be necessary to look for other supplies of the metal. Next to Russia the most important sources of platinum, so far as is known, are Colombia, British Columbia, and the United States.

At present Colombia produces but 125 kilos. of platinum per annum, entirely the result of native washing. The platiniferous area, although of low grade, is, however, quite extensive, and in part suitable for hydraulic mining. A considerable amount of American capital has already been invested there, and it is quite probable that Colombia will become an important producer of the metal. The only platinum deposits of importance in British Columbia are found on the Talameen River. Recently a company has been formed to hydraulic these gravels, but so far the output has been small. The total production of British Columbia is about 65 kilos.

In the United States much prospecting has been done to find platinum in paying quantities, but so far without success, and up to the present time all the platinum produced has been incidental to the production of gold from various auriferous gravels in California and Oregon. If the laws prohibiting hydraulic mining in California should be repealed, that State may become a more important producer of platinum.—*Engineering and Mining Journal.*

PETROLEUM IN THE ARGENTINE REPUBLIC.

At Cachenta, in the province of Mendoza, in the Argentine, a considerable petroleum industry has sprung up during the last two years. In this district there is a promise of great mineral wealth, but as yet it has been worked only in a desultory manner. There seems to be a future before the petroleum industry. Up to the present time three successful borings have been made, and the total output since the first boring in April 1890 has been 1,500 tons. The oil is conducted through pipes to the storage tanks at San Vincente. It finds a ready sale at the Rio Cuarto and Mendoza gasworks, and at the Argentine Great Western Railroad. This railroad has 12 locomotives which use the oil as fuel.—*Ibid.*

SOAP-MAKING IN MEXICO.

A writer in the *Seifenfabrikant*, who has lived many years in Mexico, states that the soaps known as "toilet-soaps" in Europe scarcely exist in the Mexican market. What little of this kind of soap is imported is either French glycerine soap or soap-powder. In order to sell well soap must not smell of cocoanut oil, which, in the popular estimation, causes the hair to fall out. Before purchasing a cake of soap, the average Mexican will both smell and taste it. The operation of smelling has for its object to convince the would-be buyer that the soap contains plenty of grease, and he tastes it so as to make sure that it does not "bite the tongue." Most of the soap consumed in the country is produced by the great hog breeders, of whom there are a large number in Mexico. The hogs are killed simply for their lard, or "manteca," which is the common substitute for butter in the country. The residue of the lard is boiled, and forms the "manteca jabon" or common soap, with which the imported article has not hitherto been able to compete. The oil-plants which abound in the country, are not used for the purposes of obtaining soap-stock, and the mutton and goat tallow, of which vast quantities are produced, is made into candles, mostly for use in mining operations.—*Chemist and Druggist.*

MANUFACTURE OF PAPER IN CHINA.

A Chinese syndicate has established a paper factory at Hong Kong with European machinery, business at which was begun at the commencement of last year. From a minute description of the machinery and the manufacture, the factory appears to have been established on most modern principles for converting rags and rice straw into paper, and it is further stated that the manufactured article finds very great favour in the country, and that there is every probability that within a short time the factory will be fully occupied.—*Chamber of Commerce Journal.*

GLASS PRINTING TYPE.

The French journals speak of a new kind of type made of glass, which is stated to "remain clean for ever." It is said to resist wear and tear better than metal type, and that it can be cast with such sharp outlines as to produce very distinct impressions with great ease. The Journal *La Patrie* of Paris is now being printed with it.—*Ibid.*

THE DRUG-TRADE IN JAPAN.

The importation of mineral waters in Japan is threatened with extinction in consequence of the competition of local waters, which are sold at somewhat lower rates than the foreign article. The largest of the Japanese springs is the Hirano spring, situated in the neighbourhood of Kobe. During last year the exportation of Japanese anise (from *Illicium religiosum*) to China has increased very largely. It is said to be used for admixture with the true Chinese star-anise. The exports of camphor from the island Kiu-Siu are constantly on the decline owing to the want of re-afforestation of the camphor-trees. The shipments from Nagasaki in 1891 amounted to 417,086 catties. Among the exports of "Japanese drugs" from Nagasaki in the same year we also observe 44,896 catties of cubebs.—*Chemist and Druggist.*

TARTARIC ACID MANUFACTURE IN MARSEILLES.

In 1891 the manufacture of tartaric acid in Marseilles amounted to 650 tons. This is a very considerable increase upon former years, and was caused by the establishment of large factories in the city.—*Ibid.*

SALE OF FOOD AND DRUGS ACT AMENDMENT BILL.

The following is the text of this Bill. It is backed by Dr. Cameron, Mr. Channing, Dr. Farquharson, Mr. Frye, and Mr. Kearley. It was read a first time on February 17, and is down for second reading on May 24:—

A Bill to amend the Sale of Food and Drugs Act, 1875, and the Margarine Act, 1887.

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. The provisions of the Sale of Food and Drugs Act, 1875, and of any Act amending the same, shall apply to and include every wholesale trader or manufacturer of any article of food or drug who shall sell, to the prejudice of the purchaser, any article of food or drug which is not of the nature, substance, and quality of the article demanded by such purchaser; and the seventeenth section of the said Act shall be read as if the words "whether by wholesale or" were inserted between the words "on sale" and the words "by retail" in the said section.

2. The twenty-fifth section of the said Act shall be, and is hereby amended by the deletion of the word "written" before the words "warranty to that effect," and every wholesale trader or manufacturer of any article of food or drug, or other person who in the course of trade shall sell to any person any article of food or drug, with intent that the same may be resold by retail in the state in which it is purchased from him, shall, unless he has in writing informed the purchaser to the contrary, be deemed, for the purposes of the said Act, to have given a warranty to the person purchasing from him that such article of food or drug is of the nature, substance, and quality demanded by such purchaser.

3. In any proceedings under the principal Act having reference to the sale of "margarine" as defined by the Margarine Act, 1887, it shall be a good defence to prove that the sale was made in conformity with the regulations of the said Margarine Act, 1887, and in the case of proceedings in Scotland under the said Margarine Act, the thirty-third section of the Food and Drugs Act, 1875, shall be held to be added to the sections 12 to 28 inclusive incorporated in section 12 of that Act.

4. In determining whether an offence has been committed under section 6 of the principal Act, by selling to the prejudice of the purchaser coffee not adulterated otherwise than by the admixture of chicory, it shall be a good defence to prove that the seller delivered with or on such mixture a notice by a label distinctly and legibly written or printed, in the form given in the schedule to this Act, stating the proportions of coffee and chicory contained in such mixture.

5. Whereas it is desirable to interpret the law as to the proportion of water in butter which shall be deemed as constituting an offence in proceedings under the principal Act: be it enacted that the sale of butter containing more than   per centum by weight of water sold as butter shall be deemed to constitute a sale to the prejudice of the purchaser, unless such excess of water is intimated by the seller at the time of sale, and the onus of proving such intimation shall lie with the said seller.

6. This Act shall be read and construed with the Sale of Food and Drugs Act, 1875, and any Act amending the same,

7. This Act may be cited for any purposes as the Sale of Food and Drugs Act, 1875, Amendment Act, 1893.

SCHEDULE.

Coffee-Mixture containing—

Coffee………… four-fifths } or { three-fourths } or
Chicory……… one-fifth } { one-fourth }
{ one-half } or { one-fourth
{ one-half } { three-fourths

And so on, as the case may be, specifying in equal parts on each label the respective proportions of coffee and chicory contained in the mixture sold.—*Ibid.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

—	Month ending 28th February	
	1892.	1893.
	£	£
Metals……………………………	1,752,223	1,682,538
Chemicals and dyestuffs…………	866,634	754,160
Oils……………………………	592,953	615,841
Raw materials for non-textile industries.	2,488,456	2,099,446
Total value of all imports….	34,877,931	29,758,748

SUMMARY OF EXPORTS.

—	Month ending 28th February	
	1892.	1893.
	£	£
Metals (other than machinery) ….	2,629,389	2,301,823
Chemicals and medicines ……….	701,022	735,736
Miscellaneous articles……………	2,439,194	2,256,704
Total value of all exports…..	19,328,753	17,093,309

IMPORTS OF METALS FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
Copper:—			£	£
Ore………… Tons	5,738	2,114	28,510	13,372
Regulus……… „	8,243	7,560	218,950	189,778
Unwrought …. „	2,630	3,547	123,979	169,463
Iron:—				
Ore………… „	386,277	372,711	278,187	264,419
Bolt, bar, &c.… „	4,045	1,226	36,526	10,107
Steel, unwrought.. „	388	162	4,138	2,125
Lead, pig and sheet „	14,630	12,666	158,410	126,625
Pyrites………… „	59,194	47,048	104,812	80,881
Quicksilver……. Lb.	417,905	947,515	39,158	80,662
Silver ore……. Value £	..	..	281,715	214,723
Tin…………… Cwt.	58,644	67,029	263,824	307,535
Zinc………… Tons	3,475	3,820	73,023	70,104
Other articles …Value £	..	..	141,391	152,744
Total value of metals	..	..	1,752,223	1,682,538

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali………… Cwt.	2,937	4,209	2,654	3,844
Bark (tanners, &c.) „	40,766	14,556	16,776	5,309
Brimstone……… „	38,073	62,736	11,105	15,031
Chemicals…… Value £	..	..	134,951	102,450
Cochineal ……… Cwt.	256	250	2,080	1,471
Cutch and gambier Tons	3,216	1,162	77,361	25,968
Dyes:—				
Aniline……. Value £	..	..	16,735	11,628
Alizarine….. „	..	..	26,939	20,456
Other ……… „	..	..	258	2,050
Indigo ……….. Cwt.	16,450	17,168	332,347	368,064
Nitrate of potash . „	30,253	23,050	25,772	24,065
Valonia……….. Tons	4,326	4,133	63,223	55,214
Other articles… Value £	..	..	156,383	118,610
Total value of chemicals	..	..	866,634	754,160

IMPORTS OF OILS FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut .... Cwt.	12,487	12,709	14,125	16,152
Olive .... Tuns	2,118	2,122	77,747	80,283
Palm .... Cwt.	77,626	80,640	90,004	108,345
Petroleum .... Gall.	10,450,723	13,760,479	196,212	231,436
Seed .... Tons	1,978	2,301	52,967	58,915
Train, &c. .... Tuns	1,134	991	24,670	19,385
Turpentine .... Cwt.	45,780	31,144	58,002	36,685
Other articles .. Value £	..	..	79,226	64,640
Total value of oils ...	..	..	592,953	615,847

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	12,717	17,042	28,541	34,294
Bristles .... Lb.	176,369	192,789	23,059	22,770
Caoutchouc ...... Cwt.	31,531	19,385	375,265	228,302
Gum :—				
Arabic .... „	6,335	4,728	20,813	12,759
Lac, &c. .... „	8,122	12,592	32,498	58,301
Gutta-percha .... „	3,816	2,666	47,591	25,739
Hides, raw :—				
Dry .... „	31,374	26,037	80,647	64,672
Wet .... „	34,304	29,744	71,346	64,080
Ivory .... „	530	498	27,734	24,529
Manure :—				
Guano .... Tons	4,081	983	29,526	7,205
Bones .... „	7,542	5,117	33,707	22,931
Nitrate of soda . „	7,994	5,703	75,199	51,498
Phosphate of lime „	16,473	33,096	36,722	60,588
Paraffin .... Cwt.	41,603	50,727	60,128	53,497
Linen rags .... Tons	2,448	2,438	23,725	27,020
Esparto .... „	24,817	14,522	117,634	68,753
Pulp of wood .... „	17,578	11,037	77,834	54,860
Rosin .... Cwt.	210,430	136,166	41,360	25,440
Tallow and stearin „	101,495	56,219	133,121	82,282
Tar .... Barrels	2,338	708	1,591	317
Wood :—				
Hewn .... Loads	126,947	93,240	214,898	161,179
Sawn .... „	78,551	37,944	203,443	108,541
Staves .... „	5,666	2,612	35,868	13,331
Mahogany ..... Tons	5,531	5,119	50,567	44,745
Other articles .... Value £	..	..	645,639	781,813
Total value	..	..	2,488,456	2,099,446

Besides the above, drugs to the value of 73,934*l.* were imported, as against 85,414*l.* in February 1892.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass .... Cwt.	8,827	7,055	39,295	31,147
Copper :—				
Unwrought ..... „	78,539	37,116	188,545	91,014
Wrought .... „	33,778	21,873	101,628	65,471
Mixed metal .... „	29,615	24,749	75,361	69,496
Hardware ..... Value £	..	..	180,074	156,430
Implements .... „	..	..	98,516	89,141
Iron and steel ..... Tons	184,310	191,223	1,694,132	1,554,251
Lead .... „	4,257	2,274	55,847	27,622
Plated wares ... Value £	..	..	23,712	17,228
Telegraph wires „	..	..	31,006	97,496
Tin .... Cwt.	8,414	8,761	39,719	41,787
Zinc .... „	14,920	16,670	14,887	14,017
Other articles .. Value £	..	..	86,667	61 783
Total value	..	..	2,629,389	2,307,823

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 28TH FEBRUARY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder ...... Lb.	460,100	449,300	11,372	11,547
Military stores .. Value £	..	..	62,099	85,362
Candles .... Lb.	1,553,200	1,708,800	30,043	30,480
Caoutchouc ..... Value £	..	..	98,087	92,362
Cement .... Tons	39,780	27,155	76,225	46,988
Products of coal Value £	..	..	130,805	93,398
Earthenware ... „	..	..	157,824	153,563
Stoneware ...... „	..	..	14,331	13,135
Glass :—				
Plate .... Sq. Ft.	242,951	137,749	12,800	6,017
Flint .... Cwt.	8,249	6,085	17,511	14,607
Bottles .... „	61,282	48,310	28,948	22,071
Other kinds .... „	13,322	15,517	10,757	13,694
Leather :—				
Unwrought .... „	11,006	12,216	100,799	121,082
Wrought ..... Value £	..	..	24,904	22,410
Seed oil .... Tons	6,435	5,041	128,121	108,020
Floorcloth ..... Sq. Yds.	1,869,400	1,547,600	74,846	64,279
Painters' materials Val. £	..	..	123,774	110,263
Paper .... Cwt.	83,731	61,484	142,812	111,916
Rags .... Tons	4,658	5,510	33,953	42,291
Soap .... Cwt.	43,590	39,315	48,182	44,736
Total value	..	..	2,439,194	2,256,704

Exports of Drugs and Chemicals for Month ending 28th February.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	420,176	492,928	152,855	164,684
Bleaching materials „	116,384	112,496	46,972	46,576
Chemical manures. Tons	27,620	33,426	202,469	222,307
Medicines....... Value£	..	..	83,600	71,607
Other articles ... „	..	..	215,126	230,562
Total value	..	..	701,022	735,736

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

3170. J. A. Morrell and J. Fromherz. Improvements in apparatus applicable for evaporating liquids or saccharine solutions. Complete Specification. February 13.

3224. A. C. Thomson. *See* Class III.

3337. D. B. Morison. Improvements in and relating to apparatus for evaporating liquids by means of steam. February 15.

3471. J. R. Quain. Improvements relating to the production of cold, and to apparatus therefor. February 16.

3507. G. C. Douglas. From W. Don and T. Watson, India. Improved non-conducting composition for retarding the radiation of heat from boilers, pipes, cylinders, or other heating apparatus. February 17.

3606. G. A. J. Schott. Improvements in apparatus for filtering oil and other liquids. February 18.

3862. A. Stein. Improvements in kilns and furnaces. Complete Specification. February 21.

3996. J. Bradbury. Improvements in apparatus and furnaces for concentrating sulphuric acid and other liquids. February 23.

4076. J. J. Meldrum and T. F. Meldrum. Improvements in or connected with gas producers. February 24.

4112. E. L. Pease. An improvement in the construction of gas washers and ammonia stills. February 24.

4200. W. P. Thompson. Improvements in separating gases of different specific gravities, and in apparatus therefor. February 25.

4218. J. A. Henderson. Improved compositions for preventing the radiation or transmission of heat. Complete Specification. February 25.

4245. A. Shiels. Improvements connected with refrigerating apparatus. February 27.

4421. G. W. Elliott. Improvements in centrifugal hydro-extractors. March 1.

4528. J. M. Smales. Apparatus for removing deposit from filtering material. March 2.

4563. A. Atkinson and A. G. Barrett. An improvement in the construction of lime kilns or furnaces for the better and more economical burning, roasting, or calcining of limestone or other minerals. March 2.

4568. B. F. Wickens. A new and improved dehydrator. March 2.

4669. C. A. Chappell. Improvements in and relating to evaporating apparatus for obtaining salt. March 3.

4852. W. E. Dennis. Improvements in and connected with condensers. Complete Specification. March 6.

Complete Specifications Accepted.*

1892.

2908. H. Salmon. Acid condenser and smoke arrester, the object of which is to clear the atmosphere. February 22.

6535. W. Birch. Improved means and apparatus for separating solid or semi-solid substances from sludge or other fluid or semi-fluid matters. March 15.

7923. W. Foulis. Apparatus for regulating the flow and pressure of gas. March 15.

1893.

145. J. Y. Johnson.—From A. Bornholdt and J. Glatz. Apparatus for separating, by means of highly compressed air, fluid from solid substances, or lighter from heavier particles of liquid bodies. February 22.

187. B. Redwood, F. Clowes, and S. Waters. Detection and estimation of combustible gas or vapour present in air, and apparatus for that purpose. February 22.

2665. R. Dietrich. Regenerative furnaces. March 15.

II.—FUEL, GAS, AND LIGHT.

Applications.

3159. G. T. Beilby. The manufacture of cyanides. February 13.

3298. T. Price and T. S. Payne. Improvements in the manufacture of artificial fuel. February 14.

3316. O. J. Steinhart. Improvements in the production of cyanides. February 14.

3445. J. Bond. A method for the removal of sulphur compounds other than sulphuretted hydrogen from coal-gas. February 16.

3554. T. A. Dillon. An improved method of preparing peat for heating, gas generating, and other purposes. February 17.

3815. J. R. Paisley. An improvement in apparatus for the manufacture of water-gas. February 21.

3863. J. Hull. Improvements in fire-lighters. February 21.

4022. F. Siemens. A process and apparatus for converting hydrocarbons into combustible gas. February 23.

4037. H. Aitken. Improvements in and apparatus for obtaining cyanogen, cyanides, and other products from carbonaceous matter, or substances containing ammonia or nitrogen, or compounds thereof. February 23.

4205. A. J. Boult.—From F. J. Collin, Germany. Improvements in or relating to coke-ovens. Complete Specification. February 25.

4225. W. G. Bedford. Improvements relating to the generation of gas from water, steam, and the like, and to apparatus therefor. Complete Specification. February 25.

4331. D. France. Improvements in means for consuming smoke and economising fuel. February 28.

4475. F. Brunck. Improvements in horizontal coke-ovens. March 1.

4510. F. W. Clark and A. Forbes. Improvements relating to the distillation and breaking up of liquid hydrocarbons and similar substances, and to apparatus therefor. March 1.

4843. T. Macneil. Improved manufacture of artificial fuel. March 6.

4986. W. S. Simpson. Means and apparatus in connection with the conversion of air into ozone. March 7.

5199. J. Hargreaves. Improvements in gas producers. March 10.

Complete Specifications Accepted.

1891.

21,598. V. B. Lewes. Manufacture or production of carburetted hydrogen for illuminating purposes, and apparatus therefor. March 15.

1892.

3619. T. Zohrab. Method of and apparatus for the treatment of peat and the conversion of peat into charcoal. March 1.

4411. J. H. Parkinson. Separation of oxygen, nitrogen, and other mechanically mixed fluids, and obtainment thereof. March 15.

6062. W. Belton, G. E. Davis, and A. R. Davis. Purification of coal-gas and obtaining products therefrom. March 8.

6909. H. Collet and M. Merichenski. Improvements in carburettors. March 8.

7614. G. Heslop. *See* Class VII.

14,383. C. H. Ridsdale. Treatment or solidification of mineral oils and other liquid hydrocarbons. March 8.

18,521. H. H. Lake. — From T. G. B. de Ferrari. Apparatus for burning petroleum, naphtha, and other liquid fuels in steam-boiler furnaces. March 1.

23,498. H. H. Lake.—From A. Kimber. Improvements relating to the generation of gas, and apparatus therefor. March 1.

1893.

555. W. P. Watson. Process of manufacturing gas. March 1.

658. J. Morley. Composition for fire-lighters. March 1

874. J. Webster. Method of and apparatus for charging gas retorts. March 1.

1269. W. P. Gibbons and R. Masters. Certain improvements in the setting of gas retorts. March 1.

2590. T. S. K. Hawxhurst. A composition suitable for use in the manufacture of candles, night lights, and the like. March 15.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

3224. A. C. Thomson. An improvement in retorts used for the destructive distillation of carbonaceous substances for the production of mineral oil and ammonia. February 14.

4097. J. A. Wanklyn and W. J. Cooper. Improvements in the distillation of petroleum. February 24.

5284. J. Y. Johnson.—F. von Heyden, Germany. Improvements in the manufacture of guaiacol. March 11.

IV.—COLOURING MATTERS and DYES.

Applications.

3395. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of leuco compounds and colouring matters therefrom. February 15.

3487. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new acid colouring matters. February 16.

3495. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of alkylated sulpho-acids and colouring matters therefrom. February 16.

3737. C. D. Abel.—From Kern, Sandoz, and Co., Switzerland. Manufacture of colouring matters capable of dyeing cotton direct. Complete Specification. February 20.

10,138*a*. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements relating to the manufacture of a new class of basic dyestuffs or colouring matters, and of materials and intermediate products relating thereto. Filed February 27. Date claimed May 27, 1892.

10,138*b*. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements relating to the manufacture of sulpho-acids of a new class of basic dyestuffs or colouring matters, and of materials and intermediate products relating thereto. Filed February 27. Date claimed May 27, 1892.

10,138c. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements relating to the manufacture of a new class of basic dyestuffs or colouring matters, and of sulpho-acids thereof, and of materials and intermediate products relating thereto. Filed February 27. Date claimed May 27, 1892.

4276. R. Varley. A new or improved combination of ingredients for dyeing cotton, wool, silk, or other fibrous substances or materials. February 27.

4287. H. H. Lake.—From Kalle and Co., Germany. Improvements in the manufacture of indigo. February 27.

4612. S. Pitt.—From L. Cassella and Co., Germany. The production on the fibre by the aid of *p*-amido-diphenylamine of dyestuffs fast to light and washing. March 2.

4613. S. Pitt.—From L. Cassella and Co., Germany. Improvements in the production of diamidonaphthalene sulpho-acid and amidonaphthol sulpho-acid, and colouring matters therefrom. March 2.

4979. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture and production of sulpho-acids of the naphthalene series, and of colouring matters obtainable therefrom. March 7.

5039. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improved manufacture of colouring matters. March 8.

5141. S. Pitt.—From L. Cassella and Co., Germany. Improvement in the production of disazo dyestuffs from γ-amidonaphthol sulpho-acid. March 9.

5265. S. Pitt.—From The Chemischè Fabrik auf Actien vorm. E. Schering, Germany. Improvements in the preparation of piperazine. March 10.

5316. J. Hickisson. Improvements in the manufacture of coloured marking inks and marking ink pencils. March 11.

5320. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of piperazine and its salts. March 11.

Complete Specifications Accepted.

1892.

5815. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Production of fast colours on fibre for printing and dyeing purposes. March 8.

7298. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of dyestuffs. March 1.

7337. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of colouring matters and new materials therefor. March 1.

7337*a*. B. Willcox.—From the Farbenfabriken vormals F. Bayer and Co. Manufacture of alkylated naphthylamine sulpho-acids. March 1.

8269. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Bruning, Germany. Manufacture of di-alkylised meta-methoxy, meta-ethoxy, and meta-benzyloxy-paramido benzophenones. March 15.

8455. J. Y. Johnson.—From F. von Heyden. Manufacture of α-oxyuvitic acid. March 15.

8456. J. Y. Johnson.—From F. von Heyden. Manufacture of colouring matter from α-oxyuvitic acid. March 15.

8634. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of triphenylmethane dyestuffs. March 1.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

3179. H. Whitehead. Improvements in filling, finishing, stiffening, or dressing cotton, woollen, and other textile fabrics. February 13.

3506. A. Gruschwitz. An improved process for retting, cleansing, and deoxydising textile fibres. Complete Specification. February 17.

Complete Specification Accepted.

1893.

2989. A. Torngren. Improvements in treating bast and wood for obtaining therefrom fibre suitable for being spun or woven. March 15.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

3186. A. G. Brookes.—From The Arnold Print Works, United States. Improvements in the process of producing and fixing coloured figures in cotton material, in conjunction with grounds of contrasting colour. Complete Specification. February 13.

3380. G. A. Fyson. Improvements in means employed in the dyeing or colouring of straw plait, chip, and like material. February 15.

3660. H. Ashwell. Improvements in or relating to vats or like vessels for dyeing or treating textile fabrics or garments. February 18.

3704. R. Pickup. The production of coloured patterns upon aniline black and other coloured grounds in calico printing. February 20.

4067. E. Brook. Improvements in or connected with machines for dyeing, scouring, or drying hanks of yarn or tops. February 24.

4417. J. Bromley. Improvements in machinery for bronzing, colouring, and similarly ornamenting paper or other material in sheets or continuous rolls. Complete Specification. February 28.

4437. C. Owens and J. Whiteley. Improvements in machines for washing, bleaching, mordanting, dyeing cotton, wool, or other fibres in a raw, spun, or manufactured state. March 1.

4512. S. Pitt.—From L. Cassella and Co., Germany. *See* Class IV.

Complete Specifications Accepted.

1892.

4823. C. J. E. de Haen. Improvements in or relating to the bleaching of vegetable and animal fibres or other organic substances. March 15.

7339. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Production of fast colours on fibres. March 8.

10,381. H. H. Lake.—From C. Castellani. An improved chemical preparation to be used for washing, scouring, fulling, bleaching, boiling, and other purposes. March 8.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

3349. W. Edge, K. Edge, and J. Edge. A new or improved method of packing and sealing up deliquescent salts and other powders or substances containing volatile matters, also liquids, semi-liquids, and pastes, in such manner as makes them impervious to air and moisture, and which prevents the escape of volatile matter. February 15.

3800. M. N. d'Andria. Improvements in the recovery of hydrochloric acid and oxide of manganese from solutions of manganese chloride. February 21.

3996. J. Bradbury. *See* Class I.

4310. A. Gray. *See* Class X.

4342. M. N. d'Andria. *See* Class XIII.

4920. T. Parker and A. E. Robinson. Improvements in the utilisation of chlorides of sodium and potassium for the obtainment of useful products. March 7.

Complete Specifications Accepted.

1892.

7393. F. Hurter. Manufacture of bleaching powder, and apparatus to be employed therein. March 8.

7614. G. Heslop. The application of a by-product of the manufacture of acetates for warming and heating purposes. February 22.

7958. H. Precht. A process for the production of phosphates of potassium or aluminium soluble in water. March 1.

13,822. H. W. Wallis. Manufacture of chlorine. March 1.

1893.

1298. P. Buisine. Manufacture of ferric chloride. March 1.

2148. J. Heibling. Manufacture of potash, alum, and alumina. March 8.

VIII.—GLASS, POTTERY, and EARTHENWARE.

Applications.

3844. T. R. Jones. Hardening china and other clays by a chemical process. February 21.

4385. H. Hilde. Improved method and machinery for blowing and casting articles of glass. February 28.

4542. W. W. Pilkington. Improved system of and means for making hollow articles in blown glass. March 2.

4789. E. R. Corn. Improved combination of appliances for use in supporting pottery ware whilst being fired. March 6.

Complete Specifications Accepted.

1892.

4545. H. H. Pitt. Improvements in the process of the manufacture of pressed glass articles, and in apparatus therefor. March 15.

8865. V. B. Lewes. Manufacture of glass. March 15.

24,602. C. Werfel. Manufacture of composition for the production of ceramic fancy ware. March 15.

1893.

2033. F. Welz. Process or mode of making glass having an orange-yellow colour when the light passes through it, and a greenish colour when the light falls upon it. March 15.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

3338. C. George. Improvements in the manufacture of artificial stone and apparatus in connection therewith. Complete Specification. February 15.

3356. A. A. Hely. Certain improvements in the preservation of wood. February 15.

3429. P. J. Jackson. Improvements in or relating to paving for streets, floors, and the like. Complete Specification. February 16.

3995. A. McAra. Improvements in the manufacture of Portland cement. February 23.

4155. J. S. Gibson and S. B. Russell. An improved form of fireproof floors and ceilings. February 25.

4259. T. Potter. Improvements in the construction of fire-resisting floors. February 27.

4550. J. C. Richardson. Improvements in or relating to the utilisation of slate waste for various manufactures. March 2.

4588. S. McDougall and R. Parry. Improvements in or relating to street pavements, floors, platforms, steps, or the like. March 2.

4737. L. Nathan. Improvements in the manufacture of artificial marble. March 4.

4825. E. Nelson. Improvements relating to damp course materials used in the foundations of buildings. Complete Specification. March 6.

4987. H. B. Sheridan. Improvements in the manufacture of metallic paving for roadways, footpaths, covers for streets, and the like. Complete Specification. March 7.

5132. J. Hill. Improvements in the utilisation in the manufacture of Portland cement of precipitated carbonate of lime, forming waste products from chemical works, and in apparatus for employment therein, and otherwise in the reduction or disintegration of clays. March 9.

5315. G. L. Falconar. Improvements in the manufacture or production of blocks or slabs for use for flooring, paving, or in step, staircase, or wall construction, and for analogous purposes. March 11.

Complete Specifications Accepted.

1892.

4131. J. T. Knowles.—From The Actien Gesellschaft "Cimbra." A process for the treatment of raw materials to be used in the production of Portland cement. March 8.

7270. R. Huppertsberg. Manufacture of artificial bituminous stone. March 15.

8460. W. W. Hewitt and A. Suart. Compounds for paving or covering roads, paths, or floors, and for manufacture of paving bricks or blocks. March 15.

8777. T. W. Brittain. Improvements in apparatus for grinding cement or other substances. March 15.

1893.

249. M. Fawcett, B. A. Elphicke, and J. Hope. Construction of fireproof floors. March 8.

354. F. A. Beny. Improvements in bricks or blocks for building purposes. February 22.

X.—METALLURGY, MINING, Etc.

Applications.

3171. H. D. Hibbard. Improvements in apparatus for casting pig iron. Complete Specification. February 13.

3345. G. B. Ellis. Improvements in the manufacture or treatment of iron and steel, more especially intended for the manufacture or treatment of armour plates and projectiles. February 15.

3583. F. Elie de Fursac, J. C. Moisset, and J. P. J. Véry. Processes of separating metals, covering scraps, clippings, or other pieces of metal of all kinds. Filed February 17. Date applied for 9th September 1892, being date of application in France.

3586. F. G. Bates. Improvements in compounds for converting iron or low-grade steel into high-grade steel by the cementation process. Complete Specification. February 17.

3652. A. Bowen and J. Price. Improvements in the manufacture of steel. February 18.

3834. A. Wilson. Improvements in the manufacture of compound armour plates. February 21.

4001. H. W. Hemingway. Improvements in the manufacture of oxide of iron and in means applicable for use in such manufacture. February 23.

4072. H. Bird. Improvements connected with the production of purple ore, bricks, or blocks for use in blast furnaces or other furnaces for the production of iron and for other furnaces. Complete Specification. February 24.

4079. H. C. Bull and Gustavus Baron de Overbeck. Improvements in the treatment of galena and in apparatus therefor. February 24.

4102. P. J. G. Rouquette. Novel application of aluminium and its alloys. February 24.

4114. J. C. Richardson. An improved method of converting metallic copper into copper oxide. February 24.

4127. H. F. Taylor. Improvements in apparatus for coating with tin, lead, or other metals, or alloys of same. February 24.

4133. H. Parkes. Improvements in the extraction of gold and silver from ores or compounds containing the same. February 24.

4251. F. B. Stone. A process for freeing copper from arsenic. Complete Specification. February 27.

4267. T. E. Weatherall. An improvement in electroplating. February 27.

4310. A. Gray. Improvements in and relating to the manufacture of zinc oxides. February 28.

4328. A. Longsdon. From L. Grambow, Germany. A new or improved process for improving the quality of steel armour plates. February 28.

4358. W. P. Thompson.—From O. Nicolai, Germany. Improved flux or fluxes for use in soldering aluminium and other metals. February 28.

4496. H. Parkes. Improvements in the extraction of gold and silver from ores or compounds containing the same. March 1.

4551. P. Robinson. Improvements in the manufacture or production of channelled or troughed iron, steel, or other metals. March 2.

4677. A. C. Fel. Improvements relating to the soldering of aluminium. March 3.

4887. A. V. C. Fenby and J. B. Fenby. Coating iron and steel with brass and other metallic alloys. March 7.

5156. C. Raleigh. A combination of matter adapted for use in the process of chlorination, and means for producing the same. March 9.

5218. J. S. MacArthur, acting for the Cassel Gold Extracting Co., Lim., and C. J. Ellis. Improvements in extracting gold and silver from ores and the like. March 10.

5223. L. W. Broadwell. Improvements in smelting furnaces. March 10.

5313. J. A. Coombes. A new or improved means of and apparatus for the extraction of tin, copper, and the like. March 11.

5327. T. M. Ash, H. W. Gill, and L. Green. An improved process for coating or plating non-metallic articles with metal. March 11.

Complete Specifications Accepted.

1892.

3024. A. G. Brookes.—From B. C. Molloy. Improvements in precipitating and collecting metals from solutions containing them. February 22.

3493. R. L. Sentinella. An improved treatment of iron and steel for casting the same from crucibles. February 1.

4333. F. Sugden and T. Sugden. Treatment of cast iron. February 15.

4488. T. Evans and H. C. Bunkell. Amalgamating precious metals and their ores and the like, and apparatus therefor. January 25.

5026. T. H. Mallaband. Melting furnaces. March 8.

6612. T. Twynam. Manufacture of iron and steel. March 1.

7332. G. Retterer. Improvements in galvanising iron, and apparatus therefor. March 8.

7748. R. Evans and E. Davies. Improvements in means or apparatus to facilitate the manufacture of moulds for use in casting moulds for ingots of steel or other metal. March 1.

23,491. W. B. Hollingshead and S. H. Carney. Compound sheet-metal plates, and the process of producing same. March 1.

1893.

512. G. Wegner and P. Guhrs. Improvements in soldering aluminium and alloys of aluminium. March 15.

530. P. C. Choate. Art of producing metallic zinc. February 22.

2066. W. H. Greene and W. H. Wahl. Process of producing metallic alloys. March 8.

2724. C. Endruweit. Method of producing thin films of metal and manufacturing metal-surfaced paper therewith. March 15.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Applications.

3210. S. W. Maquay. Improvements in primary batteries and in miners' and like portable lamps. February 13.

3477. H. Nehmer. Improvements in constructing and connecting galvanic elements. February 16.

3573. E. Taussig. Improvements relating to the extraction of metals by means of electricity and to apparatus therefor. February 17.

3734. A. Hough and O. March. Improvements in secondary battery plates or elements. February 20.

3743. E. H. Liveing. Improvements in the preparation of carbon electrodes for electrolytic operations. February 20.

3744. E. H. Liveing. Improvements in the construction of carbon electrodes. February 20.

3747. M. Perreur-Lloyd. Improved process for the production of electrolytic copper. Complete Specification. February 20.

4024. W. P. Thompson. — From A. Vogel and Co., Germany. Improvements in storage batteries or accumulators. February 23.

4106. L. Epstein. A process for maintaining positive plates of secondary voltaic batteries in good operative condition. February 24.

4144. A. W. Armstrong. An improvement in the electrodes of electric, galvanic, and other batteries. February 24.

4356. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to welding metals electrically. February 28.

4360. W. P. Thompson. — From La Société Electric Phœbus, France. Improvements in the construction of plates for accumulators or secondary batteries. February 28.

4691. The Lithanode and General Electric Co., Lim., and J. T. Niblett. Improvements in the manufacture and production of elements for secondary batteries. March 3.

4726. J. A. Heap. Improvements in the electrolytic production of chlorate of potash and chlorate of soda. March 4.

4869. W. T. Gibbs and S. P. Franchot. Improvements in the process of obtaining chlorates of the alkalis or of the alkaline earth metals by electrolysis. Complete Specification. March 7.

4871. N. Rolland. Improvements in electric batteries. March 7.

5051. T. Coad. Improvements in primary batteries. March 8.

5197. J. Hargreaves and T. Bird. Improvements in the production of alkali and in apparatus therefor, the said apparatus being applicable for electrolysis generally. March 10.

5198. J. Hargreaves and T. Bird. Improvements in and in making electrolytic apparatus. March 10.

5341. C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell. Improvements in or connected with electric batteries. March 11.

Complete Specifications Accepted.

1892.

6465. G. E. Heyl. Improvements in electrical secondary or storage batteries. February 22.

6637. G. E. Heyl. Electrodes for secondary batteries. March 8.

8108. J. W. Davis and J. O. Evans. Manufacture of metallic articles by electro-deposition. March 15.

21,193. G. E. Cassal and F. A. Kjellin. Method of producing zinc from blende by means of electrolysis. March 8.

22,950. R. Haddan.—From R. Gabarro. Improved galvanic dry battery or cell, and a composition for use in such cells. March 15.

1893.

1502. W. P. Thompson.—From E. Correns. Process and apparatus for the electrolytic production of porous finely-subdivided lead for use in secondary batteries. March 1.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

3368. H. J. Saunders and H. Bain. Improvements in the manufacture of grease and oils for lubricating purposes so as to resist heating, and in the manufacture of fabrics, cloths, curtains, wall-paper, and various other articles, so as to render them fireproof. February 15.

3469. J. S. Fairfax.—From W. D. Field, United States. Improvements in or relating to compounds of "blown" or aërated oils with pyroxyline. February 16.

3606. G. A. J. Schott. *See* Class I.

4586. T. Nicholson. Improvements in soap. March 2.

4935. R. Haddan.—From E. Schaal, Germany. Improvements in the process of and apparatus for thickening linseed oil. Complete Specification. March 7.

5040. The Patent Syndicate Lightning Oil Extractor Co., Lim., and H. A. A. Dombrain. Apparatus for driving off heavy vapours of solvents. March 8.

5107. H. D. Morgan. Soap-cooling frames. March 9.

Complete Specifications Accepted.

1892.

18,744. A. Teal. Method of and apparatus for brightening rape, linseed, and similar oils. March 8.

24,153. E. Opderbeck. A new process for making consistent fish-fat, train, and other oils by means of compressed oxygen. February 22.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

3398. A. Gentzsch, J. Goldschmidt, and E. Ritter von Scanavi. An improved insulating material for electrical purposes, and method of preparing same. February 15.

3557. J. Perl. Non-oxidising liquid bronze. Complete Specification. February 17.

3886. W. M. Walters. Improvements in the composition and treatment of substances for use as glue, putty, and cement. February 22.

4100. J. Anderson, jun. An improved process for reclaiming india-rubber from waste india-rubber goods. February 24.

4110. F. W. Golby. — From M. Corneille, France. Improvements in apparatus for distilling crude resins. February 24.

4176. H. G. Powell. Improvements in, and in apparatus employed in, the treatment of iron salts and hydrates for the production of red and other oxides of iron, suitable as pigments, applicable or partly applicable also to other purposes such as the drying, roasting, washing, and levigating of ores and alkalis. February 25.

4342. M. N. d'Andria. Improvements in and relating to the manufacture of paints, sulphuric and sulphurous acid from proto-sulphate of iron. February 28.

4870. A. P. Laurie. Improvements in the methods of preparing for use pigments containing oxide of zinc or other oxides or salts of metals. March 7.

5316. J. Hickisson. *See* Class IV.

Complete Specifications Accepted.

1892.

5120. H. W. Picton and S. E. Linder. Manufacture of vermilion. February 22.

5862. J. R. Carruthers. Improvements in colour cakes, blocks, or sticks for marking or colouring purposes. March 1.

6542. J. S. Fairfax.—From F. Crane. Manufacture of pyroxyline solutions and compounds for varnishes and coatings. February 22.

7631. E. Waller and C. A. Sniffen. Manufacture of white lead for use as a pigment. March 8.

1893.

2705. H. C. Higginson. Manufacture of whiting. March 15.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

3886. W. M. Walters. *See* Class XIII.

4274. W. Becker. An improved process to make leather soft, durable, and waterproof. February 27.

4738. J. Grass. Improvements in the manufacture of adhesive or glutinous material, suitable for bookbinding, sizing textile materials, and other purposes. March 4.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

3170. J. A. Morrell and J. Fromherz. *See* Class I.

3302. S. Pratt. Improvements in the treatment of starch-containing substances for use in brewing, distilling, the manufacture of glucose, and in similar operations. February 14.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

3653. R. O. Bischof. Improvements in the manufacture of dried yeast. February 18.

4927. W. P. Thompson.—From J. Uhlmann, Germany. Improvements in the preparation or treatment of beer, and of an extract of malt to be used therefor. Complete Specification. March 7.

4981. F. E. V. Baines. Improvements in the treatment of rice or other grain for the production therefrom of a material suitable for use in brewing or for other purposes. March 7.

Complete Specifications Accepted.

1892.

7534. J. Y. Johnson.—From J. A. Salidin. Manufacture of malt and apparatus employed therein. March 8.

7547. O. Ritter, J. H. A. Meyer, and L. Hofman. An improved wort and yeast aërator. March 1.

8623. T. Haynes, jun. Drying and curing malt. March 8.

20,903. R. H. Leaker. Improvements in distilling and rectifying brandy, whisky, and other spirits, and oils, essences, and the like, and in machinery and apparatus therefor. March 8.

23,894. M. Krouchkoll. Process for the manufacture of yeast without alcohol. March 15.

1893.

1591. A. Werner. Treatment of beer and other liquids and apparatus for the same. March 8.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

3325. T. G. Rogers. Mazaline or maizilline, an improvement in the preparation of maize or Indian corn and for other cereals for brewing and for food purposes. February 15.

3437. D. Rylands. Improvements in the use of carbonic acid gas as applied to the preservation of fruits, meats, and other comestibles. February 16.

3499. E. Barker. Improvements in or relating to the preparation or treatment of certain waste products to make them suitable for use as food, and in apparatus therefor. February 16.

3972. S. L. Urban and J. Kolliner. Process and means for preserving articles of food. February 23.

4479. J. D. Marshall. An improved chemical food biscuit. March 1.

4486. W. Clark. Improvements in fluid meats and the process of manufacturing same. March 1.

4487. W. Clark. Improvements in food preparations and in their manufacture. March 1.

4592. A. Bernstein. Improvements in apparatus for treating milk. March 2.

4649. G. A. Nussbaum. Improvements in the manufacture of antiseptic ice. March 3.

4657. W. Chivers, J. Chivers, and S. Chivers. Improvements in or relating to powders or preparations for producing custard, blancmange, and the like. Complete Specification. March 3.

B.—Sanitary Chemistry.

3882. F. P. Candy. Improvements in the purification of sewage and impure waters. February 22.

4821. G. Webb, G. Webb, jun., and A. E. Burton. Improvements in the purification of sewage. March 6.

4972. W. H. Daniels. Improvements in the treatment of sewage, drainage, and other foul liquid matters. March 7.

C.—Disinfectants.

4950. C. R. Alder Wright. Improvements in the manufacture of antiseptic and disinfectant materials for sanitary purposes. March 7.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

22,922. A. J. Boult.—From L. Fromm. Improvements in or in a method of relating to the preservation of farinaceous and other food products. February 22.

1893.

2683. W. P. Thompson. From B. G. Hudnut. New or improved corn product and process of manufacturing the same. March 15.

B.—Sanitary Chemistry.

1892.

6211. J. Price. Treatment of sewage. March 8.

6396. F. W. Lacey. Apparatus for the treatment of noxious gases. March 1.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

3848. H. H. Lake.—From A. Howard and A. N. Kidder, United States. Improvements relating to the manufacture of paper and to apparatus therefor. February 21.

5178. E. Gelinek and W. Gelinek. Improved process and apparatus for manufacturing plastic articles from paper-pulp. Complete Specification. March 9.

2724. C. Endruweit. *See* Class X.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

Applications.

3182. C. D. Abel.—From Küchler, Buff, and Co., Germany. Manufacture of amido-alkylsalicylic acid and acetamidoalkylsalicylic acid. February 13.

3735. P. Rogatien de Lambilly. An improved method of producing formiate of ammonia and hydrocyanic acid. February 20.

3961. P. Fritsch. Manufacture of salicylic-acid-ester of acetol. February 22.

4191. O. Imray.—From The Society of Chemical Industry in Basle, Switzerland. Manufacture of new pharmaceutical compounds. February 25.

4998. J. Stevenson. A new or improved process for making extract of coffee or tea. March 8.

5167. J. D. Cahill. New or improved process for treating tea to eliminate the solution of tannin and to produce a detannated essence or solution. March 9.

Complete Specifications Accepted.

1892.

4497. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Manufacture of pipirazine and its salts. March 8.

7782. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Manufacture of periodides of phenols and phenolcarboxylic acids. March 8.

7979. E. Kauder and L. Merck. Improvements relating to the production of narceinesodium-sodium-salicylicum. March 15.

20,903. R. H. Leaker. *See* Class XVII.

XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

Applications.

3804. J. Waring. Improvements in electro-photography. February 21.

3847. R. Mitchell. Improvements in the production of lantern slides and other transparent photographic images, in which are also contained an improved means of transferring photographic reproductions to porcelain, metal, and other surfaces. February 21.

4188. R. Kennedy. Improvements in electric retouching of photographs and in apparatus therefor. February 25.

4214. W. H. Walker. New or improved apparatus for the manufacture of films, more especially intended for the manufacture of films for photographic purposes. February 25.

4520. A. J. Boult.—From W. J. H. Auton, France. Improvements in or relating to photographic processes. March 1.

4951. S. Pitt.—From The Chemische Fabrik auf actien vorm. E. Schering, Germany. Improvements in photography by the use of new developers. March 7.

Complete Specification Accepted.

1892.

7501. A. J. Boult.—From G. Eastman. Improvements in or relating to photographic films or the like. March 15.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

3267. W. P. Thompson.—From E. Lagneau, Belgium. Improvements in the manufacture of matches. February 14.

2784. W. Briscall. Improvements in wax-vesta making. February 21.

Complete Specifications Accepted.

1892.

7392. A. R. Molison and A. McLucas. A steam cartridge for blasting purposes. March 1.

7978. C. H. Curtis and G. G. André. Improvements in explosives. March 8.

10,493. P. Lorenz and R. Wuppermann. Improvements in and relating to matches. March 15.

12,452. J. A. C. de Latouche. Military and sporting ammunition. March 15.

1893.

580. B. J. B. Mills.—From C. E. Munroe. Improvements in explosive material and in the manufacture thereof. March 1.

XXIII.—ANALYTICAL CHEMISTRY.

Applications.

3388. F. Soxhlet. An improved method and means for retaining disk stoppers upon the mouths of bottles and other vessels. Complete Specification. February 15.

4409. P. V. P. Berg. Improved apparatus for determining the relative percentages of the fluid components of a compound fluid. Complete Specification. February 28.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL
OF THE
Society of Chemical Industry:
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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. E. C. C. Stanford has been nominated to the office of President; and Sir John Evans, K.C.B., F.R.S., has been nominated Vice-President under Rule 11.

Sir Frederick Abel, K.C.B., F.R.S., Mr. H. Brunner, Mr. Horace Brown, F.R.S., and Sir John Evans, K.C.B., F.R.S., have been nominated Vice-Presidents under Rule 8; and Prof. G. G. Henderson, D.Sc., has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. E. C. C. Stanford, nominated President.

Mr. E. K. Muspratt has been nominated a Vice-President under Rule 24, and the Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18 :—" No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Annual General Meeting.

The Annual General Meeting will be held in Liverpool on the 12th, 13th, and 14th July next. An outline draft of the programme appears below. Tickets of Membership will be issued in time for the meeting and will form, as heretofore, vouchers for visits to works and excursions.

Draft Programme.

Wednesday, July 12th.

2.30 p.m.—Council Meeting.
3 p.m.—Annual General Meeting and President's Address.
4.30 to 6 p.m.—College Buildings open for inspection ; tea.
8.30 p.m.—Conversazione—Walker Art Gallery.

Thursday, July 13th.

Excursions.

United Alkali Co., Widnes.
Cope Bros.' Tobacco Manufactory.
Lancashire and Yorkshire Railway Works, Horwick.
Wigan Coal and Iron Co.
Liverpool Overhead Railway and Generating Stations.
Grain Storage Co. and Docks.
Liverpool Cold Storage Co.
Atlantic Liners.
Watch Factory, Prescot.
Electrical Wire Works, Prescot.
7.30 p.m.—Annual Dinner.

Friday, July 14th.

Excursion on Ship Canal.
9 p.m.—Smoking Concert.

The following gentlemen have been nominated by the Scottish Section to serve on the Patent Laws Committee : Messrs. E. C. C. Stanford, G. Beilby, and John S. MacArthur.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application, accompanied by remittance at the rates quoted on the first page, to the General Secretary only, to whom also changes of address should be communicated.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The Secretary is prepared to offer 5*s*. each for copies of the Society's Journal for January 1883 in saleable condition.

LIST OF MEMBERS ELECTED, 21st APRIL 1893.

Blears, John, c/o Langworthy Bros. & Co., Ld., Greengate Mills, Salford, dyer and printer.

Cunningham, Edw., Milton, Mass., U.S.A., chemical engineer.

Hall, Jas. W., Bombay Baroda and Central India Railway, Parell, Bombay, linseed oil mills manager.

Harris, Sydney W., 15, Lansdowne Terrace, Walters Road, Swansea, assayer.

Harvey, Thos. P., Hazeldene, Church Lane, Merton Park, Surrey, varnish maker.

Hawkins, J. Dawson, c/o Holden Smelting and Milling Co., Aspen, Col., U.S.A., manager.

Hefford, Geo., Jr., 40, Chapel Lane, Headingley, Leeds, chemical student.

Hunt, Fred. F., 77, Pine Street, New York City, U.S.A., analytical chemist.

Larsen, John, 18, Pine Street, Chicago, Ill., U.S.A., assistant chemist.

McKesson, John, 91, Fulton Street, New York City, U.S.A., manufacturer and druggist.

Pearson, Frank P., Arnold Printworks, North Adams, Mass., U.S.A., manager.

Pritchard, Edgar J., Burrows, Swansea, works manager.

Schwab, Dr. L. C., Sedanstrasse, 53, Bernburg (Anhalt), Germany, technical chemist.

Scrymgeour, A., c/o South African Gold Recovery Co., (Journals) Box 1283, Johannesburg, S.A.R. ; and (subs.) Shore Road, Stevenston, Ayrshire, assayer.

Taylor, Geo. W., Prospect Villa, Gamesley, Dinting, near Manchester, printworks chemist.

CHANGES OF ADDRESS.

Ashburn, W. B., l/o Strathblane; Newton Bank Printworks, Hyde, Cheshire.

Baker, Theodore, Journals to Gie Appantor, Axim, Gold Coast, Africa.

Bird, H., l/o Stonehouse; 10, Lockyer Road, Mutley, Plymouth.

Broome, F. J., Journals to Muskoka Falls, Ontario, Canada.

Carulla, F. M., Journals to 84, Argyll Terrace, Derby.

Chemistry, The Institute of, l/o Adelphi Terrace; 30, Bloomsbury Square, W.C.

Conroy, J. T., l/o Hamilton Road : Woodstock, New Brighton, Cheshire.

Galbraith, Wm., l/o Highfield Road ; West Park, Saltergate, Chesterfield.

Gibbs, W. T., Journal to Laboratory, Ottawa, Canada.

Giles, W. B., l/o Belmont Villas ; 1, The Avenue, Church Road, Leyton, E.

Hartridge, J. Hills, l/o London ; Holmwood, Hendon.

Heron, John, l/o Wimbledon : 74, North Side, Clapham Common, S.W.

Johnstone, Dr. Wm., l/o Fish Street Hill; Effingham House, Arundel Street, Strand, W.C.

Kemp, D. S., l/o Shepherd's Bush ; 10, Bedford Terrace, Kensington, W.

Kynaston, J. W., l/o Kensington; 3, Oak Terrace, Beech Street, Liverpool.

Langer, Dr. C., l/o London; 3, Cuthbert Terrace, Westgate on Sea.

Lee, C. Tennant, l/o Hartford Street; 146, Franklin Street, Boston, Mass., U.S.A.

McLellan, J. Y., l/o Annenstrasse; 34, Friedrich Strasse, Bernburg, Anhalt.

Mason, Jas., l/o Mayfair; Eynsham Hall, Witney, Oxon.

Mensching, Dr. C., l/o Cheetham Hill; Crumpsall Vale Works, Blackley, near Manchester.

Preston, Alf., l/o Vicarage View; 4, Market Street, Bury, Lancashire.

Quinn, J. Cardwell, l/o Liverpool; The Gas Works, Carlisle.

Rowell, W. A., Journals to Hedworth Barium Works, East Jarrow.

Trewby, H., l/o Clapham Park; Radnor House, Ribblesdale Road, Hornsey, N.

Turner, H. B. H., Journals to Trinity College, Cambridge.

Williams, W. Collingwood, l/o Mulgrave Street; 68, Grove Street, Liverpool.

Wood, Jas., l/o Misterton; Almahurst, Green Street, Upton Park, E.

CHANGES OF ADDRESS REQUIRED.

Dunn, S., l/o Upper Park Road, Haverstock Hill, N.W.

Gibbs, D. Cecil, l/o Hanover Court, Milton Street, E.C.

Kressell, Edw., l/o 41, Park Avenue, Wood Green, N.

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W. Kellner.
B. E. R. Newlands.
W. Ramsay.
F. G. Adair Roberts.
A. Gordon Salamon.
G. N. Stoker.
F. Napier Sutton.
T. E. Thorpe.
T. Tyrer.
Frank Wilson.

Hon. Local Secretary: John Heron,
74, North Side, Clapham Common, S.W.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Committee:* E. J. Bevan, W. G. Blagden, T. A. Lawson, R. Messel, and C. R. Alder Wright.

SESSION 1892-93.

Monday, May 1st:—
  Dr. P. Dvorkovitch. "The Gasification of Coal and Liquid Hydrocarbons."
  Mr. W. P. Dreaper. "Estimation of Tannic and Gallic Acids."
Monday, June 5th:—
  Mr. H. G. Watel. "The Movement of Air as Applied to Chemical Industries."
  Messrs. Cross and Bevan. "New Cellulose Derivatives and their Industrial Application."

Meeting held Monday, April 10th, 1893.

MR. WM. THORP IN THE CHAIR.

THE APPLICATION OF "COWPER STOVES" TO CHEMICAL INDUSTRIES.

BY E. A. COWPER.

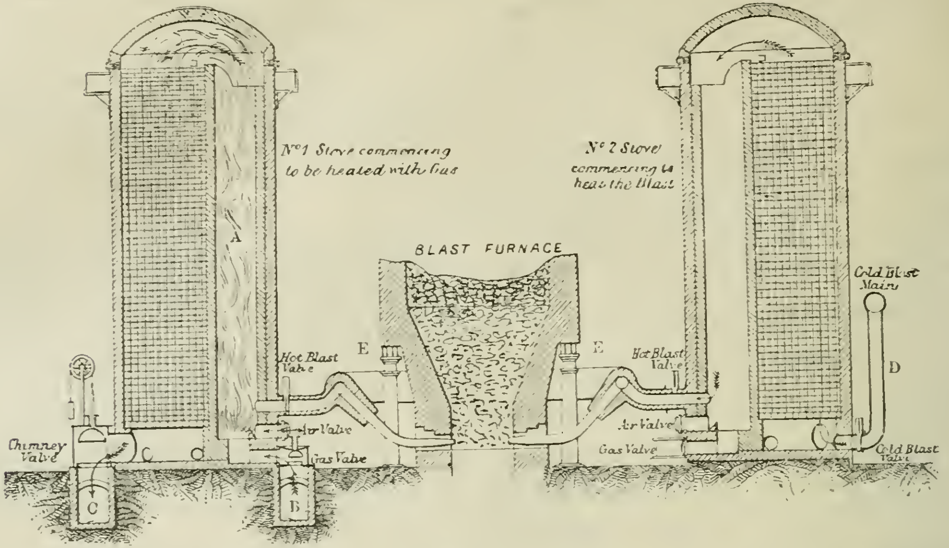
Having been requested to give some information in reference to my "patent hot-blast stoves" for heating air, steam, gas, or other aeriform fluids to high temperatures, for application to chemical industry and other purposes, I have much pleasure in responding to the call, simply premising (as I have already explained to your Secretary) that although my stoves are used all over the world for heating the blast for blowing blast furnaces, and are a most thorough success in every way, the application of the stoves to chemical purposes has been comparatively of recent date, except that the late Mr. James Young, many years ago, took licenses from me for distilling paraffin from boghead and other coal by means of highly-heated steam or gas heated in "Cowper stoves." The stoves work on the so-called regenerative system first introduced by Mr. Frederic Siemens.

The two large diagrams on the wall show the sectional plan and sectional elevation of a "Cowper stove"; the black boundary lines show the wrought-iron air-tight casing that retains the blast or gases contained in the stove, but as iron plating will not stand fire the stove is lined throughout with firebrick, so that the stove will effectually stand both heat and pressure. Within the stove there is a cylindrical firebrick flame-flue reaching to nearly the top of the stove, and having a gas valve and an air valve at the bottom for the admission of gas and air for heating the stove; the rest of the stove (except a space at bottom and in the dome) is entirely filled with "honeycomb bricks," *i.e.*, bricks having the shape of the cell of a honeycomb, but having short spurs or projections, which go towards making up other cells outside the first brick; these rest on heavy cast-iron gratings below and are placed truly one above another, thus forming a regenerator, with a large number of vertical passages through it, for taking up and giving off heat.

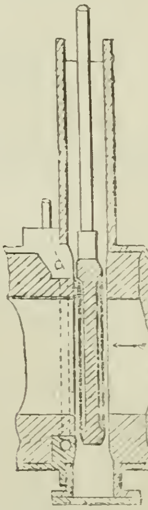
There is a chimney valve at the bottom, to make a connection to the chimney when heating the stove by the combustion of the gas and air admitted through the valves first named; and the absorption of heat is so perfect that at no time are the bottom of the stove or the chimney valve much above 250° to 300° F.; then, when the honeycomb brickwork has been heated nearly down to the bottom, the gas and air are shut off and the chimney valve shut, and two other valves are then opened, one to let the air, steam, or any gas into the bottom of the stove, and another valve (the hot-blast valve) to let the same out of the flame-flue after it has been heated by the stove to a red-hot temperature, commonly for smelting iron a temperature of 1500° F. (815° C.), or still hotter when required, as, for instance, 1832° F., as is necessary for some chemical purposes; but 2000° can readily be obtained.

Thus it will be seen that the top of the stove is hottest and the bottom coolest, so that any gas or air or products of combustion tend to stratify, and there is no mixing of hot and cold together, but the products of combustion gradually heat the regenerator red hot lower and lower down; and then, when the gas or air is admitted at the bottom, it is as gradually heated up very nearly to the temperature of the bricks, and issues at the hot-blast valve at a red heat or higher. Two or more stoves are always worked together, so that whilst one is blowing one or more are being heated up, the usual time of heating and of blowing being three hours, or a shorter time if very great uniformity of temperature is required.

The construction of the hot-blast valve is shown on the separate diagram. The seat of the valve is of cast iron, with a wrought-iron tube cast in it, and cold water is passed through the tube, and protects the seat effectually from the heat, in the same way as all tuyeres to blast furnaces are protected, even when they project 18 inches into the furnace. Then the steel valve, when shut, is in contact with the cool



seat, and is thus kept down in temperature, and it is prevented from absorbing heat very quickly, by a sheet of asbestos on each side of it (kept in place by a plate), so that the valve stands well when shut; then when open it is drawn up into the valve box, far above the stream of hot air or gas passing through the pipe, which pipe is lined throughout with firebrick, which, of course, is red hot. The valve box has a small supply of cold air or gas to the top of it, so as to keep the hot blast out of the box to a great extent. When the very highest temperatures are required, cold water is supplied to the valve, as well as the seat, but it has been found unnecessary for a blast at 1500° F.



Hot-Blast Valve.

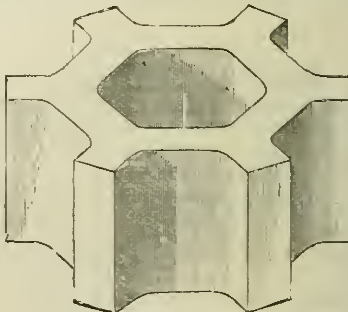
It is interesting to know that the specific heat of firebrick is two and a quarter times the specific heat of copper, so that the amount of heat held in a stove when it has been heated is enormous; in fact, a stove has been used and heated blast three days after having been heated up (owing to a stoppage of the blast furnace).

With regard to the working of a stove on the regenerative plan, it may be noticed that the little working model before you, when heated, will heat blast so as to "cut" or melt lead, whilst the opposite end of the regenerator will not burn the hand, the regenerator being only one foot high.

The current of gas, steam, or air through the stove may be maintained in a variety of ways (partly depending upon the material to be acted on); a blowing-engine may be used, as at blast furnaces; a fan will be sufficient for most chemical purposes, or an exhauster, such as is used at gas works, or a gas-holder; but in many cases a small high-pressure steam jet will be sufficient, or a common pair of double bellows, blowing in of course at the cold end of the stove.

Now, as it is very important, in many chemical manufactures, to have full command *over the temperature* of any mass of material or quantity of liquid, either for boiling, roasting, smelting, oxidising, distilling, calcining, melting, or reducing, &c., &c., and to be able to *introduce heat* just where required, it follows that there must be many chemical processes in which the stoves would be found to be most valuable.

I have referred to the heat *being introduced* just *where required*, and I call your particular attention to this, for it



often happens that heating materials through the walls of a retort, crucible, or brickwork, is very unsatisfactory; even a "sand-bath" does not cause an equal heating either in time or temperature, as the outside of the mass is the *only portion* heated at first, and *it* has to *communicate* the heat which it has received *to the interior of the mass*, thus keeping down the speed of the operation, and, what is often much worse, subjecting *different parts* of the material to *different degrees of heat*, whereby one part may be acted on *over much* or too long, whilst other parts (as in the centre for instance) are *not sufficiently acted on*, thus causing an uncertain and irregular result.

Now the heating of the whole mass may be done by simply passing a highly heated current from the stoves through it, taking care that the current is unobjectionable in itself. Any given temperature of current can be *commanded* by a bye-pass. Of course it is obvious that heated atmospheric air must not pass through coal, for instance, as it would burn a considerable portion, but heated gas or steam will answer the purpose completely, just as heated steam does in distilling acidulated palm oil, or other fats, in regular working in the candle manufacture.

Heated carbonic acid gas, carbonic oxide, carburetted hydrogen, "water-gas" or producer-gas, would answer the same purpose, and could be used as a vehicle to carry the heat into the mass to be heated. Ammonia and other gases or vapours can be heated in the stoves.

It is this power of conveying heat in a perfectly uniform manner to large masses by highly heated currents, unobjectionable in character, and at a certain fixed temperature, that induced the well-known firm of Messrs. Brunner, Mond, and Co. to apply first one pair of stoves, and, these having proved a success, to extend the applications by putting up more stoves.

I am informed that the stoves are being used for two different purposes, the first for raising the temperature of a material which may not be brought into contact with the ordinary products of combustion without being decomposed, by heating an inert gas free from vapour of water and oxygen by means of the stoves, and then passing this hot inert gas through the material to be heated. This method of heating has the additional advantage that the temperature can be regulated with great accuracy and certainty. By mixing through a bye-pass a regulated quantity of cold inert gas with the hot inert gas issuing from the stove, the temperature of this gas can be kept very regular, and thus absolutely avoid over-heating and get the whole mass of the same temperature.

Secondly, the stoves are employed for supplying air at a very high temperature for the purpose of converting magnesium chloride into magnesium oxide and chlorine.

The chemical change taking place causes an absorption of heat, and only takes place at a high temperature. In the ordinary way such a reaction would have to be carried out in vessels heated from the outside to supply the heat which is absorbed, which is not only a wasteful method, but makes the treatment of large masses almost impossible, because the heat would only penetrate these masses very slowly from the outside. By heating the air sufficiently in the stove, the heat necessary for the reaction is carried into the mass by the hot air itself, and large masses can now be treated in big cylinders thickly lined with brickwork without applying any external heat.

So that you will observe that I am entirely supported in my expectation as to the favourable results to be attained in two different processes.

I have proposed the use of the stoves for distilling camphor, and materials of that character, requiring a high temperature, and a regular heat, instead of trusting to an ordinary fire, which, at best, will not give a perfectly uniform temperature throughout the stills.

I have likewise proposed to concentrate sulphuric acid, or other acids, by highly heated gas, so as to obviate the necessity of passing all the heat through the walls of a glass or platinum still.

There are, however, so many other chemical processes, such as producing red lead or litharge, &c., &c., that will no doubt occur to many members, that I am greatly in hopes that many among you will at once think of applications that I cannot at the moment go into, and many of which I am not myself familiar with.

I trust, therefore, that I am not too sanguine in hoping that by thus drawing the attention of the members of the Society of Chemical Industry to the *means which exist* of applying high temperatures in any manner desirable, may lead to some *improvements* in certain chemical processes, and this is my reason for laying before you a simple means of heating, and producing chemical effects.

Samples of bent glass, melted antimony, oxidised copper coins, &c., are on the table.

It may perhaps be interesting to some of the members if I add a few words as to the very extensive use that is now made of "Cowper stoves," as they are in fact all over the world, being used in England, Scotland, and Wales, France, Germany, Switzerland, Sweden, Russia, America, and India, to the number of more than 500, all working most successfully. The amount that has been laid out on them considerably exceeds half a million sterling, and they pay for themselves in less than twelve months in smelting iron, as more iron is made from a given blast furnace and much less fuel is used per ton of iron made. The usual temperature adopted is 1500° F. (815° C.), but 2000° F. (1093° C.) can easily be attained where necessary, and a much more regular temperature is maintained than is got with the now old-fashioned cast-iron pipe stoves.

The stoves are practically everlasting, as the heat does not wear out the firebricks.

DISCUSSION.

The CHAIRMAN said Mr. Cowper had given a very interesting paper, and one which was of importance, because it came from one engaged in the manufacture of iron and steel, in one sense a department of chemical industry, but of so distinct and large a character with its own definite methods that it was not generally included. Nevertheless, those who had to deal with matters on a smaller scale might employ with advantage some of these very ingenious contrivances.

Sir JOHN EVANS said that hearing from Mr. Cowper that he was going to read this paper, and having known him now for a great many years, he felt sure he would bring forward something worth hearing. Those who had heard the paper would appreciate the value of the communication. They must all admire this ingenious adaptation of Siemens' regenerator, the furnace being used in the first place as a recipient of heat, and subsequently as the means of giving out that heat in any amount, at any given temperature, and in any character, either as some special gas or as atmospheric air. He presumed that means were adopted to prevent radiation of heat.

Mr. COWPER said there was no outside coating. The stove was perfectly naked, but there was a firebrick lining of four rings, and within the rim the bricks against the curve did not quite fit closely, so that there were an enormous number of air spaces between the bricks, which answered perfectly. It was only the top which was hot. One could bear one's hand upon the stove near the bottom; in fact, at the bottom near the chimney valve it was cold, and when it was shut off one could open the air valve and crawl in there.

Sir JOHN EVANS asked if there were any means of judging when the heat disappeared.

Mr. COWPER said they generally worked them three hours on and three hours off. They had had them going on for three days quite satisfactorily.

Sir JOHN EVANS asked how they knew when the available heat had been absorbed, and the bricks were cooling sufficiently near the top to require to reverse the action.

Mr. COWPER said they knew by experience how long it took. If they wanted a very regular temperature they would change every hour or every hour and a half, but they did not mind a difference of 50° in blast furnaces. He ought to have mentioned one thing which he had forgotten—that he tried the specific heat of a piece of firebrick and a piece of copper, and the firebrick had $2\frac{1}{4}$ times the specific heat of a piece of copper of the same weight, not the same size. They often sent 10,000 cub. ft. of gas per minute through these stoves for three hours at about 1500° C., which was a grand store of heat.

Mr. T. TYRER said that some few years ago he asked Mr. Cowper how his principle was to be adapted to a number of small sources of heat, and in reply to Mr. Cowper's letter of inquiry for further particulars he gave him two or three illustrations; one was that of what was practically a sand-bath of 80, 90, or 100 ft. long, and about 4 ft. wide. The question was, how would heat be applied uniformly by this system to the above area? Then another requirement was to heat a number of pots set in brickwork in the ordinary way, in pairs or triplets or quadruplets, pots $1\frac{1}{2}$ to 2 in. thick; in fact, sand-baths. Supposing they were placed in a series of 16 pairs, making 32 pots, how would he propose to heat them uniformly for three or four days continuously at a comparatively low temperature? Mr. Cowper went into the question in correspondence, but he could not say that the answers at that time were sufficiently satisfactory, and as he had not the opportunity then of seeing Mr. Cowper personally he thought it as well to put the question again, because the answer might be of interest and value to many other members. It was one thing to have heat concentrated at a particular point, and quite another thing to distribute it over a large area equally and at a moderately low temperature. If any modification of this apparatus could accomplish that there was quite a wide field for its application.

Mr. J. I. Vaughan asked how the amount of heat was determined. He understood Mr. Cowper to say that it was done by long practice, that a certain amount of time with a given sized furnace would produce a certain effect; but that was rather an expensive mode of learning, and he should be glad to know if there was any particular kind of pyrometer which would stand sufficiently well to give reliable data on this point. He had had a great deal of experience of high heats with superheated steam, and so on, and found Gauntlet's pyrometer stood better than anything else, but that was a good many years ago, and perhaps something better had been discovered more recently.

Mr. W. F. Reid asked what was the smallest size of plant which he could fit up economically, because to some extent on the size depended its use in many chemical industries.

Mr. Cowper said the smallest size was on the table before them, the largest was about 30 ft. in diameter and 70 ft. high.

Mr. Bernays said the larger sized stoves did not interest the chemical industries so much as the iron industries. Some time ago he had an interesting conversation with Mr. Cowper about the concentration of sulphuric acid by means of hot air. That seemed an application which was capable of very great extension, and he should like to ask him if he had devoted any further attention to that point, and whether he had been successful. At that time the difficulty was in finding some material which would stand the sulphuric acid. Again, he should like to know whether he had ever used it for tempering steel, which was not exclusively a chemical industry; but every research made on steel showed that chemistry had a great deal to do with it. If in the course of using this hot gas one were compelled to pass it from one place to another, and could not do so by pressure behind, was there any means of pumping the hot air into the place where it was wanted?

Mr. Watson Smith asked if Mr. Cowper could give any further information as to the material or manufacture of the perforated bricks he employed, and more particularly how they stood a suddenly applied heat or a slowly raised temperature. He had been reading an interesting paper by Le Chatelier, from whose investigations it appeared that in steel furnaces the silica or quartzose bricks acted differently under a suddenly increased temperature, from the way in which they acted under a slowly raised temperature. In the first case the silicious matter was changed into a kind of allotropic modification, *Tridymite*, which possessed a lower melting-point than the ordinary material, and the consequence was it was liable to fuse. In the latter case, when the furnace was slowly heated, the bricks did not undergo this change (this Journal 1893, 383).

Mr. Cowper said, in reply:—

That for supplying heat by means of heated air, steam, or gases to a long narrow chamber or series of chambers, say 100 ft. long by 4 ft. or 5 ft. wide, a number of small branch pipes would be used, leading out of a long hot blast main, which would itself be supplied through several branches from a parent main. By such a system of ramification the hot blast from a central installation of one pair of stoves (mingled with a certain amount of cold blast if required to lower the temperature) would be uniformly distributed along the 100-ft. chamber. As a further precaution to ensure regularity of temperature, each branch pipe to the chamber might be furnished with a throttling damper, consisting of a conical plug of firebrick pushed more or less into the branch, and with a "bye-pass" valve or cock for the admission of such further amount of cold blast as might be necessary to tone the hot blast down to the required temperature.

Even in cases where a considerable amount of cold blast had to be added to the hot blast, the heat would be obtained in the most economical manner, as the products of combustion passed away from the stoves at a very low temperature, showing that all the heat has been utilised.

With regard to another question, as to the pyrometer that it was best to use, he might say he had tried several, but found none nearly so accurate as the one he always used, viz.:—a piece of copper or steel heated in the blast and dropped into a given quantity of water having fifty times the specific heat, then the temperature was read off at once with a common thermometer graduated to suit. This idea was not new, but was published by a Mr. Wilson many years ago at the Institute of Mechanical Engineers. He (Mr. Cowper) suggested the plan to the late Mr. Siemens, who made the pyrometers which commonly go by his name.

Another question was, as to the applicability of the hot blast for tempering steel, &c., and he must say that he did not think it was required for such a purpose, as an oven or muffle properly constructed answered every purpose. He had once had a bright steel wire thrust right up one of the passages of a hot stove, and it was interesting to see the shade of colour on the wire when it was withdrawn.

Mr. W. F. Reid had asked what was the usual size of the stoves, and his answer was:—any size from the working model on the table up to 30 ft. diameter and 70 ft. high, but a very common size was 20 ft. diameter by 60 ft. high; for many chemical purposes much smaller stoves would be more convenient.

Mr. Watson Smith asked how the firebricks stood heating and cooling suddenly, and the answer was, that some had been heated and cooled every three hours for ten years and were none the worse; but "Dinas" or pure "silica bricks" were not adapted for heating and cooling; it required Stourbridge or other good firebrick for the purpose.

Mr. Oscar Guttmann said he might give a little further information in reply to Mr. Reid's question as to the concentration of sulphuric acid. He had recently had the opportunity of seeing a sulphuric acid concentration plant worked by hot gas, designed by Mr. L. Kessler, of Clermont Ferrand, which had been described in the Journal of the Society, and an illustration had appeared in the German papers. It essentially consisted of a gas furnace and a concentrating apparatus, through which the hot gas passed. There was a tank made of volvic lava, a material which stood acid very well, and was lined outside with lead. On the top of the tank was a kind of Lunge tower, also made of the same material, with perforated plates, over which the sulphuric acid trickled down into the tank. At the side of the tank a hot blast was introduced through a leaden worm, which was perforated and allowed the hot gases to ascend and concentrate the acid as it trickled down. He had seen acid of 53° B. concentrated to 65° B. It worked very well, the only fault he had to find with it being that the concentration was not carried sufficiently high.

NOTES ON CHEMICAL MANUFACTURING IN RUSSIA.

BY R. BOWMAN.

If we take the night train from Moscow and travel all night, we reach Nighni Novgorod the following morning; and by taking the steamer from there and travelling one day and night down the river Volga, and one day and night up the river Kama, we come to a little village perched upon the hillside called in English "The quiet hills." Leaving the boat here, a drive of a quarter of an hour over the brow of the hill brings us to the only Le Blanc soda works in

Russia, that of Messrs. P. K. Oushkoff & Co. The appearance of the works is a good deal different from the usual appearance of an English Chemical work; the outward construction being considerably modified owing to the enormous extremes of temperature which we have to cope with there. There is a difference of 100° C. between the extreme summer heat and the extreme cold of winter.

In the manufacture of sulphuric acid these extremes of temperature are much felt; it being necessary to have at least 25 cubic feet, but better 28 cubic feet of chamber space per lb. of sulphur daily charged, to ensure a good yield, combined with a low consumption of nitre in the great heat of the summer months. But yet with every care and attention the results obtained are not nearly so regular as those obtained during the extreme cold of winter, the consumption of nitre being greater and the yield obtained being considerably inferior to the winter work.

The cold of winter is so extreme that I have frequently found the temperature of the last chamber as low as −15° C., yet the work proceeds with great regularity, the yield being excellent with a consumption of nitre averaging 1·5 lb. on the sulphur charged. Of course with these extremes of temperature it is absolutely necessary to roof and cover in both chambers and towers.

The pyrites used is of a rather inferior quality, being a cupreous pyrites of about 38 to 45 per cent. S. which we bring from our own mines in the Ural mountains.

The major portion of our sulphuric acid we consume ourselves in the manufacture of sulphate of soda, bichromates of potash and soda, sulphate of alumina, &c., the rest being sold in the form of concentrated acid of 66° B., being concentrated partly in platinum stills and partly in glass retorts.

A few words as to our method of concentrating in glass retorts may be of interest as illustrating a method primitive in the extreme, but, under the circumstances of the case, effective. The retorts, 72 in number, are placed in three double rows of 24 each, each double row having two fire places at one end. Naturally those retorts nearest the fire are finished before those at the farther and cooler end; so as soon as the man in charge, on looking through the little window fixed in the door of the retort house, sees that the acid in those retorts nearest the fire are finished, he with a long rake pushes the blazing logs of wood which constitute our fuel further up the flue beneath the more distant retorts, and so on, until the whole row of 24 is finished. The retorts themselves are made of a very common quality of glass, being the only quality of glass which we can command in the neighbourhood and are formed in shape like the ordinary laboratory retort, all in one piece, with the neck only a little shorter. This neck rests in an ordinary globular glass receiver, the receiver itself resting upon the floor of the retort house.

For the manufacture of sulphate of soda we have in use two styles of furnace; the ordinary muffle as used in the Lancashire district; and the ordinary open furnace as seen upon the Tyne. The HCl from the close furnaces is condensed by the German system of Woulf Bottles, combined with wash towers, as used at Aussig, while that from the open furnaces is condensed by the English system of coke towers. It may be interesting to remark, that while both systems are worked with the greatest care and watchfulness, we find the escaping gases from the German system are always from 30 to 40 per cent. greater than that from the English system. The salt used we bring from the Astrakan district, and is of a very high quality, regularly testing 97 to 98·5 per cent. $NaCl$, and also of a fine open grain, dissolving with great readiness.

The whole of the HCl is used up for the manufacture of bleaching powder; the limestone for which purpose we bring from the banks of the Volga, and is of moderate quality. In bleach manufacturing again, the extremes of temperature cause many little changes in the method of working to be necessary. In beginning this manufacture in Russia, I was of course prepared for the difficulties of making a high strength bleach during the great summer heat; the difficulties of the winter I did not fear very greatly.

However, in this connection, I may mention a rather curious incident which happened during our first year of bleach making, when the outside temperature was about −25° C. A chamber of bleach which had had about one half of its necessary quantity of gas, was suddenly twisted and buckled out of shape, the roof and sides being drawn inwards; notwithstanding the fact that there were two four-inch open air inlets into the chamber and that it was connected with another freshly limed chamber. My first impression was that this was caused by an excess of steam getting into the chamber, thereby causing with the great cold a sudden formation of chlorine hydrate; but upon careful examination of the inside of the chamber, no evidence whatever of such a formation could be found; and when the chamber was finished, the bleach was found to be a fairly normal product, testing over 36 per cent. of available chlorine, while the difference between the available and total Cl was 0·25 per cent.

Of course the bleaching powder chambers, like the sulphuric acid chambers, are entirely covered in, great care being taken to exclude every cold draught: the corridors and passages around the boxes are also heated by steam pipes, as I have found that a temperature lower than about −15° C. leads to a formation of an exceedingly hard and stonelike crust, which crust I find not to be formed if the temperature is kept higher than that I have mentioned.

The packing of the bleach too in the summer time was found to be quite impossible in the usual English manner, *i.e.* by the packers protecting themselves only by means of folds of flannel over the mouth and nose. The greater heat causes at the same time a more copious perspiration of the men and a greater evolution of gas from the bleach. To meet this a plan was introduced by Mr. Kovenitroff, one of the directors of the firm, which has much lessened this difficulty while being much appreciated by the men; that is a simple soft leather helmet and jacket made entirely of one piece and built upon a light framework of wire, the jacket being closed tightly at the waist and wrist, and the helmet being fitted with glass sights for the eyes, an inlet tube for air at the crown, and an outlet opposite the mouth. The air is supplied through a half-inch india-rubber tube, and is pumped in by means of an ordinary blacksmith's bellows, the outlet for the breath not finishing immediately outside the helmet, but being extended for about one and a half feet by means of an india-rubber tube, which tube the workmen tucks through a loop at the side of the jacket, thus keeping the air inside the helmet perfectly fresh and free from gas and enabling the workmen to remain a full hour within the chamber with comfort and ease.

In the matter of sampling I may mention that I have found the samples from the chamber to be much more reliable if taken in the following way:

A thin sheet iron box of cubical form, though without top or bottom, is taken, measuring about one cubic foot in capacity, and having handles fitted to its upper edge. When it is necessary to sample a chamber, this is pushed through the crust of bleach down to the chamber floor, then all the bleach within the iron frame is lifted out, thus ensuring a true average of all the layers of the product, it so being impossible to get more of one layer than another. This is done in eight or ten different parts of the chamber, and I have always found a sample so taken to give an exceedingly true idea of the average strength of the chamber.

I may also mention that I have found it a great advantage not to admit the gas, only by one, or at most two parts of the chamber, but for an ordinary 10 ton box, to admit it in five different parts. This I do by taking from the usual 6-in. main pipe, 5 separate 2-in. pipes, one passing through the centre of the roof of the chamber, and two more at either end, this I find adds greatly to the uniformity of the product. Before adopting this method I found often a difference of from 1 to 1·5 per cent., and even in some cases 2 per cent. in the strength of the bleach taken from the end of the chamber when the gas entered, and that taken from the end near the exit for the excess gas into the next chamber.

In Russia there is only a very small outlet for sulphate of soda as such, almost our entire make being used by ourselves in the manufacture of caustic soda and bichromate of soda. The caustic is made by the old Le Blanc process, the extreme climate I am glad to say having practically no effect here. The only thing worthy of note here is the impossibility of using Russian plate iron in the boiling down of even the weakest caustic liquors, the softness of the iron and the openness of its grain rendering it much more easily attacked than the English sheet iron. For this reason, it is only possible to use cast iron boot pans even for the first evaporation.

Up to within quite recently, manufacturing industries in Russia have been much handicapped for want of coal for fuel, the wood used each year getting dearer and dearer. Upon this point now we need have no more fear, as within the past year we have introduced the use of liquid fuel, of which we have a cheap and ample supply in the naphtha residuum from the petroleum fields at Baku. So successful has this been as fuel for chemical purposes, that we have now laid down a pipe line from our wharf on the Kama river to our works, a distance of about two miles, the naphtha being pumped direct from the barges on the river into the reservoir at the works, from which it is drawn as wanted.

In the soda works, with the exception of the first evaporation by means of the waste heat from the bell furnaces, the whole of the evaporating is done, as well as the product finished, by means of liquid fuel, with greater rapidity, cleanliness, and economy.

The whole of our steam is now raised by means of this fuel; its utility being shown by the fact that we regularly evaporate in our steam boilers, upwards of 14 lb. of water per lb. of fuel used; our average figure being with wood only $3\frac{1}{2}$ to 4 lb. per lb. of fuel. Before leaving to visit this country, I introduced the use of this fuel in the working of the sulphate muffle furnace with great success and economy.

But though we have in Russia much to be thankful for for the ready access we have to such an ideal fuel, chemical manufacturing in Russia is by no means a bed of roses, which you will readily believe when I say that for more than six months out of the year we have to send our products a horse and sledge journey of close upon 600 miles before we can place them upon the market, and that one horse will carry no more than 7 cwt.

DISCUSSION.

Mr. TYRER said he should like to have some details of the apparatus by which the liquid fuel was applied and consumed. Fuel was not very cheap in London or the neighbourhood, the railway rates being responsible for about 8s. per ton on ordinary fuel, so that this point was of considerable interest.

Mr. WATSON SMITH asked what kind of pyrites kilns were employed, the ordinary Spanish burners or those of the older type once used for burning Irish pyrites. He noticed that the last of a series of sulphuric acid chambers often reached a temperature of – 13° in winter; and when that was so he should like to know what was the temperature of the working chamber, because it was essential that there should be a certain degree of warmth to maintain the chemical action. It would also be interesting to know what average temperature the hot weather in that part of Russia represented, and what sort of bleach could be obtained under such circumstances. He would further like to know what kind of salt-cake pots were used, the size and kind of metal. In Lancashire and on the Tyne there had been considerable difficulty in getting material for salt-cake pots which would stand wear and tear, more particularly the risk of cracking; and a special brand of cast-iron had to be employed. With regard to the protection of the bleach-packers from chlorine fumes, it would be interesting to know how these bleaching-powder packers in Russia were paid, whether on the day-wage or piece-work system. They would then be able to form some idea whether such helmets, &c., would be applicable in the Tyne or South Lancashire district, for these things very much depended on conditions of work, time, and payment.

Dr. R. MESSEL said that manufacturers would welcome any improvement on the present method of packing bleach, and begged Mr. Bowman to give the fullest description and illustrations of the costume referred to, &c., as attempts made in this country some 20 years ago with a complete diver's outfit did not prove successful.

Mr. D. HOWARD said he hardly knew whether a temperature of – 15° C. or the excessive heat of the summer was more disastrous to chemical manufacture than the incurable obstinacy of British workmen.

Mr. BOWMAN, in reply, said the apparatus for dealing with the naphtha residues used for fuel was the common form of steam injector in which the naphtha passed into a tube with a blast of steam behind it. The steam and naphtha played upon a metal ball which vapourised the liquid fuel, and it burnt more as a gas than anything else, the naphtha only igniting after it had passed out of the injector upwards of 2 ft. The pyrites employed was a cupreous pyrites of 38 to 45 per cent. Two kinds of kilns were used, one the old-fashioned kiln used for the large ore, and as there was an alarming quantity of smalls with it, the other was a Schaffner & Helbig ring burner. The average temperature of the first working chamber, when the lowest was at – 15° he should say would range from 50° to 70° Celsius. The bleach produced in winter was of a very fine quality indeed, the difficulty being to keep down the strength. In fact they had complaints all round from firms in Russia who had been accustomed to English bleach that theirs made in winter weather was too strong. On the other hand there were equally numerous complaints of what was made in the summer being unstable, and he was afraid of not as high quality as should be. He thought he saw his way to modify this to some extent on his return. With regard to iron decomposing pots they were very happily situated. He had had a fair experience of the unequal quality of pots supplied in England, but from three years working of pots from Ural mountain charcoal iron he did not remember one instance of a pot turning out less than from 1,500 to 2,000 tons of salt, and in many 3,500 and upwards. The same remark applied to their caustic potash which was of very high quality indeed. As to the packers, in mentioning the apparatus he did not wish it to be considered that he advised its use in England. He himself some years ago tried to introduce a similar apparatus, but he was afraid in this country work was carried on at too high pressure for such things to be used. The difference in the rate of work would be seen at once when he said that it was customary in England to have possibly two packers for an ordinary 10 ton box of bleaching powder, and that would be done in from 5 to 7 hours. In Russia it required 25 men, and they took from 15 to 16 hours to do the work. They were not paid by the piece, such a form of payment was entirely unknown. He wished to introduce it on beginning the manufacture, but the feeling in Russia was very much against such a thing.

THE PRESENCE AND DETERMINATION OF GOLD AND SILVER IN ANTIMONY AND IN BISMUTH.

BY ERNEST A. SMITH, ASSOC. R.S.M.

Assistant Instructor in Assaying, Royal School of Mines, London.

GOLD and silver are found associated in larger or smaller quantities with most of the ores of antimony and of bismuth. It is therefore interesting to ascertain to what extent, with the modern methods of extraction, these metals are retained in the metallic antimony and bismuth as they come into the market.

Practically the only ore from which the antimony of commerce is derived is the sulphide stibnite, Sb_2S_3. The chief sources of supply at the present time are Borneo, Australia, Portugal, and Japan, and smaller quantities from China and India. Gold has long been known to accompany the antimony ores from Borneo and Australia. The ores from Portugal are always associated with gold, and in some cases the amount is considerable. The metal smelted from these ores contains on an average, I believe, $2\frac{1}{2}$ ounces of gold to the ton.

The metal comes into the market in the form of conical ingots known as "star antimony."

Although the presence of the precious metals in metallic antimony has been known for many years, yet the numerous text-books on metallurgy rarely contain any satisfactory information as to the determination of the gold and silver present.

The usual methods are scorification and methods involving solution, but in the case of scorification, as not less than 500 grains of antimony have to be operated upon, the method cannot be recommended on account of the large quantity of lead necessary to ensure the elimination of the whole of the antimony.

Wet methods also are scarcely applicable owing to the very small percentage of gold and silver contained in the mass of metallic antimony treated.

Having had occasion to examine a sample of antimony for gold and silver and failing to find any method for effecting the object in view, the oxidising action of litharge when heated with metallic antimony, as pointed out by Berthier in his "Traité des Essais par la voié sèche," occurred to me as likely to afford a method free from objection.

In determining the gold and silver present in the commercial metal, after experimenting on various methods, the following, to which reference has already been made, were selected as most suitable and satisfactory:—

First method.—Each sample was powdered in an iron mortar, passed through a sieve of 80 holes to the linear inch, and afterwards well mixed. 500 grains of the finely-powdered sample were then mixed with 3,000 grains of litharge, transferred to a small earthen crucible, and heated in an air furnace at a red heat until the contents were thoroughly tranquil. The crucible was partly covered during the operation, which lasted about 15 minutes. When fusion was complete the contents were poured into an ingot mould, and when cold the slag detached from the lead button. The buttons of lead obtained were a little hard, but malleable, and after scorifying to a convenient size they were carefully cupelled. As it was found that on working on samples fairly rich in gold and silver that small quantities of the precious metals were retained by the slags, they were "cleaned" by crushing them to a coarse powder, mixing with 500 grains of litharge and 20 grains of charcoal powder, and fusing under the same conditions as before.

In the majority of samples experimented upon no gold or silver was found in the slags.

The gold and silver buttons obtained from the cupellations were weighed and treated first with very dilute nitric acid at a gentle heat until all action had ceased, and then with strong nitric acid. The black residual gold was carefully washed with distilled water by decantation, transferred to a small "gold-annealing" crucible, dried on a hot plate, heated in a muffle for about five minutes until the gold assumed its characteristic golden colour, then allowed to cool and weighed.

When necessary, 2½ to 3 times its weight of silver was added to the gold and silver button before parting with nitric acid.

In every case duplicate assays were made. The amount of silver present in the litharge used was estimated by reducing 500 grains with charcoal powder in the usual way and cupelling the resulting button of lead. From the weight of the silver button thus obtained the amount of silver in 3,000 grains of litharge (the quantity used) was calculated, and the amount deducted from the weight of the gold and silver buttons obtained from the fusion for the assay of the sample of antimony. The litharge used also contained a minute trace of gold.

Second method.—The following method, which consists of replacing part of the litharge by potassium nitrate as an oxidising agent for the antimony, I found gave very satisfactory results.

The charge used was:—

	Grains.
Antimony..........................	500
Litharge............................	1,000
Potassium nitrate..................	200
Sodium carbonate..................	200

The fusions were made in earthen crucibles at a dull red heat, the crucibles being partly covered as before, and the contents poured when fusion had taken place and the charge was quite tranquil. The fusion was complete in about 15 minutes. The buttons of lead, which were perfectly malleable and weighed about 500 grains, were cupelled direct without any difficulty. This method is perhaps preferable to that in which litharge alone is used, as it does not necessitate the scorification of the lead buttons before cupellation, thus saving time. In the case of samples rich in gold and silver the slags from the fusions by this process should be cleaned as before. The accuracy of the methods was tested by making up samples of pure antimony containing weighed quantities of gold.

The following results for gold and silver present in various samples of commercial "star antimony" were obtained:—

SAMPLE NO. 1.

	Ozs.	Dwts.	Grs.	
Gold...0·0030 per cent. =	0	19	14·4	Per Ton of 2,240 lb.
Silver..0·0054 per cent. =	1	15	7	

SAMPLE NO. 2.

	Ozs.	Dwts.	Grs.	
Gold...0·0049 per cent. =	1	12	0	Per ton of 2,240 lb.
Silver..0·0008 per cent. =	0	5	5	

SAMPLE NO. 3.

	Ozs.	Dwts.	Grs.	
Gold...0·0007 per cent. =	0	4	14	Per ton of 2,240 lb.
Silver..0·0191 per cent. =	6	4	19	

SAMPLE NO. 4.

Part of an ingot from New Zealand exhibited at the Paris Exhibition, 1889.

	Ozs.	Dwts.	Grs.	
Gold..0·0002 per cent. =	0	1	7·36	Per ton of 2,240 lb.
Silver.0·0026 per cent. =	0	17	0	

SAMPLE NO. 5.

	Ozs.	Dwts.	Grs.	
Gold......................		Trace		Per ton of 2,240 lb.
Silver..0·0015 per cent. =	0	9	19	

SAMPLE NO. 6.

Smelted from antimony ore from Servia.

	Ozs.	Dwts.	Grs.	
Gold...0·0001 per cent. =	0	0	16	Per ton of 2,240 lb.
Silver..0·0023 per cent. =	0	15	0	

SAMPLE NO. 7.

Smelted from antimony ore from Oporto, Portugal.

	Ozs.	Dwts.	Grs.	
Gold...0·0054 per cent. =	1	15	7	Per ton of 2,240 lb.
Silver..0·0050 per cent. =	1	12	16	

SAMPLE NO. 8.

	Ozs.	Dwts.	Grs.	
Gold.0·0021 per cent. =	0	13	17·28	Per ton of 2,240 lb.
Silver 0·0013 per cent. =	0	8	12	

Bismuth.—A considerable portion of the bismuth employed in commerce is derived from the native metal, which often contains small quantities of gold and silver and is frequently found accompanying ores of silver.

Smaller quantities are extracted from the sulphide of bismuth, bismuth glance, bismuthinite, Bi_2S_3 and from the oxide of bismuth, bismuth ochre, Bi_2O_3. In Australia, which is one of the principal sources of supply, the bismuth is found in the forms of telluride, sulphide, carbonate, and also in small quantities as native bismuth. In most cases there is a varying quantity of gold and silver found associated with these ores.

Other sources of supply are Germany and America.

About 40 tons of bismuth ores have hitherto been imported annually into this country. The ores contain on an average about 60 per cent. of metallic bismuth and are imported chiefly from Australia. The bismuth of commerce comes into the market in the form of circular "cakes."

As bismuth cupels as readily as lead, the various samples examined were subjected to this process for the estimation of the gold and silver present.

The samples of commercial bismuth selected were melted down separately in small earthenware crucibles under a layer of charcoal to prevent oxidation (a small piece of resin may be added with advantage before pouring) and cast into ingot moulds so as to obtain "buttons" weighing about 500 grains.

The buttons were afterwards adjusted to 500 grains and carefully cupelled in a muffle at a slightly lower temperature than that employed for the cupellation of lead.

The resulting buttons of gold and silver were weighed and then subjected to parting in dilute nitric acid in the usual manner.

The following are the results of the gold and silver obtained from the cupellation of samples of commercial bismuth recently purchased in London.

Duplicate assays were made in each case.

SAMPLE NO. 1.

	Ozs.	Dwts.	Grs.	
Gold...0·0018 per cent. =	0	11	18	Per ton of 2,240 lb.
Silver..0·2230 per cent. =	72	16	22	

SAMPLE NO. 2.

Marked Australian bismuth.

	Ozs.	Dwts.	Grs.	
Gold..0·0110 per cent. =	3	11	21	Per ton of 2,240 lb.
Silver.0·3319 per cent. =	108	8	10	

SAMPLE NO. 3.

Marked German bismuth.

	Ozs.	Dwts.	Grs.	
Gold...0·0003 per cent. =	0	1	23	Per ton of 2,240 lb.
Silver..0·0729 per cent. =	23	16	21	

SAMPLE NO. 4.

Marked American bismuth.

	Ozs.	Dwts.	Grs.	
Gold...0·0005 per cent. =	0	3	6·5	Per ton of 2,240 lb.
Silver..0·0705 per cent. =	23	0	14	

The bismuth may be extracted from the cupels in the following manner:—

After breaking off and rejecting the white portions of the cupels the stained portion is powdered and passed through a sieve of about 60 holes to the linear inch. The powder is then mixed with sufficient charcoal powder to reduce all the oxide of bismuth present and with suitable fluxes. I have found the following mixture work well :—

	Grains.
Powdered cupels	1,000
Fluorspar	800
Sodium carbonate	400
Borax	200
Charcoal	45—50

A part of the sodium carbonate or borax should be reserved and spread over the top of the charge.

The mixture is fused in an earthen crucible in a wind furnace at a red heat, the temperature being increased towards the end of the operation to keep the charge molten. After pouring the contents of the crucible into an ingot mould, the mould should not be disturbed until cool, as the bismuth on account of its low melting-point is kept in the molten state for some time by the hot slag which covers it.

Some of the buttons of bismuth obtained from the fusions of the cupels used for the cupellations of the various samples assayed were cupelled to ascertain to what extent gold and silver were absorbed by the cupel. The buttons obtained were very small and may be disregarded except when great exactness is required.

From the results of the quantities of gold and silver obtained from the above samples of metallic antimony and of bismuth, it is somewhat remarkable that profitable methods for the extraction of the precious metals have not been more generally introduced.

DISCUSSION.

Mr. HOWARD said he was sorry to say one of the melancholy results of the progress of science was the improvement in these methods of removing gold and silver from bismuth, to the great detriment of those to whom it properly belonged—those who used it. There used to be a much more satisfactory percentage than was now found.

Mr. TYRER said the influence of mass action as a solvent on precious metals which existed in comparatively minute quantities compared to the bulk, should not be forgotten. He believed that the research of Professor Roberts-Austen on alloys had been almost exhaustive on this point. He had had something to do with bismuth. There was no English bismuth, but Saxony, Australian, and Bolivian came into the English market, and was treated here, he believed, by an eminent firm of metallurgists in a scientific manner. In recent numbers of the Chemical News would be found papers which were communications to the Royal Society by, he believed, Mr. Edward Matthey, and in those papers would be found a complete answer to the questions which had been put. It was to be regretted, perhaps, that Mr. Smith had not treated larger quantities than what really were analytical quantities, but he noticed some difference in the description of his experiments and those reported by Mr. Matthey. If members had not read those papers, they would certainly repay perusal, though probably none of them would be able to repeat the experiments on the same scale as Mr. Matthey; but seeing that a very considerable quantity of bismuth used in this country by makers of bismuth preparations, who were responsible for the impurities in pharmaceutical preparations, it was satisfactory that that firm had produced bismuth lately of such very remarkable purity that it was very occasionally indeed that you could find silver and gold, still less tellurium, which was the "*bête noir*" of the physician when occurring in bismuth preparations. Its existence gave rise to a very unpleasant odour in the breath, as if the patient had been freely partaking of onions, yet so completely had the metallurgical purification of bismuth been carried out, that very rarely did tellurium appear. They were indebted to Mr. Smith for two things, first for the exact data he gave, and secondly for the details of the mixtures and fluxes he used for the purification. Manufacturers received the bismuth in the form he had described, and did certainly treat it as well as they could, but, of course, their object was to get to business, and they were as rapid as they could be, and, if he might use the expression, as gross as they dare be in the process of purification. Still, when one came to the end of a year or six months' work, and found a vessel full of scoriæ and refuse which contained a large percentage of bismuth, with all the impurities, then came the question to which this paper was an extremely valuable contribution—how to obtain all that was of value out of that refuse. He should like to emphasise two points, first that very rarely indeed did they find silver in a quantity which seriously affected the bismuth, and very rarely was found any quantity of gold, showing that the metallurgists knew where to look before they sent the bismuth into the market. If Mr. Smith had come across any tellurium, he should be glad to hear if he had devised any special means for its removal.

Mr. HOLLOWAY asked if there were any special reason for the much larger proportion of silver than gold which was found in antimony, bearing in mind that antimony contained nearly as much gold as silver. Had Mr. Smith made any analyses of the ores from which the antimony was obtained?

Mr. B. KITTO said he had read the article referred to by Mr. Tyrer in the Chemical News, but his impression was that no mention was made of the precious metal; Mr. Matthey had, however, referred to the methods for getting rid of small quantities of arsenic.

Mr. TYRER said the series he referred to was published in 1890.

Mr. BENEDICT KITTO said the Society were indebted to Mr. Smith for giving the details of the processes he had adopted for ascertaining the exact amount of gold and silver in these metals. He would like to ask if he had formed any idea why the German and American specimens of bismuth were so much poorer in the precious metals than others, whether it was that they had so much better methods of extracting the gold or silver, or whether the ores contained less. He had hoped to hear something of the extraction of these metals on a large scale but perhaps Mr. Smith had not given his attention in that direction. Until recently he had not found that smelters would pay anything for the gold and silver contained in antimony ore, but he now found that there were one or two firms which would pay up to about 40*s.* an oz. for any gold which might be present in sulphide of antimony.

Mr. Ernest A. Smith in reply said that the bismuth ores which came from Australia were generally richer in gold and silver, and would naturally give bismuth richer in the precious metals. He had read the valuable papers by Mr. Edward Matthey on bismuth. The one relating to the separation of gold and silver was presented to the Royal Society in 1889, in which the author stated that the precious metals might be perfectly extracted by the addition of 2 per cent. of zinc to the molten bismuth.* The large amount of gold obtained when cupelling a sample of bismuth purchased three or four years ago led him to purchase more recent samples to see how much gold and silver was present in the commercial metal.

From the results obtained it was difficult to believe that 23 oz. of silver per ton would not pay for extraction, when such a simple method existed as that pointed out by Mr. Matthey. In reply to Mr. Holloway's remarks with regard to the large proportion of silver compared with gold in metallic antimony, he could not account for that unless it were that the gold was of very low standard. He took special care to deduct any quantity of silver which might come from the chemicals used.

Liverpool Section.

University College, Brownlow Street.

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Hon. Treasurer : W P. Thompson.
Hon. Local Secretary :
Dr. Chas. A. Kohn, University College, Liverpool.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next :—*Chairman :* E. Carey ; *Vice-Chairman :* H. Brunner ; *Committee :* P. Bateson, Frank Tate, H. Tate, jun., E. Scott, and A. Smetham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

May 3rd :—
Geo. Tate, Ph.D. "The Relation of Bacteriology to Industries."
A. Richardson, Ph.D. "The Action of Light on Phenol."

Meeting held Wednesday, April 5th, 1893.

MR. HENRY BRUNNER IN THE CHAIR.

SUGGESTIONS AS TO THE TREATMENT OF THE WASTE GASES OF THE CHANCE-CLAUS SULPHUR RECOVERY PROCESS.

BY J. W. KYNASTON, F.C.S., F.I.C.

The subject which I have the privilege to bring before the section this evening, is one which to me is of profound interest. In common, with many others whose lives have been passed in association with the manufacture of alkali and its allied products, the recovery of the sulphur of alkali waste has been to me an ever present problem, which in the interests of economy ought to be solved, whilst in the purely scientific bearings of the question, I have been perhaps more deeply interested than some others of my contemporaries who have devoted themselves to the subject.

The Chance-Claus process, briefly stated, consists in decomposing alkali waste made into a thick emulsion with water, by pumping through it a stream of carbonic acid gas drawn from a lime kiln ; the carbonic acid is absorbed by the mixture, producing in the first instance a solution of calcium hydrosulphide, and later by further accession of carbonic acid, the hydrosulphide is decomposed, hydrogen sulphide is eliminated, mixed only with the atmospheric nitrogen admitted to the lime kiln, and some trifling impurities of the lime kiln gases, and there is left in the decomposing vessel a watery emulsion of calcium carbonate and the impurities contained in the alkali waste. During one of the stages of the carbonating operation, that is, during the production of the hydrosulphide, the carbonic acid and hydrogen sulphide liberated from a previous vessel, are so completely absorbed, that nitrogen, carrying with it only a minute proportion of hydrogen sulphide, passes away. Theoretically, this nitrogen ought to come away in a state of purity, but in reality it always carries with it more or less H_2S, and it is necessary, in order to avoid the nuisance that would arise from the passage into the atmosphere of even comparatively trifling quantities of H_2S, to use some means for its retention before the inert gas can be passed away. This is the first difficulty we have to contend with.

The so-called inert gas having been passed away by another channel, the main current of hydrogen sulphide containing 35 to 40 per cent. by volume of real H_2S, is led first to a gasholder from which a regular and constant current is passed to the Claus kiln, at the entrance to which it is mixed with atmospheric air, containing a sufficiency of oxygen to burn the H_2 to H_2O, setting free the sulphur. A considerable proportion of the sulphur set free is caught in the Claus kiln, and drains therefrom into a pan, alongside from which it is from time to time drawn off. The gases passing away from the Claus kiln at a very high temperature, carry with them a large quantity of sulphur in the state of vapour, and this sulphur is for the most part deposited in a series of chambers as the gases cool down, and eventually there issues from the final outlet the incondensible gas, the great bulk of which is nitrogen, but it contains also hydrogen sulphide, sulphurous acid, all the aqueous vapour proceeding from the re-action, and some other gases in small quantity. These escaping gases, as may be imagined, are of a highly noxious character, and it is the incompleteness of the re-action in the Claus kiln which permits the escape of these sulphur gases, and constitutes the second difficulty of the process under consideration.

For still another and third reason the process successful as it is, is yet imperfect. The enormous bulk of impure calcium carbonate, a bulk somewhat greater than that of the vat waste treated, has still to be deposited and land provided upon which to lay it. Though several attempts have been made to utilize it, as for instance in the manufacture of cement, yet only trifling quantities have been applied to any useful purpose. With this third difficulty, however, we do not to-night concern ourselves. It is with the exit gases of the process we have to deal and I will now ask your attention to the proposals which have been made and adopted, and to the suggestions I venture to make.

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* See Journal of Soc. of Chem. Ind., Vol. VIII. 1889, page 286.

The original proposals of Mr. Chance which were adopted in several of the plants erected in the early days of the process were two-fold, the one to deal with the comparatively small quantity of H_2S carried away with the so-called inert gases and the other to remove from the exit gases passing from the chambers the H_2S and SO_2 contained therein. In the first case, that in which H_2S only required to be removed, the ordinary scrubbers containing layers of ferric oxide, as used in the coal gas manufacture, were adopted, and when sufficiently capacious and when maintained in good working order they were effective in removing almost the last traces of H_2S from the gases. In the case of the final exit gases, of immensely greater bulk than the first, and containing both H_2S and SO_2 and also vapour of sulphur and aqueous vapour in large quantity, the dry slaked lime scrubber was used. The lime was just sufficiently damped to cause it to cohere and a small proportion of sawdust was added to give it porosity. These scrubbers also were effective so long as they could be maintained in good working order. In both cases, however, this maintenance of the plant in effective working order was a matter of no small difficulty. The frequency with which the scrubbers of both kinds required to be emptied and refilled, the heavy cost of labour and material, and the fact that the products obtained were not only valueless, but so much waste material requiring to be carted away, these and other minor causes compelled the abandonment of both methods of treatment. But the matter had still to be dealt with. It would be simply intolerable that such highly noxious gases should be allowed to escape.

The plans which have been adopted to meet the difficulty are not uniform. In some of the works, the inert gases which pass from the carbonators at one stage of the process, that is during the formation of the soluble calcium hydrosulphide and also during the carbonation of the free CaO, instead of being drawn off separately, are sent to the gasholder together with the strong H_2S gas subsequently evolved, thus reducing by one-half the strength of the H_2S gas to be sent to the Claus kiln, and of course vastly increasing the bulk of the gas to be treated therein. I think this is very unsatisfactory. If of two evils one should choose the least, surely it is unadvisable to relinquish what has seemed to me one of the greatest advantages of Mr. Chance's invention, viz., the production of highly concentrated H_2S gas by means of lime kiln CO_2 necessarily of much lower percentage. According to theory, and indeed in actual practice, more than one-half of the whole nitrogen introduced with the lime kiln gas is eliminated. The first stage of the reaction is—

$$2\ CaS + H_2O + (\overbrace{CO_2 + xN}^{\text{lime kiln gas}}) = CaCO_3 + CaH_2S_2 + xN$$

in which all the nitrogen introduced passes away almost pure. In the second stage—

$$CaH_2S_2 + CO_2 + xN + H_2O = CaCO_3 + 2H_2S + xN,$$

the nitrogen must necessarily come off together with the H_2S. But besides these reactions there is a third, viz., that upon the 5 to 7 or 8 per cent. of free CaO always contained in waste. The reaction in this case is $CaO + CO_2 + xN = CaCO_3 + xN$, and it of course permits the elimination of more of the nitrogen introduced, so that altogether some 60 per cent. of the nitrogen ought to be withdrawn from the carbonators. I think it is a mistake to deprive ourselves of the manifest advantages to be derived by careful attention to these reactions. The actual quantity of H_2S carried away with these inert gases, as compared with that passing from the exit from the sulphur chambers is really trivial if proper care is exercised in the opening and closing of the valves at the right moment. The point at which H_2S gas takes fire and burns at a jet is when it contains 25 to 26 per cent. by volume of real H_2S and the rough test applied by the workman is to pass a jet of the gas into a Bunsen burner placed alongside another Bunsen lamp burning ordinary coal gas. As soon as the H_2S gas commences to decrease in strength, it ceases to burn, and when the jet begins to flicker before actually taking fire, it is known that H_2S is again coming off. The change is easily observable and a dexterous opening and closing of the valves sends the gas in the direction it is intended to travel. But it seems to be impossible to prevent some H_2S passing in the wrong direction and as a very small quantity is intolerably offensive, it is imperative that these inert gases be in some way rendered inoffensive before they are allowed to pass away. The suggestions for their treatment which I propose to bring to your notice I will defer until we have considered the greater and more difficult matter of the gases escaping from the exit from the sulphur chambers after all the sulphur recoverable has been condensed.

These exit gases, in those works where the inert gases are separately drawn off, consist of about 50 per cent. of the nitrogen of the atmospheric air passed into the lime kiln, all the nitrogen of the air admitted to the Claus kiln to burn the H_2 of the H_2S, all the aqueous vapour produced by the reaction, sulphur in the condition of H_2S and SO_2 amounting to about 13 grains of sulphur per cubic foot of gas, some sulphur vapour and small quantities of oxygen and carbonic oxide. The bulk of the gases is of course enormous. At the works at which my experiments were made, producing about 60 tons of sulphur weekly, the volume of gas passing from the exit, exclusive of aqueous vapour, was 1,270,000 cubic feet per 24 hours. If carried with it, as H_2S and SO_2, sulphur amounting to 2,358 lbs. per 24 hours, equal to a weekly total of 6 tons, 16 cwts., 3 qrs. 0 lbs. of sulphur. In other words, of the quantity of sulphur as H_2S sent into the Claus kilns, there is a loss of sulphur in these exit gases amounting to over 10 per cent. of the whole—a very serious defect of the process.

Although this quantity of sulphur, contained in the exit gases, is so considerable a proportion of that actually liberated from the waste, yet it will be apparent that if it were all oxydised to sulphurous acid, and allowed to pass into the works chimney, the actual addition to the contamination of the atmosphere of a manufacturing district would be comparatively very small. The emanation of SO_2 from a large sulphur plant would not exceed that proceeding from the combustion weekly of 300 tons of fuel containing 2 per cent. of sulphur, and in a district in which many thousands of tons are consumed weekly, the very slight addition from these sources would be scarcely noticeable. But as these exit gases, besides SO_2 contain also H_2S in somewhat larger proportion than the SO_2, it is quite inadmissible to allow them to escape without prior treatment, and further, the loyal obedience of the alkali makers to the provisions of the Alkali Acts, which has been so often acknowledged by the Government authorities, has impelled them to adopt the "best practicable means" for the prevention of the nuisance likely to be produced.

The most obvious means of treatment is to burn the H_2S by heating the gas mixed with sufficient air so as to obtain all the sulphur in the condition of SO_2 when the further treatment becomes more simple. This combustion of the H_2S is not difficult though it entails considerable expenditure of fuel. The furnace used in this district is of similar construction to the old-fashioned "open" salt-cake furnace in which the flame passes first over the bed, and then through a series of flues underneath the bed. The exit gases from the sulphur plant are admitted by a channel in the bridge of the furnace, and becoming mixed with the fire gases, the whole travel together, and the combustion of the H_2S is so complete that not a trace can be detected at the outlet of the furnace.

Another plan of effecting the combustion of the H_2S and free sulphur has been proposed and patented by Professor C. W. Heaton. His furnace consists of a combustion chamber traversed backwards and forwards by a series of inclined tubes or chambers through which the exit gases, previously mixed with sufficient air, are caused to travel. Mr. Heaton calls this arrangement a "supplementary Claus kiln," but it has not the least resemblance to a Claus kiln, nor is the work to be done in any sense similar to that performed by the Claus kiln. The plan has been adopted by the Oldbury Company, and I am assured by them that the system is perfectly efficacious. I do not doubt that the H_2S can be completely burnt in such an apparatus, but I confess I do not see the advantage it possesses over the very simple furnace used in this district.

The exit gas after treatment in one or other of these furnaces, and now containing all the sulphur in the condition of SO_2 is, in some works, further manipulated with a view to the removal and detention of the SO_2. In neither of the processes which have been adopted is any valuable result obtained other than the diminution or absolute suppression of the nuisance that would arise from the passage into the air of the SO_2. But the product obtained is either totally valueless, or it is obtained at a cost out of all proportion to its value. In the one case the gas is conducted to a tower built on the plan first proposed by Franke, and which has been extensively used for the manufacture of calcium bisulphite for use in the wood pulp industry. The tower resembles the ordinary hydrochloric acid condenser, but instead of coke it is packed with lump limestone. Water is allowed to trickle down the tower in the usual way, meeting the ascending current of gas, and there runs from the bottom of the tower a solution of calcium bisulphite so very weak that it has no commercial value, and it is allowed to run to waste. In the Franke process in which pyrites gas is used, the solution of calcium bisulphite obtained tests from 6° to 8° Tw. which is sufficiently strong to disintegrate and bleach wood to be used in the manufacture of paper, but with this very dilute exit gas the strongest solution obtainable is, I am told, only 1° or 2° Tw., and it has no value.

The other process used for the abstraction of the SO_2 from this exit gas has seemed to me about the wildest and most impracticable which has ever been conceived, and yet it has been used by men who have proved themselves by no means deficient in ability as managers or manufacturers. This plan is to pass the gas into vitriol chambers with a view to convert the SO_2 into sulphuric acid.

Now, bearing in mind the enormous volume of gas to be manipulated, it will be understood how great is the difficulty to be overcome. Taking the case of the works I have mentioned, producing about 60 tons weekly of sulphur, the volume of gas passing from the exit is 1,270,000 cubic feet per 24 hours. After passing through the combustion furnace this bulk is largely increased by the addition of the fire gases, each 100 volumes of exit gas having added to them 76 volumes, and the total volume of the mixed gases to be dealt with becomes 2,235,000 cubic feet per 24 hours. The composition of this gas by volume, ignoring for the moment the aqueous vapour, is represented approximately by the following analyses made on different days :—

Sulphurous acid	1·18	1·26
Carbonic acid	5·02	4·44
Oxygen	4·20	6·60
Nitrogen	89·60	87·70
	100·00	100·00

Comparing this with the composition of ordinary pyrites burner gas, which is approximately—

Sulphurous acid	9·00
Oxygen	10·00
Nitrogen	81·00
	100·00

it will be seen that to convert the sulphurous acid into vitriol by the ordinary chamber process is a difficult problem. Even if it were possible, which it is not, to pass in a continuous current of the gas, and to get it of fairly constant composition, it is evident from its extreme dilution, either that the chamber space must be eight times larger than for the same weight of sulphur in pyrites gas or, if of the same size, that the gas must pass eight times more rapidly through the chambers. Either alternative seems to me, an old vitriol maker, to present great difficulties. But even this is not the worst of the case. The frequent entire suspension of the current, owing to temporary causes of various kinds, the complete stoppage of the Chance-Claus plant for at least 12 hours each week-end, and the irregularity of composition of the gas, would seem to make it impossible to control the reactions in the chamber by which vitriol is produced.

Lists of Tests at exit of Combustion Furnace.

No.	Grains SO_2 per cubic foot.	No.	Grains SO_2 per cubic foot.
1	13·90	10	17·37
2	14·00	11	18·59
3	13·80	12	15·35
4	17·08	13	14·20
5	15·91	14	14·84
6	20·00	15	15·53
7	23·56	16	15·53
8	11·90	17	18·60
9	16·84		

In this statement of the case I have so far assumed that only the exit gases from the chambers are treated as described for the production of sulphuric acid, and that the inert gases are otherwise treated. If these inert gases are not separately drawn off, as I think they ought to be, or if being drawn off they are brought to the combustion furnace together with the final exit gases, then the volume of gases is increased by 50 per cent., and the difficulties of treatment are correspondingly increased. Yet I am strongly of opinion that any process of treatment to be permanently successful must permit of the treatment of the gases from both outlets in one operation.

These plans of treatment, based upon the combustion of the H_2S to SO_2 and water, have no doubt been adopted, notwithstanding that they are so defective in their economical results, because of the facility with which the noxious H_2S is destroyed. The prevention of the escape of H_2S is an absolutely indispensable condition, and it may be that manufacturers will prefer to continue the initial step in the mode of treatment I have described. If so, then I venture to suggest a modification of the plan of treatment of the very dilute SO_2 gas. Instead of passing the gas into vitriol chambers and deranging, as I believe it does, the whole process of sulphuric acid manufacture, I propose to pass it direct from the combustion furnace (in the flue from which a small quantity of nitrate of soda may be decomposed as usual) first through a Glover tower, to which is supplied a limited quantity of nitrous vitriol, then through a lead flue or flues of sufficient capacity to ensure the cooling of the gas, and then direct to a Gay-Lussac tower, worked in the ordinary way, to absorb the nitrous gases liberated and any vapour of sulphuric acid. I believe that by this treatment the greater part of the SO_2 would be arrested and converted into vitriol, and I know no reason why the process should not succeed. That there would be no difficulty in passing the volume of gas we have to deal with through a Glover and Gay-Lussac tower may, I think, be taken for granted. At the works with which I am connected the volume of gases passing from a set of vitriol chambers and entering a Gay-Lussac tower is 1,780,000 cubic feet per 24 hours, and with this quantity passing the damper is more than half closed. The volume of gas to be passed from the Chance-Claus final exit is 2,235,000 cubic feet, or 25 per cent. more than is passed from the sulphuric acid chambers to the Gay-Lussac tower. If the inert gases, after having been passed through the combustion furnace, are united to the final exit gases, the total volume would be increased to about 4,000,000 cubic feet, and I believe even this quantity would be passed through the apparatus without difficulty. But there is a difficulty to be overcome arising from the presence in the gas of too large a quantity of aqueous vapour in proportion to the SO_2 present. The tests I have made show an average of about 13 grains of H_2O per cubic foot, and if the whole of the SO_2 present were converted into H_2SO_4, and the whole of the water condensed, the strength of the acid produced would be about 126° Tw., and as it is quite probable that some SO_2 would escape oxidation, whilst the whole of the H_2O would be condensed, the acid produced would probably not exceed 120° Tw. But the acid to be supplied to the Gay-Lussac tower must not be lower than 150° Tw., and therefore the excess of water must in some way be removed. If the situation of the sulphur recovery plant is such that the acid from the Glover tower can be conveyed easily to the salt cake department, the matter would be quite simple. In that case the weak acid would be used in the manufacture of salt cake and the necessary supply of acid of 150° Tw. taken from the usual source. But in neither of the St. Helens sulphur works is this practicable otherwise than by conveying the acid to and fro in tanks. It is perhaps also desirable that the sulphur recovery plant should be self-dependent, as in some of these works no salt cake is manufactured.

If then, the excess of water must be removed, two alternative processes are available. In the first, the gases from the final exit would require to be sufficiently cooled to permit of the condensation of a portion of the water before being passed to the combustion furnace. The aqueous vapour required to be removed is about 4 grains per cubic foot, and it should retain about 9 grains. Some sulphur would also be removed and recovered by this means; first, by the condensation of sulphur vapour, and secondly, by the reaction between the H_2S and SO_2 present. The other alternative is to pass the gas, wet as it is, first through the combustion furnace and then to the Glover tower, and afterwards to concentrate the acid obtained by boiling down in the usual way, and so get rid of the excess of water. On the whole, I am disposed to think the latter the best mode of procedure. The reactions in the Glover tower would certainly be more favourable in presence of the excess of water than without it. The quantity of water to be driven off, in a works of the capacity of which I have been speaking, that is producing about 60 tons of sulphur weekly, would be about 36 tons per week, or say 6 tons per day. I estimate the costs that would be incurred in working such a plant as follows:—10 tons of fuel, 50*s.*; wages of 2 men, 60*s.*; loss of nitre, 10 cwt.; 5*l.*, or a total of 10*l.* 10*s.* The produce obtained should be sulphuric acid equal to 24 tons of salt cake, the value of which acid at 15*s.* per ton is 18*l.*, leaving a margin for maintenance of plant, and some little profit.

I have brought these suggestions before you in some detail for the reason that this plan of treatment would be most easily adapted to the plants as they at present exist. In all the works in this district the arrangements for burning the H_2S to SO_2 and water are complete and in actual operation. It is therefore necessary only to provide the means of treatment of the dilute SO_2 already at one's disposal and a source of nuisance until it is condensed. But I may say at once that I am not satisfied with this or any of the methods of treating these exit gases which have been proposed or adopted, the basis of which is the conversion of the H_2S and free sulphur into sulphurous acid. It is the main purpose of the manufacturing chemist to convert a given substance of low value into a form in which the value is greatly increased, and it is the constant effort of the technical chemist to increase the yield of the more valuable substance, and to minimise the cost of conversion. The conversion of the sulphur of pyrites into free elementary sulphur of very high purity, in which condition its value is increased four-fold, is a case in point, and the obtainment of this sulphur in the condition of hydrogen sulphide is a very long step in advance towards the liberation of the sulphur in the free or elementary condition, and it does seem to me, having proceeded thus far, by no means satisfactory to retrace one's steps and to reconvert this hydrogen sulphide into substances so much less valuable. I must now therefore ask your attention to some suggestions as to the treatment of these waste gases, the purpose of which is to obtain products of greater value than the substances used to produce them.

You will have in mind the plan adopted in the early days of the Chance-Claus process for avoiding the nuisance that would arise from the escape of the final exit gases, viz., the passage of the gases through dry lime scrubbers or purifiers. It was not anticipated that the lime compound obtained would possess any value, and as a matter of fact the anticipation was realised. The stuff as emptied from the scrubbers was a very heterogeneous mixture, some of it quite dry, and some of it so wet as to be almost sloppy, and it was carted away to the nearest waste heap. It consisted of calcium sulphite, calcium carbonate, calcium sulphide, free sulphur, and some other matters.

Just at the time this method of treatment was abandoned I was fortunate enough to secure samples of the material in various stages of saturation, but the pressure of other work at the time prevented me following up the matter. Eventually, after long delay, I made analyses of the several samples, only one of which it is necessary now to particularise. This material was perfectly saturated, that is, it was in such condition that no further change was produced by continued passage of the gases through it. Its composition was

	Per Cent.
Calcium sulphite. $CaSO_3H_2O$	60·00
Sulphur, free........................	22·59
Other matters	11·41
	100·00

This substance possessed for me considerable interest, for the reason that some years ago I had devoted much time to the cheap production of calcium bisulphite of the highest possible density, viz., 25° Tw., and following the process which I patented, I think in 1884, very pure calcium bisulphite of 22° Tw. was obtained. The process is very simple. A quantity of the crude sulphite is divided into two equal parts. The one part is finely ground and mixed with water; the other part is treated with just sufficient hydrochloric acid to decompose it, and the sulphurous acid liberated is passed into the watery mixture of the first part. Solution of the calcium sulphite is effected and calcium bisulphite is obtained of higher density than can be obtained by any other means commercially applicable. The free sulphur remains undissolved by the hydrochloric or the sulphurous acid, but mixed with other insoluble matters, and after separation from the solutions by deposition or filtration, it is recoverable as pure brimstone by treatment in the steam melter under pressure.

On further consideration of the composition of this crude mixture of calcium sulphite and free sulphur, the idea suggested itself that by proper treatment, it was convertible into calcium hyposulphite, and that by decomposing this with sodium sulphate, sodium hyposulphite might be obtained. The quantity of free sulphur present, viz., 22·59 per cent., is more than is required by the 57·40 per cent. of $CaSO_3$ according to the equation—

$$CaSO_3 + S = CaS_2O_3,$$

which requires only 15·30 per cent. of sulphur.

But before proceeding further, it seemed to be important to determine the circumstances under which this crude mixture of calcium sulphite and sulphur was produced, and whether or not one might rely upon a supply of fairly constant composition. Shortly stated, it was found that when the final exit gases were passed over or through dry hydrate of lime, in the first instance, the H_2S, the SO_2 and CO_2 were all absorbed. Afterwards, when the lime has become partially saturated, the SO_2 only is completely retained and the H_2S and CO_2 pass on and are absorbed farther on in the purifiers, the final result when SO_2 ceases to be absorbed by the first layers of material, being that the calcium sulphide and carbonate first formed have been decomposed, the SO_2 has reacted upon the calcium sulphide leading to a liberation of free sulphur, and the mass remaining is essentially a mixture of calcium sulphite and free sulphur, having approximately the composition represented above. The ultimate production of a mass consisting mainly of calcium sulphite and free sulphur seems to be constant in the actual work of the purifiers if the passage of the gases be continued until no more is absorbed.

Experiments were now made with specially prepared calcium sulphite containing 94·30 per cent. $CaSO_3H_2O$, by adding the theoretical quantity of sulphur and heating with water. Calcium hyposulphite was produced, but after several hours continuous treatment, only 26·78 per cent. of the calcium sulphite was converted. Calcium sulphite itself is very insoluble in water, and on this account it does not readily take up sulphur. Moreover, calcium hyposulphite in solution begins to decompose into calcium sulphite and sulphur if the temperature be raised above 140° Fahr., so that positive harm would ensue on boiling the mixture.

It was next tried to obtain conversion of the sulphite into hyposulphite by adding to the mixture of calcium sulphite and sulphur the necessary quantity of sodium sulphate to produce sodium hyposulphite and boiling the mixture for three hours. The result was better, but still quite unsatisfactory, the quantity of sulphite converted to hyposulphite being 38·64 per cent. The possibility of using sodium sulphate as the decomposing agent seemed then doubtful.

It was then tried to produce sodium hyposulphite by boiling together a mixture of calcium sulphite with sulphur and sodium carbonate in the quantities theoretically necessary, and this was quite successful, the decomposition was almost complete, the quantity of sodium hyposulphite obtained being 93·66 per cent. of the quantity possible to be produced.

Next, a quantity of material from the purifiers, of which the following is a complete analysis, was tried:—

Calcium sulphite, $CaSO_3$	40·15
„ carbonate	25·23
„ sulphate	3·33
„ oxide	1·51
Alumina and ferric oxide	0·55
Free sulphur	15·17
Sawdust	4·38
Mineral matter insoluble in acid	1·95
Water combined with $CaSO_3$	6·02
„ „ „ CaO	0·49
Moisture (not determined)	1·22
	100·00

The lime with which the purifier had been charged was the waste dross from the lime kiln, and the sawdust was added to give porosity to the mass. The sulphur present in this is also in excess of the quantity required, 40·15 per cent. of $CaSO_3$, requiring 10·70 per cent. of sulphur.

This material was finely powdered, and with the theoretical quantity of sodium carbonate, boiled with water. The decomposition was perfect after one hour's treatment, and the theoretical quantity of sodium hyposulphite was obtained. But the crystals were brownish coloured, and the last crystals from the final mother liquor were deep brown, owing to the action of the liquor on the sawdust present.

A further experiment was made on a portion of material from the purifiers to which sawdust had not been added. This material was in the purifiers when they were thrown out of work, and was not saturated with sulphur gases. It was also very wet. The Chance-Claus escaping gases were passed through a portion of this material until SO_2 came freely through. The product was still very wet. It contained no sulphide but some thionate, probably trithionate CaS_3O_6, had been produced.

The composition was as follows :—

Calcium sulphite, $CaSO_3$	34·70
Thionate taken as CaS_3O_6	10·88
Calcium sulphate	4·47
„ carbonate	7·08
„ oxide	1·50
Free sulphur	13·15
Mineral matter insoluble in acid	2·60
Water lost at 212° Fahr.	18·20
Combined water, &c.	7·42
	100·00

This material, after being crushed, was first washed with water to remove the thionate which is readily soluble. It was then boiled with water to which was added the quantity of sodium carbonate necessary to decompose the calcium sulphite and sulphate. The solution of hyposulphite obtained was yellow owing to the presence of a polysulphide. This was ascertained to be due to the small quantity ($1\frac{1}{2}$ per cent.) of free lime which gave rise to the production of its equivalent of caustic soda which in turn dissolved a little of the free sulphur. To destroy the polysulphide, carbonic acid was blown through the solution until it was decolourised. The solution then boiled down to the crystallising point, gave large, clear, and colourless crystals of pure sodium hyposulphite, and the yield was equivalent to the whole of the calcium sulphite contained in the material used. The sulphur acids which had been consumed in the production of thionate were however lost, and there was also a loss of 3·90 per cent. of the free sulphur, the total loss of sulphur being 31·23 per cent. of that available for the production of hyposulphite.

Attention was now directed to the elucidation of the circumstances which give rise to the production of thionates. They can be easily washed out of the material but with some loss of available sulphur, and if they are not removed the solution of hyposulphite when concentrated to the requisite degree becomes turbid from separation of sulphur.

The most striking difference in the composition of the material upon which the experiments have been tried, is that the first, viz., that which had been perfectly saturated in the purifiers, and which contains no trace of thionate or hyposulphite, was quite dry, whereas that which contained thionate was wet, containing 18 per cent. of uncombined water. Some experiments with soda solutions, in which thionate was largely produced, also seemed to show that the production of thionates was induced by the presence of much water. To avoid this, it was first tried to use unslaked lime as the absorbent, but this proved quite ineffective. The gas was partially dried, but the sulphur constituents passed through almost unaltered. A mixture was next made of equal parts of unslaked lime coarsely crushed, and of lime slaked to a dry hydrate, and the gases were passed through the mixture. This was not effective at first in the complete absorption of the sulphur gases, but after a little while both the H_2S and SO_2 were completely absorbed; afterwards H_2S passed freely away, the SO_2 being retained. The current of gas through the material was continued until SO_2 came freely through, and it was observed that as the mass approached saturation with SO_2, water vapour passed through unabsorbed. The composition of the material so obtained was as follows :—

Calcium sulphite, $CaSO_3$	48·80
„ hyposulphite, CaS_2O_3	7·45
„ sulphate	1·05
„ carbonate	16·33
„ oxide	3·96
Free sulphur	4·12
Insoluble in acid	0·16
Water combined with $CaSO_3$	7·32
„ „ „ CaO and $CaSO_4$	1·45
„ lost at 212° Fahr.	8·80
	99·47

No thionate could be detected, but instead, hyposulphite was found, and it was observed that this gradually decomposed into calcium sulphite and free sulphur. Within a period of seven days the percentage of hyposulphite was reduced from 19·76 to 7·45 per cent., the percentage of sulphite being correspondingly increased. The quantity of free sulphur contained in this product is insufficient for the conversion of the sulphite into hyposulphite, and it is evident that in an experiment of this kind the reactions in the purifiers, and especially the effects produced by the higher temperature, are not exactly imitated. In *all* the samples of material from the purifiers, *more* free sulphur has been found than is required for the conversion of the sulphite present into hyposulphite. But the experiment demonstrates that, in the absence of much water thionates are not produced, and that if formed in the wet material in the purifiers, they are decomposed as the mass becomes more dry and as the temperature increases by prolonged passage of the hot gases. The drying of the mass in the later stages is accounted for by the conversion of the calcium carbonate into sulphite, which at the moment of formation assimilates to itself a molecule of water to produce the perfectly dry sulphite $CaSO_3H_2O$.

The manufacture then of sodium hyposulphite from these waste gases seems to be quite feasible, and assuming that the loss of sulphur now escaping amounts, in the case of the words I have cited, to seven tons weekly, which is quite within the truth, and that this could be all converted into hyposulphite, it would yeild 27 tons of that salt. But there will inevitably be some loss of sulphur. by reason of the difficulty of ensuring that the gases entering the absorbers shall contain the H_2S and SO_2, in the exact proportions required to produce calcium sulphite with the necessary quantity of free sulphur; also by conversion of some sulphur to sulphate and by mechanical losses. Sulphate of soda would accumulate in the mother liquors to a greater extent than is revealed by the foregoing analyses, for reasons that will be mentioned later. But there need not be any considerable loss of hyposulphite by reason of this admixture, for, on concentrating solution of hyposulphite containing much sulphate, the latter salts out and can be removed very completely by fishing. Allowing a large margin for possible losses of every kind, it seems certain that at least 20 tons weekly of sodium hyposulphite could be produced at these works.

The gases leaving the Chance-Claus chambers, contain sulphur in the proportion of about nine grains, as H_2S to seven grains as SO_2 per cube foot, and it is necessary to maintain approximately this proportion. The yield of sulphur in the Claus kiln and chambers is undoubtedly greater when the H_2S is in this excess than when SO_2 predominates. But in order to utilize the whole of this sulphur in the production of hyposulphite, the relative proportions of H_2S to SO_2 must be modified before the gas is passed to the purifiers. The re-action between these gases and lime which leads to the production of hyposulphite or rather the mixture of calcium sulphite and sulphur, which is subsequently convertible into hyposulphite, is as follows :—

$$3\,CaO + 2\,H_2S + 4\,SO_2 = 3\,CaSO_3 + 3\,S + 2\,H_2O.$$

This requires that there shall be two parts of SO_2 for each one part of sulphur as H_2S. These proportions would be obtained by drawing from the flue by means of a Roots' blower two-fifths of the volume of the gas, burning the H_2S in this to SO_2, and then conducting it to the purifiers together with the other three-fifths of unburnt gas. There is no difficulty about this operation, but it may have a slightly prejudicial effect upon the quality of the product by the oxidation of some sulphite to sulphate by the free oxygen introduced with the furnace gases. I assume also that no insuperable difficulty would arise from the passage of the inert gases, containing a comparatively trifling quantity of H_2S. Testing of the gases at the entrance to and exit from the purifiers would enable one to maintain the necessary proportion of SO_2. The sodium carbonate used in the process would, of course, be in the form of black ash vat liquor, and for two reasons it will be necessary to carbonate this liquor and to carry the carbonation so far as to produce a little sesqui or bicarbonate. Vat liquor always contains some sodium hydrate, and the material from the purifiers will always contain a little lime which has escaped the action of the sulphur acids. Either sodium hydrate or calcium hydrate, when boiled with free sulphur, dissolve it, producing a polysulphide. This would be avoided by the carbonation of the vat liquor. The quantity of CO_2 required would be approximately the quantity produced by burning 32 cwts. of limestone, and would be obtained from the surplus gases of the lime kiln.

To minimize as much as possible the evil arising from the presence of so much aqueous vapour in the gases, I propose to mix the slaked lime for the purifiers with crushed unslaked lime to the extent of 20 or 25 per cent., or as much as it is found in practice can be introduced without interfering with the absorbent quality of the mixture. This also gives to the mass the necessary porosity, and will dispense with the sawdust before used for that purpose.

Now, as to the probable cost of production, the quantity of sodium carbonate required to produce one ton of sodium hyposulphite, allowing 10 per cent. for losses, would be the quantity of vat-liquor equal to 10 cwt. of 56 per cent. soda ash, and of lime there would be required eight cwt.

Other items of cost I estimate as follows :—

	£	*s.*	*d.*
Vat liquor = 10 cwt. of 56 per cent. soda ash ..	2	0	0
Eight cwt. lime at 12*s.* 6*d.* per ton	0	5	0
Wages at purifiers and grinding	0	3	0
Fuel, say two tons at 5*s.* 6*d*......................	0	11	0
Process wages, say..............................	0	5	0
Casks	0	10	0
	3	15	0

There still remains the question, perhaps the most crucial of all, viz., is there probability that a market would be found for the large quantities of materials possible to be produced by the processes I have ventured to suggest? I am afraid that at present the answer must be in the negative. But as to this point, I am not old enough to remember the time when the late Mr. James Muspratt first began to manufacture black ash and had to give it away to induce consumers of alkali to give it a trial. But I do remember when the manufacture of caustic soda was first commenced, that Messrs. Muspratt made a present of a large parcel to a London soap-maker and that even then the soap-maker declined to continue to use it, and I do remember being engaged, on behalf of Messrs. Muspratt, with Mr. George Routledge, who first introduced esparto grass to the paper-makers, in some experiments on the use of caustic soda in that manufacture and that it was very difficult to persuade the paper-makers of its value for the purpose. But the consumption of caustic soda increased "by leaps and bounds," and so it may be with hyposulphite and calcium bisulphite when produced at low cost. The principal use of hyposulphite at present is in the paper and textile industry as antichlor. Probably it would be largely used, if at a sufficiently low cost, in the extraction of silver from some of its ores. Calcium bisulphite is manufactured now in considerable quantities, principally for brewer's use, and there are numerous works for its production scattered all over the country. The sulphurous acid for its manufacture is, I believe, obtained almost solely by heating rectified sulphuric acid with charcoal, which is of course a very costly procedure compared with the process I have sketched, whilst the fact that bisulphite of 4° or 5° Tw. higher can be obtained by the method I have indicated than by any other process commercially available, is a further advantage.

There is one other possible outlet for the material—I mean the mixture of calcium sulphite and free sulphur obtained in the lime purifiers—which perhaps I ought to mention, though I am not sanguine, that a high price would be obtained for it for the purpose. The paper makers now largely manufacture wood pulp by the bisulphite process at their own mills, producing the sulphurous acid required, in some cases by burning brimstone, and in others pyrites, and conducting the dilute SO_2 into milk of lime. The mixture of calcium sulphite and free sulphur evidently contains all the material required for the purpose. Treated with sulphurous acid it would yield the solution of calcium bisulphite required, whilst the sulphur left undissolved, when dried and burned, would yield the sulphurous acid wanted.

It may be that the suggestions I have ventured to lay before you may not be the true and perfect solution of the difficulty to be overcome. But the matter cannot be allowed to continue indefinitely in its present unsatisfactory condition. "In the multitude of councillors there is wisdom," and let me hope that my contribution may not be an altogether fruitless effort towards the elucidation of the problem.

Manchester Section.

Chairman: Ivan Levinstein.

Vice-Chairman: Edw. Schunck.

Committee:

J. Angell.
G. H. Bailey.
F. H. Bowman.
R. F. Carpenter.
G. E. Davis.
H. Grimshaw.
J. Grossmann.
P. Hart.
J. M. Irving.
E. Knecht.
Sir H. E. Roscoe, M.P.
C. Truby.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. Dreyfus and W. H. Perkin, jun.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893.

Meeting held Friday, 7th April 1893.

MR. IVAN LEVINSTEIN IN THE CHAIR.

DISCUSSION ON TOWN SMOKE.

The **Chairman** said Dr. Bailey had shown by experiments that the deficiency of light in the Hulme district of Manchester was stationary, and that the atmosphere was as impure on Sundays as on week days, considering that Hulme was not a manufacturing district. This fact went to prove what has already been shown by other experts, that the impurities in the Manchester air were not altogether due to the factory chimneys, but were due to a large extent to domestic fires and heating warehouses. If this were correct it was at least as important that something should be done to prevent the smoke nuisance from houses as well as from factories. A number of remedies had been suggested, and many years ago it was proposed to erect chimney shafts to conduct the smoke, after being washed, by means of underground flues from the houses and warehouses, and if such a scheme could be practically carried out, there was no doubt the air of Manchester and other large towns would become much purer. Personally he did not see any insurmountable difficulties in the way of accomplishing this object, except the question of expense. Another remedy which had been suggested was the use of gas instead of coal for heating purposes, but one objection to its universal use was its present high price. Other suggestions made from time to time were smoke consuming fire-places, the use of anthracite, &c.; and if the discussion was to be of any practical value it should be confined to the consideration of preventive means of the smoke nuisance from domestic as well as from warehouse fires.

Mr. **Grimshaw** said, from the figures quoted by Dr. Bailey it would appear that manufacturers only contributed about 20 per cent. of smoke pollution in large towns, judging from the percentage of light obstructed in the various districts. He was much more hopeful than the Chairman was of the likelihood of freeing our large towns of the smoke nuisance by the use of gas and coke to a larger extent. He had come to this opinion many years ago and saw no reason to modify that opinion.

Dr. **Bowman** thought it was quite possible for gas-manufacturers to produce a much cheaper gas, equally good for heating as for lighting purposes, and it would also have the great advantage that with the introduction of cheaper oxygen they would be enabled to use their coke up in producing water-gas, which would increase their by-products and give a larger volume of gas. The introduction of the electric light would render the illuminating power of gas not quite so essential, and in the course of time people would look back to the present system as a very barbarous one.

Mr. **Wm. Thomson** suggested that a few large fire-bricks of about 2 ft. × 18 in. × 4 in., standing on end at the back of the furnace, in the case of boilers, and becoming red hot, was, even in hand-fired boilers, sufficient to keep up the temperature of the gases on firing to prevent the formation of black smoke; and he thought this simple device might be adopted with great advantage to a large extent in and around towns like Manchester.

Dr. **Carpenter** remarked that he had seen small installations of gas engines worked by the Dowson gas, which was very much cheaper than towns' gas, and which could be raised at small cost. They might be more generally adopted by warehouses requiring power with advantage, inasmuch as the foul products were not so great as from the exhaust of the ordinary gas engines.

Mr. **Terry** thought the question amounted to this: they were either to burn (1) gas, (2) anthracite, or (3) ordinary coal in an improved grate, and, to his mind, the only solution of the difficulty was to be found in the last proposal. He thought it ought to be made more widely known that smoke did not contain any of the benzene hydrocarbons, inasmuch as sanitary reformers were fond of saying that there was a mine of wealth in the smoke which was allowed to pass up our chimneys, whereas the fact was that the hydrocarbons produced were paraffins, and not benzenes. With regard to ammonia from house fires, very little was produced, inasmuch, as if coal was properly burnt, the nitrogen was evolved in the free state.

Dr. **Bailey**, in reply, said they had had the question of the smoke nuisance caused by furnace fires before them on several occasions, and he thought that the evils arising from domestic fires were worthy of discussion, as there were very few householders who knew anything about the burning of fuel. At the Smoke Abatement Exhibition in 1882, experiments showed that when grates were well stoked and looked after, the results were just about as good as the average works chimney, but experience showed that house coal was burnt in a much more slovenly manner than works fuel. With regard to the remedies, that of utilising gaseous fuel was a very tempting one, but it was fraught with difficulties, and he must say that those who hoped to see it carried out within reasonable time had more faith in the progress of such matters than he had. They must set aside the idea once for all, that the Corporation of Manchester would ever think of putting down two sets of pipes; indeed it was unreasonable to expect that separate services should be laid for gas for heating purposes. A gas might be cheaply supplied suitable both for heating and illuminating purposes—say of 10-candle power—and then enriched by the use of Albo-carbon. He felt that in an increased supply and use of gas would be found the solution of the problem of how to purify the atmosphere of all large towns. Gaseous fuel had an outlook worth considering, and when people were educated up to the point of feeling that some sacrifice must be made, no doubt such a scheme would be more likely to be taken up than it is now. Moreover, they were within reasonable distance of an extended application of the electric light, and if even a portion of Manchester could be relieved of this combustion of crude coal, immense relief from fog and the depressing condition of the atmosphere which now prevailed would be obtained. With regard to the immense amount of sulphur left in the gas by the Corporation, there could be no reasonable doubt but that a large portion of this ought to be removed, as its effect was to render the air of rooms where much gas was burnt absolutely intolerable.

Newcastle Section.

Chairman: A. Allhusen.
Vice-Chairman: John Pattinson.
Committee:

P. P. Bedson.
G. T. France.
G. Gatheral.
T. W. Hogg.
John Morrison.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
W. A. Rowell.
T. W. Stuart.
John Watson.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

SESSION 1892–93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

(Sectional Election unavoidably postponed.)

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: L. Archbutt.
Vice-Chairman: F. Clowes.
Committee:

F. J. R. Carulla.
J. B. Coleman.
C. H. Field.
H. Forth.
F. D. Mordle.
S. J. Pentecost.
H. J. Staples.
C. Taylor.
Sir John Turney.
G. J. Ward.
J. T. Wood.

Treasurer: J. M. C. Paton.
Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* J. M. C. Paton; *Vice-Chairman:* C. Spackman; *Treasurer:* J. T. Wood; *Committee:* L. Archbutt, F. Clowes, and J. O'Sullivan.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892–93.

Meeting held Wednesday, 1st March 1893.

MR. L. ARCHBUTT IN THE CHAIR.

THE HYDROGEN-FLAME TEST FOR INFLAMMABLE GAS OR VAPOUR IN THE AIR APPLIED TO AN ORDINARY MINERS' SAFETY-LAMP.

BY PROFESSOR F. CLOWES, D.SC., &c.

(ABSTRACT.)

PROFESSOR CLOWES showed the compact and portable form which his hydrogen oil safety-lamp has recently assumed, and illustrated by means of diagrams and lantern slides the very delicate and accurate results which the lamp yielded in detecting and measuring small percentages of fire-damp, coal-gas, water-gas, and petroleum vapour in the air by means of the "flame-cap." The lamp presented the advantage of perfect safety in air containing any proportion of inflammable gas or vapour; it further served as a good illuminator, as an ordinary rough indicator of "gas" by means of its full or reduced oil flame, and as a most accurate and delicate indicator and measurer by means of its standard hydrogen flame.

The hydrogen supply for the lamp was carried in the pocket in a small steel cylinder. The gas was compressed in this cylinder under about 100 atmospheres, and this supply furnished the standard 10 millimetre hydrogen flame burning continuously for about 40 minutes. This would serve for about 80 separate tests. When the hydrogen flame was required, the cylinder could be instantaneously attached to the lamp, and when the gas was turned on it furnished a supply to a jet beside the lamp-flame, which at once kindled it. The ordinary lamp-flame was extinguished during the test, and was rekindled from the hydrogen-flame after the test had been completed. The hydrogen-flame was then extinguished and the cylinder detached.

The hydrogen flame had long been acknowledged to be the flame best adapted to accurate and delicate gas-testing, but it was now for the first time brought into practical use, and the author was the first to carefully measure and tabulate its indications.

It will be readily understood that the main advantages resulting from the use of the hydrogen flame are the following:—

1. The flame is non-luminous, whatever its dimensions may be, and therefore does not interfere with the perception of the cap.

2. The flame can always be adjusted at once to a standard height and maintained at that height sufficiently long for the completion of the test; whereas other testing flames are constantly varying in dimensions, and most of them cannot be set to standard size at all with any certainty.

Thus a colza-petroleum flame exposed in air containing a low percentage of gas when twice adjusted gave caps of 8 and of 20 mm. The reduced oil flame often fell so quickly that cap-readings with low percentages of gas could not be taken at all.

3. The caps produced over the hydrogen flame are larger than those produced by any flame of corresponding size.

4. The size of the hydrogen flame can therefore be so far reduced as to enable it to be used in an ordinary safety-lamp.

The size of the flame may further be suitably varied so as to increase or decrease the height of the cap, and thus either increase the delicacy of the test or extend its range.

5. The hydrogen flame shows no trace of mantle or cap in air free from gas; it resembles the Pieler flame in showing only a slender thread above its apex. The colza-petroleum and the benzoline flames show pale mantles in gas-free air, which may be easily mistaken for a small percentage of gas.

6. The standard hydrogen flame burns vigorously, it is of fair size, and therefore cannot be extinguished by accident; whereas the reduced flames ordinarily used in testing burn feebly and are readily lost.

7. Hydrogen is supplied pure and of practically invariable composition; whereas oil and alcohol are apt to vary much in composition, and therefore to give flames whose indications vary with the sample of liquid which is being burnt.

The hydrogen-oil lamp has been found by use in the coal mine to be thoroughly practical. Its indications are not interfered with by the coal-dust usually present in the air of the mine. Those used to testing for gas in the ordinary way adopt it with little, if any, previous training.

DISCUSSION.

MR. W. P. THOMPSON asked if luminous paint could not be used for a scale at the back of the lamp.

The CHAIRMAN asked what provision was made to allow for the gradual falling off of pressure in the larger cylinder after the smaller one had been charged several times. As the small cylinders would no doubt stand a much greater pressure, would it not be an advantage to prepare the hydrogen on the spot?

Mr. Wood observed that the small amount of air originally present in the cylinder was not cleared out before filling it with hydrogen. Did that matter?

Professor Clowes said in answer to Mr. Thompson that they had used luminous paint for a scale at the back of the lamp for getting light in the dark, but it was not at present satisfactory, the paint being damaged by the flame when the lamp was moved about. In answer to the Chairman's queries as to the safety of the cylinders, Mr. Paton had guaranteed the cylinders for a considerably higher pressure than he had used. As regards the storage of the gas at much higher pressures, there was one objection to a higher pressure, and that was the risk of a man turning on the gas too quickly. He found that the pressure he had used was the highest advisable. There was a sufficient supply of hydrogen in the large cylinders to prevent the pressure in the small cylinders becoming too low even after some hundred charges. He did not think the idea of the Chairman of making hydrogen at the pit was a good one. Making hydrogen was a chemical process which was rather foreign to the miner, and it would be cheaper to send to some centre—of which there were many—for the purpose of obtaining this gas ready made and stored under pressure.

In answer to a question by Mr. Wood, the lecturer said that it was suggested that the opening left by the removal of the cylinder from the lamp might allow a flame to pass through and lead to a gas explosion. He, however, found that there was no fear of this happening. It was a common practice to bore a hole through the glass of the safety-lamp to heat a wire for the purpose of firing a fuse. These lamps had been carried into the most dangerous parts of a mine and found to be quite safe, the present opening was absolutely safe. He had thoroughly tested the lamp himself, and there was not the slightest appearance of risk. Mr. Wood had asked whether it was safe to neglect the air in the cylinder to begin with. The quantity of air was so infinitesimally small as compared with that of the hydrogen that there was not the least risk.

* * *

Meeting held Wednesday, 29th March 1893.

SOME NOTES ON SILK BLEACHING.

BY S. J. PENTECOST, F.C.S.

While much useful information on the subject of silk bleaching may be obtained from the few books which treat of silk dyeing some of the statements made therein are either indefinite and misleading or in one or two cases positively erroneous. In the following notes, I propose to review some of the principal methods used, to compare and examine their efficiency, and to mention details of one or two processes more recently introduced.

Silk is composed of the yellow or white filaments which the silkworm spins about itself, when entering the chrysalis state. The thread issues from the caterpillar as a double fibre seen under the microscope as two smooth cylindrical filaments cemented together by the silk gum, and this it throws around itself to form the cocoon. As soon as completed these cocoons are collected and heated in ovens, or by steam to 130° F. to kill the pupæ or insects; should these burst in this process, they soil the silk and these cocoons are put on one side. The outside loose flossy silk—about 18 to 30 per cent. of the whole—is removed before steaming, and with the soiled cocoons is used for spun silk.

There are several varieties of silk which require more or less different treatment when bleached, and these may be conveniently divided as follows:—

1. Cultivated silk	(1.) White and yellow reeled silk from China and Italy. (2.) Spun silk. (3.) Schappe.
2. Wild silk.....	Tussur.

For the production of the reeled China and Italian silks, a few dried cocoons are placed in the basin of the reeling machine which contains hot water; several ends are then taken up and reeled or twisted into a single thread. Two or more of these are again twisted or thrown by the silk throwster, and constitute the raw silk of commerce.

Spun silk is made of the waste silk of the reeling processes, and consists of silk which cannot be reeled in a continuous thread, viz.:—

(1.) The external floss silk, with outer and inner portions of the thread.

(2.) Soiled, double and defective cocoons. The silk from these sources is boiled off—all the gum being removed—then combed or carded and spun similarly to worsted or cotton yarns.

It is not generally known, I believe, that much of the spun silk produced, is tinted, before being spun with blue or other colouring matter. I have often had cause to suspect that some of the spun silks worked up in lace fabrics have been weighted also; and I am informed that the weighting of waste or spun silk is carried on to a large extent. It is therefore not surprising that at times silks which look clean and lustrous in the fabric before bleaching and dyeing, turn out poor in colour and dull in appearance after these processes are carried out. The dyer is blamed for this result, whereas the mischief is really caused by the silk spinner or manufacturer. Such practices are to be regretted; and although it is possible to weight silk up to 60 per cent. without materially impairing its colour, lustre, or strength; such weighting if required should be left to the silk bleacher. Much of the material used for this purpose is liable in conjunction with the oxidation bleaching processes to tender the fibre causing loss and damage. Raw silk is also sometimes found to be weighted in a similar manner.

Schappe silk is made in the same way as "spun," but is not boiled off before spinning being merely softened. In the stripping process it generally gives off a disagreeable odour of decomposed chrysalides.

Tussur silk is the most important of the wild silks. The cocoons are larger than those of the Bombyx Mori, and are of a greyish fawn colour. They are very hard, the fibres being stuck together by a peculiar secretion of the caterpillar which gives to the silk its drab colour. Much of this silk is combed or carded and spun, the reeling being difficult, although reeled Tussur is much more largely produced than formerly. The fibre is thicker and stronger than cultivated silk, and under the microscope shows striations which appear to be small fibrets, cemented together into one whole fibre.

Broadly speaking silk consists of an inner cylinder of fibroin and an outer coating of sericin or silk gum, the latter being about 20 per cent. to 26 per cent. of the whole. Reeled Tussur has about 22 per cent. sericin, which may be boiled off. According to Bastow and Appleyard on treatment afterwards with alcohol, a brown wax light substance may be obtained, easily soluble in NaHO, slowly in Na_2CO_3 and rapidly soluble in soap. Another constituent of Tussur silk which is important to the bleacher is lime. Lime and magnesia salts are present to the extent of about 1 per cent. of the fibre. On calcining a few grams of the fibre in a platinum crucible at low red heat 5·34 per cent. of inorganic substances were obtained as follows:—

	Per Cent.
Soda (Na_2O)........................	12·45
Potash (K_2O)........................	31·63
Alumina (Al_2O_3)........................	1·46
Lime (CaO)........................	13·32
Magnesia (MgO)........................	2·56
Acid radicles, &c........................	39·0

The means adopted for removing this lime will be mentioned further on.

In nearly all cases when silk is to be bleached it is put through the preliminary process of stripping and boiling off.

Stripping.—The operation of stripping consists in working the silk in a bath of soap solution for about half an hour, with the object of first soaking and softening the silk glue and afterwards partially removing it, together with the loose dirt, grease, &c., which has become attached to the silk during the manufacturing processes. For this purpose a solution of 13 lb. soap in 100 gallons of water is used at about 190° F. This liquor, containing the silk gum, can afterwards be used in dyeing colours, and is known as "boiled off liquor." In considering the precautions to be observed in carrying out this operation, it is necessary first to insist on the importance of good clear water free from lime and magnesium salts. Hard water, if not passed through a water softening apparatus, should be softened before use by adding to the water a suitable quantity of pure powdered 98 per cent. caustic soda. Some text books recommend the addition of Na_2CO_3 for this purpose, but since many hard waters contain more temporary than permanent hardness, this addition in most cases would be unsatisfactory, the sulphates of lime and maguesia only being precipitated, while the bicarbonates would be left in solution. The pure powdered NaHO dissolves at once and removes both permanent and temporary hardness thus—

$$CaH_2(CO_3)_2 + 2\,NaHO = Na_2CO_3 + CaCO_3 + 2H_2O$$
$$CaSO_4 + Na_2CO_3 = Na_2SO_4 + CaCO_3.$$

As an example it may be mentioned that a sample of town water gave on analysis a total hardness of 9·8 parts per 100,000, comprising 6·2 parts temporary and 3·6 parts permanent hardness. It will thus be seen that with Na_2CO_3 added to this water only $\frac{1}{3}$ of the lime would be affected. For a water of moderate hardness, such as is found in this district, 2 to 3 oz. of the caustic soda may be added to a barque containing 250 gallons of water, and stirred up thoroughly for three or four minutes before use. Should this precipitation of lime salts be neglected, a quantity of sticky lime soap is fixed upon the silk during the stripping and boiling operations, which in turn serves to fix any suspended matter which may get into the bath. At the same time the lustre is impaired and the silky feel of the fabric to a certain extent spoiled.

The quality of the soap to be used for stripping and boiling off requires careful attention. In a recent book I find cocoa-nut oil soap spoken of as a good one for this purpose. The only point in its favour, however, is that it is not decomposed by hard water with formation of lime soap. Its disadvantages are its alkalimity, and the bad smell left by it on the silk. An excess of caustic alkali is inevitable in a thoroughly saponified cocoa-nut oil soap, making it unsuitable for toilet purposes since it attacks the skin; and hence for a similar reason, viz., that it attacks the animal fibre, unsuitable for ungumming silk.

The soap used must be free from caustic alkali, must rinse out well, be a good colour and leave an agreeable odour. Potash soaps made from olive oil, tallow, or olein are the best for this operation. Of these, tallow soap rinses out more difficultly than either olive oil or olein soap, the latter being best in this respect. Therefore, having regard to the comparatively high price of olive oil, I consider the best soap for silk is a potash soap made from a good white tallow olein. Cotton seed olein is not so good, and is likely to leave objectionable smell on the goods. Potash soap is preferable to a soda soap since the former is less keen—all things being equal—than the latter, and appears to preserve the lustre, &c. of the silk better. The soap indicated rinses out well and leaves the silk lustrous and with an agreeable odour.

Although theoretically a perfectly neutral soap would seem to be best for stripping and boiling off, it is found in practice that a soap made slightly alkaline with K_2CO_3 gives on the whole somewhat better results; but it should be clearly understood that any alkalinity arising from caustic potash or soda is deleterious to the silk, making it dull and harsh.

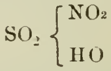
Boiling off.—The silk after being stripped is in the case of lace, fabrics, &c. put into boiling bags to be boiled off. Theb ags are loosely made of thick hempen cord, and then filled and tied at the top and put into the boiling copper which is generally heated by fire as well as steam. In the case of hank silk, the latter is worked on sticks in the boiling bath or inspecially constructed machines. The silk is then boiled in about 15 per cent. of soap, or speaking more correctly a solution of soap containing 7 lb. of soap to 100 gallons water, for one to two hours, according to the quality and thickness of the silk. After rinsing first in warm, then in cold water, the silk is ready for bleaching.

Bleaching.—The several methods used in bleaching silk may be conveniently divided as follows:—

1. Bleaching by treatment with acid.
2. Bleaching by reduction methods—
    (a.) Gas Bleaching.
    (b.) Liquid Bleaching.
3. Bleaching by Oxidation—
    (a.) Permanganate potash method.
    (b.) Hydrogen peroxide.
    (c.) Sodium peroxide.

1. *Acid treatment.*—The first method is frequently used in conjunction with the sulphuring process for bleaching raw yellow silk which requires soupling, the object of which is to gain the lustre and feel of boiled-off silk without removing the gum, or with the loss of only a small quantity of gum. It is usually carried out as follows:—The yellow silk is first softened and cleaned by working for about an hour in a warm bath of 10 per cent. soap. It is then well washed and bleached by immersing in a bath of aqua regia at about 3 or 4° Tw. The aqua regia is made by mixing 5 parts commercial hydrochloric acid with one part nitric acid and allowing to stand. The silk lays in this acid bath until it turns greenish. It is then taken out, well washed, sulphured, and soupled.

Better results however may be obtained by using in place of aqua regia a dilute solution of sulphuric acid in which an OH group has been replaced by an NO_2 group, thus—



$$SO_2\left\{\begin{array}{l}NO_2\\HO\end{array}\right.$$

This is obtained by saturating the oil of vitrol with nitrous fumes, or dissolving in it a suitable quantity of chamber crystals obtained in the manufacture of sulphuric acid. The raw yellow silk after softening by working in a 10 per cent. soap solution at 70° F. for 1 hour, is well washed and entered into the acid bath at 4° Tw. and left there for 10 to 15 minutes. If it is allowed to lay in this bath too long, it contracts a yellow tint. It is then well washed and may be sulphured, afterwards washing and soupling by working about 1 hour in acidulated water at 190° to 200° F. in the usual way.

This acid treatment can be used also to improve the colour of boiled off silk, by working the latter in the acid at a strength of $\frac{1}{2}$° Tw. (0·0025 sp. gr.) at a temperature of about 140° to 160° F.

2. *Reduction methods.*—In bleaching by these methods the colouring matter of the silk is destroyed by the reducing action of sulphur dioxide either in the form of gas or in solution. This reagent has been in use for several centuries, the exposure of silk and wool to sulphur fumes being a very old process. As at present carried out, the silk is hung up and spread out in a chamber generally termed the sulphur stove heated to 90 or 100° F. which can be securely closed to confine the fumes. The requisite amount of sulphur is then lighted and left to burn itself out, the doors being securely closed. After six hours (or all night), the doors are thrown open; the gas allowed to escape; and the silk being taken out, is washed to remove sulphuric acid, &c., which may form in the goods by oxidation of the sulphur dioxide. The amount of sulphur to be burnt should have some relation to the size of the chamber, and the percentages of sulphur given which have regard only to the quantity of silk to be bleached are therefore not always reliable. About $\frac{1}{2}$ lb sulphur per 1,000 cubit feet of stove room is a suitable quantity.

This process gives a distinct improvement in the colour of the silk, but its effect is by no means permanent. Exposure to light and air gradually brings back the original yellow or brown tint, probably owing to reoxidation. A passage through soap or an alkaline bath also to a great extent destroys the advantage gained by sulphuring, hence it is very little use for goods which have subsequently to be dyed light colours in a soap bath. It is however very largely used; its cheapness being an important consideration.

Bleaching by Sodium Hydrosulphite.—Quite recently another substance which exerts a reducing action upon the colouring matter of the silk has been applied for bleaching, viz.: Hydrosulphite of soda, $NaHSO_2$. To prepare it a clean bleached tub of 50 galls. capacity may be taken. Into this are put 32 galls. of bisulphite of soda, at 66° Tw. (1·33 sp gr.) and scraps of pure zinc are added until they reach the surface of the liquid, when it is covered up for one hour. Means are taken, if necessary, to prevent the temperature rising too high; (earthenware tubes) being sometimes suspended in the tub through which cold water circulates. The liquid is then drawn off into another tub which is filled and covered up to prevent oxidation, and left to stand for 12 hours to allow the zinc and sodium sulphites to crystallize out. The supernatant liquor is the bleaching agent, and is also kept covered up in a full tub to avoid oxidation to bisulphite. The hydrosulphite is formed thus:

$$3NaHSO_3 + Zn = NaHSO_2 + ZnSO_3 + Na_2SO_3 + H_2O.$$

For use it is only necessary to dilute the standard bleaching agent with an equal vol. of water, enter the cleansed goods, and allow them to remain in this bath for six hours; after which they are well wrung and immediately washed. If this washing is delayed the fibres are rapidly heated and thereby injured in lustre and strength. The silk should then be run through a weak hydrochloric acid bath to remove all traces of sodium and zinc sulphites which would produce yellow stains on finished goods and finally washed in abundant water. When the bleaching bath falls below its original level it may be replenished with fresh $NaHSO_2$ and will thus last for a considerable time. The undissolved zinc can also be made again serviceable by washing it with plenty of water acidulated with HCl.

3. *Oxidation Methods.*—Several substances which exert an oxidising action upon the silk have been tried at various times for bleaching it. One of those most used before the introduction of the peroxides was potassium permanganate. Its action depends upon the fact that it readily gives off oxygen in the presence of organic matter. The silk was steeped in a dilute solution of the permanganate, and afterwards worked in an acid bath which dissolved off the brown hydrate formed in the reaction.

The use of permanganate has however practically ceased, since hydrogen peroxide has been put on the market at much lower prices than formerly.

Bleaching with Hydrogen Peroxide.—This reagent has now been in use for bleaching some 18 or 20 years. Silk bleached by it was exhibited at the Paris Exhibition of 1878. It is only during the last few years however that its reduced price has allowed it general use. It is made from peroxide of barium by introducing the latter gradually into a calculated quantity of hydrofluoric acid until it is just neutralised. The process which takes about 12 hours is carried on in a copper vessel, suspended in a wooden vat filled with cold water; great care being taken to prevent a rise in temperature. The hydrofluoric acid may be regenerated from the barium fluoride formed by means of H_2SO_4. The BaO_2 is also sometimes decomposed with sulphuric or carbonic acids. Hydrogen peroxide may also be produced as follows:—finely ground barium carbonate is moulded into bricks with sawdust and pitch, and heated in a furnace to a temperature of 1,000° C. The barium oxide thus obtained is cooled to 50° C at which temperature it absorbs oxygen from the air. The BaO_2 is then mixed with water and decomposed by a current of carbon dioxide. The hydrogen peroxide formed is then decanted off and the precipitated $BaCO_3$ used for another operation. Hydrogen peroxide decomposes very easily, and should be kept in a cool dark place when stored, to prevent loss of oxygen. It is more stable when slightly acid than when neutral or alkaline. According to the experiments of Kingzett, published in the journal of the Society of Chemical Industry, 1889, its stability is further maintained by addition of alcohol, while of the acids, phosphoric acid appears to best preserve the strength.

It is sold of 10, 12 or 20 vol. strength, in carboys or barrels — the former should be preferred, since in them the strength and colour are better maintained. The exact meaning of the term "volume strength" appears to be sometimes misunderstood. I have come across one or two statements to the effect that 10 vol. peroxide is such as with the addition of permanganate of potash produces 10 volumes of oxgen. This is plainly an error, since one-half the amount of oxygen is furnished by the permanganate, and such a solution of H_2O_2 would really only contain 5 volumes of available oxygen. A 10 volume solution then is such as contains times its own volume of available oxygen.

Estimation of Peroxide of Hydrogen.—Owing to the uncertain strength of many peroxides at present sold, and also to the easy deterioration of their solutions, it becomes very necessary that every lot should be carefully tested for strength. Much of the peroxide of hydrogen sold in this country as 12 vol. varies in strength from 4½ vol. to 9 vol. Several methods of estimation are available, viz.:—

(1.) Titration with permanganate of potash until a faint pink colour is obtained. 2 grams of the peroxide are taken, diluted with 50 cc. distilled H_2O and titrated with a centinormal solution of permanganate of potash until the pink colour appears, the peroxide being first acidulated with about 2 cc. of H_2SO_4. The percentage and then the vol. of H_2O_2 may be calculated. The reaction is as follows:—

$$K_2Mn_2O_8 + 3\,H_2SO_4 + 5H_2O_2 =$$
$$2\,MnSO_4 + K_2SO_4 + 8\,H_2O + 5\,O_2.$$

Each cc. of $\frac{N}{100}$ $K_2Mn_2O_8$ taken corresponds to ·56 vol, or ·17 per cent. H_2O_2, and ∴ 2 grms. H_2O_2 of 12 vol. strength would require 21·5 cc. $\frac{N}{100}$ $K_2Mn_2O_8$.

(2.) It may also be accurately estimated by addition of potassium ferricyanide and caustic potash thus:—

$$K_6Fe_2Cy_{12} + 2\,KHO + H_2O_2 = 2\,K_4FeCy_6 + 2\,H_2O + O_2.$$

This reaction takes place with quantitative exactness. The caustic potash should be strong and used in large excess. A nitrometer (Lunge's) may be used for the estimation.

(3.) The strength may be estimated also by adding potassium iodide to an acid solution of peroxide, and estimating the iodine liberated with sodium thiosulphate and starch.

(4.) A much readier method for practical use, and one which gives approximately accurate results, may be described as follows:—A 50 cc. graduated tube closed at one end is filled with water up to about the 28 cc. mark, and a little H_2So_4 (say 1 cc.) added; 1 cc. of the peroxide to be estimated is then carefully added from a burette; the thumb placed on the mouth of tube, the latter inverted, and the volume of air read off. A few crystals of permanganate of potash are then loosely wrapped up in a bit of tissue paper and dropped into the tube; the thumb is immediately placed over the tube-mouth to make it gas-tight, while the hand firmly grasps the tube and shakes it thoroughly for two or three minutes. The tube is then plunged into a glass cylinder of cold water, mouth downwards; the mixed gases are cooled to ordinary temperature, and the volume read off. After deducting from this the volume of air space previously ascertained, one half of the residual volume obtained represents the volume of oxygen available in the sample. While shaking, the pressure on the thumb increases, and care must be taken to keep it tightly on the tube mouth to prevent escape of gas.

A consideration of the temperature at which the bleaching is performed may enable us to speak of two methods of bleaching with peroxide of hydrogen, viz.:—(1) the cold method; and (2) the warm method.

Cold Method.—A bath is prepared by diluting a quantity of 12 vol. peroxide with three times its volume of cold water, and adding sufficient ammonia to cause the bath to smell faintly of it, and cause small bubbles of oxygen to slowly rise to the surface. The goods are immersed in this liquid for one, two, or three days, according to the amount of bleaching required. As a rule, it is unwise to leave goods in this liquor longer than three days, as after this time the lustre and strength are likely to suffer. Borax, oxide of magnesium, silicate of soda, and other substances may replace the ammonia; and their comparative advantages are dealt with further on in speaking of Tussur bleaching.

Warm Method.—In this method a bath is made up at 1 part of 12 vol. H_2O_2 to 10 parts water or 1 part to 20 of water according to the amount of bleaching the silk requires. An addition is made to the bath of ammonia, or preferably for this method one of the above-named substances; the silk is entered, worked for ¼ hour, gradually heated up to 190° F. during 1 hour, and then worked for ¾ hour at this temperature, washed and scrooped.

Sodium Peroxide.—Quite recently there has been introduced a new product for bleaching silk, viz.:—Peroxide of sodium, Na_2O_2. It is manufactured by the Aluminium Company, Limited. The method of manufacture as described by Mr. Castner, the patentee, consists in treating metallic sodium contained in aluminium vessels at a temp. of 300° C., to the gradual oxidizing action of a mixture of oxygen and nitrogen in which the proportion of oxygen is gradually increased. This is done in an iron pipe which passes through the furnace and along which a current of air is passed from one end. The vessels containing the sodium pass along the entire length of the pipe, the sodium being oxidised at first by air which has been almost deprived of its oxygen, the proportion of the latter gradually increasing until it is finally oxidised by air containing the full amount of oxygen.

This method is not unlike that pursued in the manufacture of barium peroxide, in which BaO, prepared by reducing the nitrate in fireclay crucibles, is heated at a high temperature in a retort, air being allowed to pass in at one end and nitrogen to escape at the other.

The average analysis of Na_2O_2 (for which I am indebted to Mr. F. Burton, of London), shows:—

	Per Cent.
Peroxide sodium	93·0
Protoxide „	2·0
Carbonate „	2·5
Hydrate „	2·5

Compared with BaO_2 and H_2O_2 (10 vols.) solution, the available oxygen is as follows:—

93 per cent. sodium peroxide	19·5	per cent. available O.
91 „ barium „	8·6	„ „
H_2O_2 10 vol. solution	1·6	„ „

It is a yellowish white partially powdered substance which dissolves in water with a hissing sound and great evolution of heat. These characteristics are possibly partly due to particles of metallic sodium from which the peroxide is made. As at present delivered to the consumer it is by no means free from impurities, and dark coloured particles are found which might be expected to be slightly prejudicial to its bleaching effect. It is strongly alkaline and very deliquescent. *In keeping it care must be taken to keep it dry and to prevent its contact with inflammable materials, such as cotton, paper, &c.* If kept dry, it is more stable than H_2O_2, and if used carefully it comes cheaper. The makers claim for it that 1 lb. is equal in bleaching power to 1⅗th galls. of 10 vol. H_2O_2. They recommend its conversion into H_2O_2 by adding it gradually to dilute H_2SO_4; but if this is done in strong solutions without the use of suitable cooling arrangements much loss of oxygen results and the ultimate product is much dearer than ordinary H_2O_2. To make 10 galls. of 10 vol. H_2O_2 take 10¼ lb. H_2SO_4 168° Tw., mix with 8 or 9 galls. H_2O and cool. Then add 7½ lb. sodium peroxide gradually and with continual stirring, special cooling arrangements being used to keep temperature low, without which it would rise considerably and oxygen would be lost.

It is however better in practice to make the Na_2O_2 into H_2O_2 of 1 vol. strength or such strength as is required for bleaching, in order that the extra water required may be utilised to cool the whole, and so prevent escape of oxygen. Thus a 1 vol. H_2O_2 bath may be made by adding to 94 galls. of water 10¼ lb. H_2SO_4 168° Tw., previously diluted with 2 galls. H_2O and cooled, then gradually with stirring 7½ lb. Na_2O_2. In making up these solutions I find they are always slightly coloured yellowish brown; and on throwing down this coloration and examining it, it was found to consist of oxide of iron. This impurity is the most serious defect of the sodium peroxide at present sold; and it is to be hoped the makers may be able in the future to eliminate it. It can however be got rid of by a suitable addition to the bath, which carrys it down to the bottom of the vessel. Another method of using peroxide of sodium will be mentioned later under the head of Tussur bleaching.

Bleaching of Tussur Silk.—In consequence of the secretion which permeates the silk of the Tussur cocoon being more difficult of removal than in the case of cultivated silk; other and keener substances are sometimes used in the stripping bath, such as caustic soda, potash, &c. The following trials were made on reeled Tussur to determine the best scouring agent to use in stripping and boiling off:—

No. 1.	stripped ½ hour and boiled 1 hour in	¼ oz. Na_2CO_3 to 1 pint H_2O.
No. 2.	do. do.	⅛ oz. Na_2CO_3 + ½ oz. soap in 1 pint H_2O.
No. 3.	do. do.	⅛ oz. NaHO to 1 pint H_2O.
No. 4,	steeped 1 night (12 hours) in a bath containing in three pints water	½ oz. soap. 3 cc. ammonia ·880. 1 cc. turpentine.

No. 4 looked cleanest and best, No. 3 better colour than 1 and 2, but not quite so lustrous. Nos. 1 and 2 gave practically equal results. These four samples were bleached with H_2O_2 with addition of silicate of soda by the warm method.

No. 4 did not bleach well, the turpentine evidently interfering with the result. Nos. 1, 2 and 3 appeared to be very much alike in colour, No. 3 not being quite so lustrous.

The older bleaching processes which are still useful for cultivated silks are comparatively useless for Tussur, and the latter can only be bleached satisfactorily by the use of peroxides of hydrogen or sodium. A number of methods have been proposed, in which other reagents are used previous to the peroxide bath, but the best of these produce no better result than when peroxide is used alone, as will be shown by the bleaching trials given further on, while the lustre and feel are more or less impaired by them. Professor Lunge is said to have written favourably of a combination of the sulphuring and peroxide methods (*see* Hurst, silk dyeing, p. 32). But if the theory given of the action of these processes is correct, viz., that they act by reduction and oxidation respectively, the one process might be expected to neutralize the effect of the other. This appears to be so in practice. So far as Tussur silk is concerned a sample was sulphured for 12 hours, washed and bleached in a peroxide bath of 2 vol. strength for three days. The result was distinctly inferior to a second sample bleached in the same strength of peroxide alone. Boiled off Tussur was used for this experiment.

Another method given for bleaching Tussur silk in Mr. Hurst's recently published book on silk dyeing, and attributed by him to H. Koechlin is to boil or steep the silk in a bath of 22 lb. caustic soda, 66 lb. soap, 11 lb. calcined magnesia, 11 galls. 10 vol. peroxide of hydrogen, and a little ammonia. This bath would not simply bleach the Tussur but would dissolve it. It was really recommended by Koechlin for bleaching *cotton* with hydrogen peroxide and does *not* give "excellent results" with Tussur as stated by Mr. Hurst.

The following method was proposed by Ch. Girard, and has been applied for bleaching Tussur spun silk on the continent:—

1. Work in warm dil. HCl (1 to 8) for 1 hour.
2. Wash and strip with sodium carbonate or 2 per cent. caustic soda, and wash.
3. Steep in hypochlorite of ammonia for 24 hours. This bath may be repeated.
4. Wash, pass through dil. HCl and wash.
5. Steep in hydrogen peroxide of ½ vol. strength with addition or ammonia of borax.

The first hydrochloric acid bath is beneficial in that it removes the lime present in Tussur silk, but the treatment with ammonium hypochlorite before bleaching with hydrogen peroxide is quite a superfluous process, and no advantage can be gained by its use, as the following bleaching trials show:—

No. 1 sample was stripped half an hour and boiled one hour in ¼ oz. Na_2CO_3 to 1 pint water.

No. 2 was steeped in warm dilute HCl (1 in 6) for one hour, washed, then stripped and boiled as No. 1, and steeped in hypochlorite of ammonia at 1° Tw. for 24 hours.

No. 3 was treated as No. 2, but steeped in hypochlorite of soda at 1° Tw. for 21 hours.

All three were washed and separately steeped in H_2O_2 (1 vol.) with 2 cc. AmHO added to 22 ozs. for three days, then washed and scrooped.

No. 1 gave the best result both in colour and lustre. No. 3 became tender in the Na_2Cl_2O solution—1° Tw. being evidently too strong—but as No. 1 gave best colour the trial was not repeated.

The ammonium hypochlorite was made by adding 1½ oz. Am_2CO_3 dissolved in ½ pint water to 1 oz. bleaching powder rubbed down in ½ pint water, allowing to settle and using the supernatant liquor.

The sodium hypochlorite was made by mixing 5⅗ oz. bleaching powder in 1 pint water, and 3⅕ oz. crystal carbonate in 1⅘ pints water; the latter is added to the former mixture gradually; the mixture becoming much thicker, and then suddenly thin again near the completion of the reaction. It was then allowed to settle, and the liquor poured off for use.

Experiments were then made to determine the best and most economical strength of peroxide of hydrogen to use in bleaching, Three samples of reeled Tussur were worked in hot dil. HCl for 20 minutes, washed, stripped and boiled in Na_2CO_3 solution ¼ oz. to the pint, then steeped in peroxide of hydrogen solution as follows :—

Strength of 12 vol. H_2O_2.	AmHO added.	Result after 24 Hours.
No. 1.—1 part H_2O_2 to 3 parts water.	2 cc. AmHO. to 22 oz. liquor.	Nos. 1 and 2 were distinctly better than No. 3.
No. 2.—1 part H_2O_2 to 10 parts water.		
No. 3.—1 part H_2O_2 to 20 parts water.		

Left them in bleach three days.

On the second day there was a slight improvement in all. The third day scarcely helped them. On the third day they were heated in their respective liquors to 190° F. for two hours. This treatment improved the colour considerably without impairing the lustre perceptibly. After heating No. 1 was slightly better than 2. Nos. 1 and 2 much superior to No. 3.

A third series of experiments was made to determine the best addition to make to the peroxide of hydrogen bath, with a view to producing the best colour consistent with strength and lustre. Four samples of reeled Tussur prepared as indicated in previous series, were bleached in 12 vol. H_2O_2 diluted with 10 times its weight of water, with various additions as follows :—

Additions made to 22 oz. Peroxide Liquor.	Result after 1 Day.	Result after 2 Days cold Bleaching, then Heating to 190° F. in respective Liquors.
No. 1. 2 cc. AmHO (@ ·880.	Better than 2. Inferior to 4.	About alike.
No. 2. ¼ oz. $Na_2B_4O_7$	Darker than others	
No. 3. ¼ oz. MgO ..	Same as No. 1....	Slightly better than 1 and 2.
No. 4. ¼ oz. Na_2SiO_3 @ 140° Tw.	Clearest. Rather yellower than others.	Much the best.

No. 4 gave a very good result. It was a clear good colour, and lustrous, and its strength was not perceptibly diminished.

Sodium Peroxide.—Very good results may be obtained by bleaching Tussur with sodium peroxide by the following method recently patented by Dr. Haen. For 50 lb. of Tussur a bath is prepared containing 30 lb. Epsom salts in 110 galls. water. The silk after being boiled off and well washed is thoroughly impregnated with this liquor and lifted; and then 6 lb. 10 oz. peroxide of sodium are carefully added in three portions during three-quarters of an hour, working the silk in the bath after each addition. It is important not to neglect the first impregnation with $MgSO_4$ solution, as the lustre would be impaired by the strongly alkaline peroxide of sodium acting upon the silk. The whole is then gradually heated during three-quarters of an hour to 190° F., the operation lasting about 2 hours. Dilute sulphuric acid is then added to clear the liquor, which has become milky through separation of magnesium hydrate. The material is given two or three turns in this liquor washed, and then worked for half an hour in a bath of 30 per cent. soap to increase and restore its lustre, washed and brightened by stringing, &c.

The reaction which takes place appears to be the following :—

$$MgSO_4 + Na_2O_2 = Na_2SO_4 + MgO + O.$$

Samples bleached by this method gave a colour scarcely inferior to that obtained by means of hydrogen peroxide and sodium silicate; the lustre, however, was not quite so good before soaping. $ZnSO_4$ was tried in place of $MgSO_4$, but did not give so good a result, although it gave a fair colour. It may be noted, that by working silk after bleaching for half an hour in a 30 per cent. soap bath, afterwards washing and scrooping, the lustre of the silk is improved, that being the case especially with Tussur. In concluding I desire to acknowledge the assistance of Mr. Furley Davis in carrying out the bleaching trials.

Discussion.

Mr. Lloyd Whiteley hoped that this would be the first of a series of papers that Mr. Pentecost would read. He thought Mr. Pentecost might have laid even greater emphasis upon the fourth method given for the estimation of peroxide of hydrogen. He strongly advised dyers to adopt the method in the works. An estimation could easily be done in five minutes in the dye house and the bleaching liquors thus readily controlled. With regard to the use of sodium hypochlorite on Tussah silk, he thought that this would bear further investigation, at least judging by some experiments which had been carried out in his laboratory, and he hoped to examine the matter more fully.

Professor Clowes said that Mr. Pentecost came originally to the college as a student of chemistry, and then had the advantage of following on as a dyeing student. They had in him a very good illustration of what might be done by a college training followed up by practical work. They started their dyeing department some years ago, and it was fairly successful. If more of the students in the town with plastic minds would attend and follow up the scientific knowledge imparted to them, it would be very beneficial to them in the various industries in which they were engaged. But such work as Mr. Pentecost had done, and was still doing, not only did his own firm benefit, but other firms in the town as well. They must feel in any works, in which a knowledge of science was required, of what great advantage it was to have a gentleman present who had that knowledge, and was ready to understand any new production or process which came out. Practically all the materials with which Mr. Pentecost had to do were new ones, and unless he were qualified to estimate them at their true value, he would be at a serious disadvantage.

The Chairman said the society was one that existed for the benefit of all classes engaged in chemical industry. The dyers had a society of their own, but he hoped to see it ultimately affiliated to the Society of Chemical Industry. With regard to the softening of hard water. It was a subject to which he had devoted some little attention, and it seemed rather astonishing to him that gentlemen who had studied science should be content to soften water in what he considered such a primititive fashion. He explained at some length the chief reactions involved in treating different kinds of water. As to peroxide of sodium, he was glad Mr. Pentecost had referred to the dangerous nature of the chemical, which would easily set fire to cotton, wool, hay, straw, and even wood upon which it had become spilled if water were dropped upon it.

Mr. Wood asked which of the experiments with the hydrogen peroxide was found the best? He did not quite follow it. He had tried it with leather and other articles, and had not found it a success.

Mr. Pentecost in reply thanked Dr. Clowes and Mr. Whiteley for their kindly comments on the paper. He desired to acknowledge his indebtedness to the thorough character of the teaching imparted by them during the number of years he had studied chemistry and chemical technology at the Nottingham University College.

Referring to Mr. Archbutt's remarks about the softening of water—no doubt this was best done by passing the water through an efficient water softening apparatus, but if lime water were used for softening, great care must be taken that no lime was left in solution, lest lime soap should be formed in the "stripping" process.

Yorkshire Section.

Chairman: Sir James Kitson, Bart., M.P.
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Jas. Sharp.
G. W. Slatter.
G. Ward.
T. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* A. Smithells: *Vice-Chairman:* T. Fairley; *Committee:* J. E. Bedford, F. Branson, W. Mackay, and C. Rawson.

SESSION 1892–93.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

May 1.—F. W. Richardson, F.C.S., &c. "Silk, with special Reference to its Chemical Constitution, and its Estimation in Fabrics."

Meeting held March 27th, 1893.

MR. C. RAWSON IN THE CHAIR.

ON THE MORDANTING OF WOOL WITH CHROMIUM.

BY L. LIECHTI AND J. J. HUMMEL.

Part II.

In the first part of this paper it was our endeavour to explain the nature of the chemical reactions which occur when wool is mordanted with bichromate of potash either alone or with the addition of sulphuric acid.

Since, however, other assistants are frequently employed in practice, *e.g.*, oxalic acid, tartaric acid, and acid potassium tartrate (cream of tartar), it seemed very desirable to determine, if possible, in what manner they, too, react during the mordanting process.

The investigation, however, has proved to be replete with difficulties, and we cannot claim to have solved the problem. Still it is well perhaps that a record of our experiments, made with a view of throwing some light on the matter, should appear, so that others who pursue the same subject may at any rate learn what has already been attempted.

3. Bichromate of Potash and Oxalic Acid.

Wool was mordanted with 3 per cent. bichromate of potash with the addition of 0, 1, 2, 3, 4 mols. oxalic acid.

Appearance of the Bath.—No. 1 remained clear and *yellow* from production of K_2CrO_4, and showed a slightly alkaline reaction. Nos. 2—5 became during the first 20 minutes gradually paler yellow, *i.e.*, poorer in chromic acid; then the colour changed and became gradually darker and brownish, the baths remaining clear; this evidently showed that reduction had occurred to some extent.

Appearance of the Mordanted Patterns.—No. 1 was dull brownish or olive-yellow, from 2—5 the brownish tint became more pronounced. None of the patterns had the green colour of chromic oxide; they all showed that only partial reduction to chromium chromate had taken place.

It is evident from the above appearances that with the use of increasing amounts of oxalic acid, there is in the first instance a corresponding increase in the amount of chromic acid fixed; only at a later period does reduction occur, and indeed *for the most part in and upon the fibre* and not in the bath, as no doubt the prevailing opinion hitherto has been. The wool does not appear to attract the compounds if previously reduced, certainly not in the same degree as it attracts chromic acid, and one is tempted to speak of a condensation of the chromic acid on the wool. Only after a considerable amount of chromic acid has been taken up by the wool does any reduction occur, and this is a general appearance which we have noticed in all similar cases with chromic acid, &c.

Of the dyed patterns No. 2 proved to be the best, although from the appearance of the mordanted fents one would have expected the best results with the larger amounts of oxalic acid, but from No. 3 to 6 the colour became paler.

It is indeed very difficult in the case of wool to judge of the real value of any particular mordant merely by the appearance of the mordanted patterns; very often full green-coloured fents were obtained, but they dyed much worse than expected. According to the following equation—

$$K_2Cr_2O_7 + H_2O + C_2H_2O_4 = K_2C_2O_4 + 2(H_2CrO_4)$$

it is not clear how potassium oxalate should act as a reducing agent, and as a matter of fact it does not so act towards bichromate of potash, for in the absence of wool even with 3 mols. oxalic acid one can only succeed in effecting a partial reduction. When a *concentrated* solution of the mixture is boiled, carbonic acid is certainly evolved in the beginning, but it is impossible to cause the reaction to proceed to its utmost limits. By repeatedly evaporating the mixture to dryness, redissolving, &c., one invariably obtains a brown-coloured residue, from an aqueous solution of which alcohol precipitates chromium chromate in a somewhat resinous condition. The aqueous solution shows the presence of undecomposed potassium bichromate as well as free oxalic acid. Total reduction only succeeds with the employment of 6 mols. oxalic acid and with chromic acid instead of potassium bichromate, thus—

$$K_2Cr_2O_7 + H_2SO_4 + 6(C_2H_2O_4) =$$
$$Cr_2(C_2O_4)_3 + K_2SO_4 + 6CO_2 + 7H_2O,$$

and even here one is obliged to evaporate to dryness in order to complete the reaction.

Reduction also occurs with the employment of only 3 mols. oxalic acid if 4 mols. sulphuric acid are taken, probably thus—

$$K_2Cr_2O_7 + 4H_2SO_4 + 3(C_2H_2O_4) =$$
$$K_2SO_4.Cr_2(SO_4)_3 + 6CO_2 + 7H_2O$$

but here, too, only when the mixture is evaporated to dryness. Oxalic acid, which one might regard as oxidised tartaric acid, thus—

$$C_4H_6O_6 + O_3 = 2(C_2H_2O_4) + H_2O$$

shows a correspondingly smaller power of reduction than tartaric acid, which, when totally oxidised, yields only carbon dioxide and water, thus—

$$C_4H_6O_6 + O_5 = 4CO_2 + 3H_2O$$

Whenever, indeed, wool is mordanted with bichromate of potash, with additions of oxalic acid and tartaric acid, the reduction which occurs with oxalic acid is invariably less than that with tartaric acid. There are other chemical reactions also in which oxalic acid behaves as a body standing between the inorganic carbonic acid and the organic tartaric acid; *e.g.*, chromic sulphate is precipitated by alkali already in the cold when only one or two molecules of oxalic acid are present, with 3 mols. a precipitate is produced only on boiling, whereas with 3 mols. tartaric acid no precipitation occurs.

The following published statements relative to the use of oxalic acid in conjunction with bichromate of potash may be worth recording:—

According to Ganswindt the utility of oxalic acid or cream of tartar is to enable one to mordant satisfactorily in shorter time, *e.g.*, in one hour. Lepetit obtained with 0·6 mols. oxalic acid green-coloured wool. Witt and Knecht recommend amounts which correspond to 2·34 mols. Students' experiments in the Yorkshire College dye-house have shown that the use of 2 mols. oxalic acid gives ultimately brighter but paler colours. The published statement of a former student, Tepper, is to the effect that 2·82 mols. oxalic acid gives the best result, and that the mordanted patterns have a dull yellow appearance. According to Preissert, by neutralising the potassium in bichromate of potash with oxalic acid, chromium potassium oxalate is obtained, but further data are wanting; probably the basic ($K_2O.Cr_2O_3.C_2O_3$) is intended, in which case the O_3 must produce oxidising effects. Wilkinson found that green mordanted wool was not obtained by using potassium bichromate and oxalic acid.

If the mode of procedure is altered, and the wool is impregnated with solutions containing oxalic acid and bichromate of potash, and *steamed*, then even 1 mol. oxalic acid produces considerable reduction, and with 2 mols. it is complete. Here, too, it is evident that the wool itself has materially assisted in the reduction, for if a solution of 1 mol. bichromate of potash with 2 mols. oxalic acid is boiled, one only obtains partial reduction, namely, to chromium chromate and not to chromic oxide.

If, instead of potassium bichromate, one uses chromic acid and oxalic acid, the dyed results obtained are less favourable; chromic acid alone gives the deepest colour, with 1 mol. oxalic acid the shade is a little paler, with 2—4 mols. it is very considerably paler; at the same time the greenish tone of the colours dyed with quercitron bark indicate the presence of increasing amounts of chromic oxide in proportion to the chromic acid fixed.

With respect to the custom of judging as to the amount of mordant fixed from the intensity of the ultimate dyed colour, there is some difficulty in the case of wool in choosing a suitable colouring matter for exact experimental work. In the case of logwood, for example, serious errors of judgment may be made in consequence of the difference in hue of the dyed colour according as the mordant is present on the wool as chromium chromate or as chromic oxide. It is well perhaps in this connection to emphasise the fact that the mordant chromic oxide does not give a real black with crystallised haemateïn, but only bright dark blue shades, and that in order to produce a true black an oxidising mordant is essential. Now, in accordance with the various modes of mordanting employed there must inevitably be different relative amounts of chromic oxide and chromic acid in the chromium chromate fixed on the wool; hence, in the case of logwood it is found that although more chromium may be fixed on the fibre, the dyed colours appear nevertheless in certain cases paler, just because the chromic oxide predominates.

This fact has long been known in connection with cotton, for every calico-printer is aware of the fact that with logwood and chromium acetate in a steam-colour a real black is never obtained, and that to produce it an oxidation of some kind is necessary, and this is effected either by adding chlorate of potash to the printing mixture, and thus forming chromium chlorate in the colour itself, or by passing the goods, after steaming, through bichromate of potash baths.

With the chromic oxide mordant on wool, experiments were made to effect production of a true black by passing the logwood-dyed patterns through bichromate of potash baths, but the results were not so good, *i.e.*, the shade became even somewhat bluer than before.

Possibly the different results, referred to in Part I., obtained when large amounts of sulphuric acid were used with bichromate of potash, may be explained thus—

1. $K_2Cr_2O_7 + H_2SO_4 + H_2O = K_2SO_4 + 2H_2CrO_4$.

2. $K_2Cr_2O_7 + 4H_2SO_4 = K_2SO_4.Cr_2(SO_4)_3 + 4H_2O + O_3$.

In the first case there would be more a mordanting with chromic acid, in the latter more with chromic oxide; with the use of organic acids the latter condition would be brought about by reduction.

In addition to the difficulties just mentioned, of judging as to the nature and character of the mordanting process, there appears in the case of logwood, the bronzing of the colour when excess of dyestuff is used; and yet, such excess must necessarily be employed in order that the *whole* of the mordant may be combined with colouring matter. This necessity is frequently overlooked, and the consequence is that wrong conclusions are arrived at.

If alizarin be the dyestuff chosen for exact experimental work in studying the mordanting process, similar difficulties to those just cited arise. With the chromium chromate mordant the shade obtained is always a somewhat brownish-claret, with chromic oxide it is bluer and more the normal tone, but with the use of acid mordants the shade is redder.

Then again with alizarin, too, dyeing with excess of colouring matter readily occurs, and the excess must be removed by boiling with water or soap, and this may possibly lead to erroneous conclusions through being continued too long.

In the case of dyestuffs which are glucosides a further source of error creeps in, namely, the fact that acid mordants will decompose the glucoside more readily or more completely than those which are not acid.

In consequence, therefore, of the foregoing difficulties it was found necessary not to employ invariably the same colouring matter, but to select what appeared most suitable for each given case, without maintaining that the best possible had actually been selected. As a rule, logwood, alizarin, and quercitron bark were the dyestuffs employed.

4. Bichromate of Potash and Tartaric Acid.

The same experiments were carried out with tartaric acid as an assistant, as with oxalic acid. The chief difference noticed is that here total reduction, *i.e.*, green mordanted wool, is obtained with ease, and that even large amounts of tartaric acid have comparatively less injurious effects than oxalic acid.

Bichromate of potash with 1—2 mols. tartaric acid gives somewhat darker colours in dyeing than when bichromate alone is employed; with increasing amounts of tartaric acid the dyed colour becomes somewhat greener and paler (quercitron bark). The mordanted fents have a dull green colour, the intensity of which increases with the use of 1—4 mols. tartaric acid. Although the waste mordant solution with bichromate of potash and 4 mols. tartaric acid had only a pale yellowish-green colour, and the mordanted wool appeared to be the best of the series, the quercitron dyed colour appeared the palest and most greenish in tint.

If wool is padded in a solution of 1 mol. bichromate of potash and 1 mol. of tartaric acid and then *steamed*, total reduction takes place; on washing with water an alkaline chromic oxide salt solution is obtained: with 2 mols. tartaric acid the colour of the wool is grass-green, and the wash-water only very slightly alkaline: with 3 mols. tartaric acid the wool showed a violet-grey colour and water extracted chromic oxide salt solution having an acid reaction.

If a solution of bichromate of potash with the addition of only 2 mols. tartaric acid is boiled, unlike the case with oxalic acid, reduction does occur here, although only on evaporating. With larger amounts of tartaric acid the reduction is correspondingly increased, but apparently 6 mols. tartaric acid are required to effect complete reduction when boiling 2—3 hours.

With the use of chromic acid and tartaric acid as the mordant, the colours dyed with quercitron bark are again in all cases paler and greener in tint than when chromic acid alone is employed. It is noteworthy that tartaric acid seems to have less effect in making the colours pale than has oxalic acid.

According to Dépierre the use of bichromate of potash and tartaric acid fixes "an oxide of chromium" on the fibre. Kertesz recommends 2—3 per cent. bichromate of potash with 4 per cent. tartaric acid; Topper and also Ganswindt, 3 per cent. bichromate with 4 mols. tartaric acid.

Remembering the fact that greater or less reduction of the chromic acid takes place according to the nature and quantity of the assistant acid employed, it need only be added that the chemical composition of the mordant fixed on the wool seems also to depend mainly upon the amount of acid used, as will be seen later on. For the present one may say that the appearances of the dyed patterns almost seem to indicate that the old idea as to the simple formation of a lake may here require some modification, and it is just possible we have to do with coloured compounds in a state of solution. To give a complete and satisfactory explanation of these matters is extremely difficult, for it has not been found possible to prepare these variously coloured compounds apart from the fibre.

5. Bichromate of Potash and Cream of Tartar.

This is probably the oldest and most usual form of employing the chrome mordant in wool dyeing, and yet we know here perhaps least of all concerning the chemical reactions which take place.

According to Naef, Herzfeld, Cochenhausen, Witt, and nearly all authors who have written on the subject, the tartar acts essentially as a reducing agent. Herzfeld says, further, that it assists the fixing of the chromic oxide upon the fibre, which Witt considers to be fixed on the fibre in the form of a basic chromic oxide salt.

Already in 1839 there appears in an English patent the recipe: 3 per cent. bichromate of potash with 2 per cent. cream of tartar, which is identical with that now recommended by F. Bayer & Co., of Elberfeld; while the Baden Aniline and Soda Co., of Ludwigshafen, recommend 2·5 per cent. tartar, the addition being said to give more level colours and to make the wool softer.

Others state that 3—4 mols. tartar per 3 per cent. bichromate of potash give the best results.

Probably the most frequently employed proportions are 3 per cent. bichromate (1 mol.), and 2·5 per cent. tartar (1·3 mols.).

If now a solution of these two substances in the relative proportions here given, and as dilute as is usual in mordanting, be boiled for 1½ hours, no reduction whatever takes place. If the solution is evaporated to dryness on the water-bath and the residue is then re-dissolved and the solution again evaporated, or if the two dry substances mixed together are moistened with a very little water and then allowed to act upon each other, being heated on a sand-bath, reduction certainly occurs, but it is for the most part incomplete.

Most remarkable is the fact that the liquid, which is of a fine, dark, pure green or olive-green colour according to the amount of reduction, shows a *strongly alkaline reaction*, and deposits a dirty white powder.

It is known that if a concentrated solution of bichromate of potash is treated with tartaric acid until carbon dioxide ceases to be evolved, one obtains eventually a dark green vitreous mass, which is soluble in water. Alcohol precipitates from this solution a substance said to have the composition $[Cr_2(OK)_2(C_4H_4O_6)_2]$. Further, it is known that between bichromate of potash and tartaric acid the following reaction may take place :—

$$K_2Cr_2O_7 + 2(C_4H_6O_6) =$$
$$K_2C_4H_4O_6 + Cr_2O_3 + 2CH_2O_2 + 2CO_2 + 2H_2O.$$

Now, when wool is mordanted with 3 per cent. bichromate of potash and 2·5 per cent. cream of tartar, the following appearances are observed. At first the tartar merely acts as an acid and liberates chromic acid, which as usual is immediately attracted by the wool. If then the temperature is raised to about 60° C., reduction begins, and in fact upon the wool fibre itself, which thus acquires a greenish colour; the mordant solution remains of a yellow colour, due to potassium chromate, and only towards the end of the mordanting process does it become pale greenish-yellow and show a faint turbidity and an alkaline reaction. The presence of chromic hydrate can be detected in the solution by adding clear lime water, and a relatively larger proportion of potassium chromate is also discernible therein.

If chromic acid is employed instead of potassium bichromate and one evaporates to dryness, a vigorous reaction certainly occurs, but the solution seems even less greenish, being indeed rather brownish, as though less of the chromic acid had been reduced, and here, too, the reduction is not complete; further, the liquid is not alkaline, but slightly acid. Both the above-mentioned alkaline and this acid solution, when boiled with sodium carbonate, give clear solutions.

If wool is boiled with 3 per cent. bichromate of potash, 1 per cent. sulphuric acid, and 2·5 per cent. cream of tartar, the same appearances occur during the mordanting process as are above described, but the wool is decidedly better mordanted, it has a purer and darker green colour, and acquires a deeper colour in an alizarin dye-bath.

If the above-mentioned liquors are previously reduced, *i.e.*, apart from the fibre, and only then employed for mordanting wool (instead of adding the several ingredients at once to the mordant-bath), one obtains, curiously enough, very poor results; the baths contain potassium chromate and a quantity of precipitated chromic hydrate, and exhibit an alkaline reaction. When the mordanted patterns are dyed with quercitron bark the depth of the colour is less than one-third of that obtained with fresh unreduced mordant.

Our attention was first drawn to this point by noticing that poor shades were obtained whenever, in pursuing the ordinary course of dye trials, a student had allowed the mixed mordant in concentrated solution to stand over night or longer before use.

A satisfactory non-oxidising chromic oxide mordant ready for immediate use by the dyer cannot therefore be prepared in this manner. The unfavourable result is mainly to be attributed to the alkaline state of the solution, since tolerably fair results are obtained by adding to the reduced mordant solution the requisite amount of acid, for example, sulphuric acid. This experiment indicates that wool must never be mordanted in alkaline baths, a fact afterwards invariably substantiated whenever alkaline baths were incidentally employed.

Woollen fents were also padded in solutions similar to those just referred to, and then *steamed*. When using 3 per cent. bichromate of potash with 2 per cent. cream of tartar, a little of the bichromate escaped reduction, but with 2·5 per cent. bichromate the reduction seemed to be fairly complete, and the wool exhibited a fine green colour. When washed with water an alkaline chromic oxide solution was obtained. If the wool was steeped in the mordant solution *previously reduced* and then steamed, the wool had merely a dirty yellowish-green colour of little depth.

On evaporating the waste mordant liquor when using 3 per cent. bichromate of potash and 2 per cent. cream of tartar, a greenish-black residue is obtained having an alkaline reaction, and containing both chromic acid and chromic oxide. When calcined, the ash contains potassium carbonate; melted with sodium carbonate one obtains sodium chromate. Treated with sodium carbonate solution a brownish-olive liquid (chromium chromate) is obtained, which becomes green on heating.

When dyeing with alizarin, the waste dye-liquors in the case of the wool mordanted with $K_2Cr_2O_7 + C_4H_5KO_6$ show an alkaline reaction, and even that with $2H_2CrO_4 + C_4H_5KO_6$ is slightly alkaline.

This fact accounts for the necessity of using acetic acid in alizarin dye-baths, apart of course from the object of neutralising any earthy carbonates in the water employed. Strange to say, on evaporating and calcining a drop of alizarin paste an ash was obtained having a strongly alkaline reaction.

No explanation seems to have been published of the alkalinity of the mordant-bath, above referred to, indeed it has probably not hitherto been observed. When no wool is present the following equation may possibly represent the reaction which takes place between the bichromate of potash and the tartar :--

$$K_2Cr_2O_7 + C_4H_5KO_6 = \\ Cr_2O_4 + H_2O + KHCO_3 + CO_2 + 2CHKO_2.$$

During the mordanting of wool with the mixture, the reduction certainly never proceeds so far as is here represented, and since other observers also find that the best results are given with the use of 3 mols. cream of tartar, the following equation may perhaps indicate the reaction which occurs :—

$$K_2Cr_2O_7 + 3\,(C_4H_5KO_6) = \\ [Cr_2(OK)_2.(C_4H_4O_6)_2] + 2H_2O + 2CHKO_2 + KHCO_3 + CO_2.$$

During the progress of this inquiry woollen fents were obtained which, even though only mordanted with bichromate of potash and large quantities of sulphuric acid, *e.g.* 4–6 mols., were just as green in colour as those in which tartar had been employed; and if, in the latter case also, one considers that the wool itself has aided in the reduction, possibly the following equation, which corresponds with the amounts used by the Baden Aniline and Soda Co., expresses the reaction :—

$$3K_2Cr_2O_7 + 4C_4H_5KO_6 = \\ 4(K_2C_4H_4O_6) + 2KHO + H_2O + O_6 + 6CrO_2.$$

Here $6CrO_2$ may mean $2(Cr_2O_3.CrO_3)$, or transitions up to $3Cr_2O_3 + O_3$.

The following equation too is not contrary to the facts :—

$$2K_2Cr_2O_7 + 2C_4H_5KO_6 = \\ Cr_2O_3.CrO_3 + K_2CrO_4 + 2K_2C_4H_4O_6 + H_2O + O_3.$$

Should this represent the true reaction which occurs, then one might freshen up the waste mordant liquor for further use by adding the necessary amounts of bichromate of potash and sulphuric acid.

It is quite certain, however, that wool mordanted with bichromate of potash and cream of tartar, contains both chromic oxide and chromic acid, for by boiling with sodium carbonate one obtains a solution of sodium chromate and green-coloured wool.

The residue which results from the mutual reaction of equal molecules of bichromate of potash and cream of tartar is also strongly alkaline, but by titration it was only possible to detect the presence of half the quantity of caustic potash which would be liberated according to the following equation :—

$$K_2Cr_2O_7 + C_4H_5KO_6 = KHO + K_2C_4H_4O_6 + Cr_2O_3 + O_3$$

hence it is as well to leave the real nature of the reaction which occurs still an open question.

The following equation—

$$5K_2Cr_2O_7 + 7C_4H_5KO_6 = \\ 7K_2C_4H_4O_6 + 5Cr_2O_3 + 15O + 3KHO + 2H_2O$$

corresponds to the employment of 3 per cent. bichromate of potash and 2·67 per cent. cream of tartar, and the amount of the free alkali here would accord well with that determined by titration. Here, too, if the equation correctly represents what takes place, freshening up of the waste mordanting baths for further use could be simply effected by adding bichromate of potash and sulphuric acid.

The amount of free alkali found by titration accords also very well with the following equation :—

$$K_2Cr_2O_7 + 2C_4H_5KO_6 = 2KHO + O_3 + 2(K.CrO.C_4H_4O_6)$$

the last compound being one which is described in Gmelin-Kraut.

If perchance the action of the cream of tartar is merely due to its acid character, then the reaction may be simply represented as follows :—

$$K_2Cr_2O_7 + 2C_4H_5KO_6 + H_2O = 2K_2C_4H_4O_6 + 2H_2CrO_4$$

and the chromic acid would first be attracted by the wool as such, and then gradually become reduced, thus—

$$H_2CrO_4 + H_2 = 2H_2O + CrO_2 \\ 2H_2CrO_4 + 3H_2 = 5H_2O + Cr_2O_3$$

and we may regard the wool as containing compounds intermediate in composition between Cr_2O_4 and Cr_2O_3, or rather we may say that it contains mixtures of the two.

It is unfortunate not to be able to solve the question under consideration in a more thorough and complete manner, but for the present it seems to be impossible to gain a more accurate insight into the matter by analysis of the textile material, and altogether the results of experiments with wool are never so constant as in the case of cotton, even though the greatest possible care be taken to observe all the necessary conditions, and yet absolute constancy of result is required to give us a satisfactory and clear idea of the reactions which occur.

Finally the following mordanting experiments were made simultaneously, with the view of comparing the results with each other :—

1. 3 per cent. $K_2Cr_2O_7$.
2. 3 per cent. $K_2Cr_2O_7 + H_2SO_4$.
3. 3 per cent. $K_2Cr_2O_7 + C_2H_2O_4$.
4. 3 per cent. $K_2Cr_2O_7 + C_4H_6O_6$.
5. 3 per cent. $K_2Cr_2O_7 + 2C_4H_5KO_6$.
6. 3 per cent. $K_2Cr_2O_7 + 2C_4H_5KO_6 + H_2SO_4$.

The appearances of the *waste mordanting liquors* were as follows :—

1. Colour yellowish, slightly alkaline.
2. Colour paler yellow than No. 1, very slightly acid.
3. Colour similar to No. 2, but duller and slightly greenish
4. Colour greenish.
5. Colour greenish-yellow, slightly turbid, alkaline, both almost exhausted.
6. Colour as in No. 5, very slightly acid, almost exhausted.

It is noteworthy that reduction begins in No. 5 somewhat earlier than in No. 4.

The colours of the *mordanted patterns* were as follows :—

1. Pale olive-yellow.
2. Brownish olive.
3. Paler than No. 2, greyish olive, between No. 2 and No. 4.
4. Greyish-green.
5. More yellowish-green, between No. 3 and No. 4.
6. Greener than No. 5 and considerably darker, somewhat greyish.

The amount of chromic acid absorbed by the wool increases up to a certain point with increasing acidity of the bath, and is larger in the case of inorganic acids than with organic acids.

After dyeing the patterns with alizarin, the waste liquors presented the following appearances :—

1. Totally exhausted, alkaline.
2. Totally exhausted, neutral.
3. Nearly exhausted, neutral.
4. Nearly exhausted, neutral.
5. Totally exhausted, alkaline.
6. Almost totally exhausted, slightly alkaline.

The *dyed patterns* appeared as follows :—

1. The palest and bluest claret colour of the series.
2. Decidedly the deepest colour, somewhat brownish.
3. Paler than No. 2.
4. Also paler than No. 2, but darker than No. 3, almost equal to No. 5.
5. Paler than No. 2, not much better than No. 1, perhaps a little fuller and with more bloom.
6. A fine full colour, deeper than No. 5.

The general observations made were : (1) The neutral patterns begin to dye first, and with alizarin they give a claret which is bluer in hue than with the acid mordants ; (2) the more acid the mordant the more slowly does the development of colour take place, and the redder it is in hue, approaching a garnet-red ; (3) excess of bichromate also alters the hue, changing it more towards a reddish-brown, a tint which is to be avoided.

If samples of wool, silk, and cotton are mordanted with $K_2Cr_2O_7 + 2C_4H_5KO_6 + H_2SO_4$, under exactly the same conditions, the cotton, as expected, takes up no mordant whatever, and the silk behaves quite differently to wool. With silk only a very slight reduction occurs, and the fabric is not in the least coloured green, but rather pale olive, due to chromium chromate, about the same as, or even less greenish than, wool would be when mordanted with chromic acid. When it is dyed with alizarin, the colour obtained is a dark pink instead of claret. The waste mordant-bath is distinctly acid, and has a peculiar brownish-red orange colour, probably due to the presence of chromic acid and chromium tartrate. Calcium hydrate gives a precipitate of chromic hydrate.

According to Knecht, when mordanting wool with 3 per cent. bichromate of potash and tartar, 31·13 per cent. of the available chromium is fixed on the fibre. Our analysis gave somewhat less, namely, 27 per cent.

6. OVERCHROMING.

It is a well-known fact that in practice "overchroming" is only spoken of in connection with logwood dyeing, hence the question naturally arises, does anything analogous to it take place in connection with other mordants than chromic acid, or in the case of other colouring matters than logwood?

No sufficiently satisfactory explanation of "overchroming" seems hitherto to have been published. One author states that overchroming occurs when more than 2–4 per cent. bichromate of potash is used in mordanting, and the fact that overchromed wool does not dye well, or perchance not even at all, has generally been deemed to be owing to the destructive oxidising action of the chromic acid present on the mordanted wool being exerted upon the colouring matter.

It seemed desirable, therefore, to examine somewhat in detail this subject of overchroming, in order to determine the condition under which it occurs, and, if possible, its true character.

According to the different views expressed by those who have referred to this matter, the question appears always to be either a destruction of the wool or the colouring matter by over-oxidation, and in the course of our students' experimental work it has been found that the brown oxidation products of hæmateïn are capable of combining with mordants, and hence such compounds being mixed with the normal black lake might well give to the latter an unpleasant brownish appearance.

Before making further experiments on the subject, overchromed wool dyed with logwood was examined under the microscope, when it was noticed that about one-half of the fibres were almost colourless, while the other half had the normal black colour. When once made aware of this fact the difference between the two may almost be recognised by the naked eye, and certainly by means of a pocket lens.

This appearance proved the incorrectness of the view that the question is merely one of over-oxidation of the colouring matter; neither can the over-oxidation of the wool be the cause, since by remordanting the wool under normal conditions it can then be dyed a fairly good black.

Having purposely overchromed some wool, and then dyed it with a clear decoction of 30 per cent. logwood, the real cause of the defect became apparent by the production of a considerable amount of black precipitate in the dye-bath.

It has been already shown, in the first part of this paper, that when wool is boiled with bichromate of potash and sulphuric acid, there is fixed upon the fibre a chromium chromate of variable composition. This compound is decomposed into chromic hydrate and chromic acid by mere boiling with water, but more readily still when organic substances are present, *e.g.*, wool and logwood. But chromic acid may be regarded as an excellent indicator for hæmatoxylin, hence the occurrence of the precipitate in the dye-bath shows the defect of overchroming to be essentially due to the fact that the chromic acid is boiled out in such large amount from the overchromed wool into the dye-bath, that it there precipitates practically the whole of the colouring matter in the form of an inert black lake, thus rendering it useless for dyeing.

Why some of the wool fibres fix the chromic acid better than others, and are hence dyed black in the normal manner, still remains an open question. That individual wool fibres do behave very differently has been observed by us frequently in other cases, especially when dyeing wool mordanted with chromic hydrate. This difference of behaviour seems to be due to the structure and probably also the age of the fibre, for on mordanting and dyeing carefully-scoured lamb's wool, it was noticed that the intensity of the colour gradually increased from the root towards the tips of the hairs, an appearance which is well known to skin-mat dyers and others. Much greater differences are occasionally observed in the dyeing of yarns composed of different kinds or qualities of wool. This mixing of different wools is very common at the present time, and the consequences of it are sometimes serious. If such mixtures are unavoidable it would, from the dyer's point of view, be more rational to dye the different wools separately, and to mix and spin them together afterwards.

In connection with the subject under discussion the following experiments were carried out. Three sets of wool patterns, six in each set, were mordanted with the following:—

(*a.*) 12 per cent. $K_2Cr_2O_7$.
(*b.*) 12 per cent. $K_2Cr_2O_7 + H_2SO_4$.
(*c.*) 40 per cent. chrome alum.

Whenever the baths began to boil one pattern of each set was removed from the bath, squeezed, and well washed in a large quantity of water. Every subsequent quarte of an hour another pattern was removed, and so on.

The six mordanted patterns of series (*c*) varied in colour from a pale green to a violet-greyish-green, while the waste liquors remained perfectly clear without the slightest appearance of dissociation. Those of series (*b*) had all an olive colour, the last pattern removed being 3–4 times darker than the first. Of series (*a*) the patterns 1–5 had a buff colour gradually increasing in intensity, 6 had a greenish-olive colour.

Such colouring matters as alizarin, anthracene-brown, and alizarin-cyanin, did not exhibit the defect of overchroming by the production of poor, useless colours. Logwood, alizarin-blue, cochineal, and galleïn exhibited the defect in a very marked manner, the colours produced being unpleasant-looking greys in the case of logwood and alizarin-blue, and pale browns or drabs in the case of the others. It is evident from this that overchroming is not confined to logwood only, but may be met with in the case of all colouring matters susceptible to oxidation and capable of readily reacting with chromic acid. Further, the defect was only noticed in series (*b*), or at any rate only to a small extent in series (*a*). The chrome alum, as expected, produced no effect of overchroming, and it was merely employed in the experiment to show that chromic acid alone, and not equivalent amounts of a chromic salt, cause the defect. In the case of series (*b*), overchroming was evident already in the first pattern removed from the bath. On examining the dye-baths the formation of lake was only to be observed in the case of patterns mordanted with chromic acid.

If, however, overchromed wool, before dyeing, is well boiled with water, or boiled even only for a quarter of an hour with sodium carbonate solution, the excess of chromic acid is thus removed, and good results are then obtained in dyeing.

The following observation was made in the case of wool patterns which had been overchromed and then well boiled with water previous to dyeing with alizarin. The colour obtained was an extremely full claret-red or Bordeaux, but among the deeper-coloured fibres there were many red ones, especially in the samples 1—4. Such fibres had evidently taken up less chromic acid than the others, and this experiment well illustrates the above-mentioned different behaviour of individual wool fibres.

In another experiment wool was mordanted with *chromic acid* corresponding to the following amounts of bichromate of potash: 5, 6, 7, 8, 9, 10 per cent.

Already with 5 per cent., overchroming is apparent, and with 7 per cent. it is so strong that the logwood-dyed colour has a brownish-grey, irregular, and bare appearance. With 6 per cent. certain undyed fibres are noticeable, with 7 per cent., a large number, and so on. Those fibres, however, which *are* dyed, are not brown through the presence of any over-oxidised colouring matter, but have a fine black colour. The dye-baths contain a gradually increasing amount of colour-lake, which indeed is noticed occasionally when using only 4 per cent. of mordant.

If overchromed dyed wool is well washed or, better still, boiled with water for a short time, and then re-mordanted and dyed in the normal manner, a good black may be obtained. Overchroming therefore is not the result of the *wool fibre* having been attacked, although with the employment of such a large amount of mordant the wool cannot fail to be somewhat oxidised.

The action of overchroming, however, is undoubtedly altogether different to the effect produced by means of bleaching powder and acid.

If overchromed wool is well washed and dyed with magenta, merely a dull brownish-pink colour is obtained, no doubt because of the presence of sulphuric and chromic acids. If such wool, however, is dyed with an acid colour, *e.g.*, fast red E. and sulphuric acid, a full red with brownish tinge is obtained. If the overchromed wool is left steeping till the bath becomes cold the solution becomes somewhat slimy.

Finally, samples of wool were mordanted with the following:—

1. 8 per cent. $K_2Cr_2O_7$ + H_2SO_4 (sulphuric acid).
2. 8 per cent. $K_2Cr_2O_7$ + $C_2H_2O_4$ (oxalic acid).
3. 8 per cent. $K_2Cr_2O_7$ + $C_4H_6O_6$ (tartaric acid).
4. 8 per cent. $K_2Cr_2O_7$ + $2(C_4H_5KO_6)$ (cream of tartar).

The appearances of the mordanted patterns after washing were as follows:—(1) a deep brownish-olive; (2) a pale-brownish-olive; (3) a yellowish greyish-green; (4) like No. 3, but darker and a purer green.

A portion of each pattern, after washing, was extracted several times with boiling water, when their respective appearances were the following:—(1) greyish green with a tinge of yellow; (2) like No. 1, but paler; (3) a purer green than before extraction; (4) unchanged.

When the patterns were dyed with logwood, overchroming was still slightly apparent in the case of No. 1 pattern, and this may explain why dyers prefer to mordant with bichromate of potash alone or with at most the addition of tartar; there is then less risk of overchroming the material.

Some dyers are in the habit of adding a little sulphuric acid to the logwood dye-bath. In the case of slightly overchromed wool, this addition may have the effect of preventing the chromic acid from bleeding out into the dye-bath, or it may tend to dissolve any lake already formed, apart from the beneficial effect it has in consequence of its removing the alkalinity of calcareous water containing bicarbonates.

Undoubtedly it will always be best for the dyer to avoid the occurrence of overchroming by working according to well-devised methods, and by estimating the amount of chromic acid in his mordanting bath by some simple method of titration.

After the foregoing experiments had been concluded, we were pleased to find that J. Dépierre has given the same explanation as to the cause of the overchroming of wool, in his latest work (Traité de la teinture et de l'impression des matières colorantes artificielles, vol. 2, p. 196), in which he says that if wool is mordanted with more than 4–5 per cent. bichromate of potash, the ultimate result is bad, since the excess dissolves out in the dye-bath and there precipitates the colouring matter.

It is well, however, to emphasise the fact that real overchroming, in the sense of producing not merely poor, weak logwood-blacks, but such as have a dull brownish-olive colour, only occurs when the mordant used is chromic acid, *i.e.*, bichromate of potash and sulphuric acid, and not with bichromate of potash alone, unless enormously concentrated baths are employed.

In conclusion, it may be well to touch on a question which many ignore, and which by others is regarded as at least premature, namely, whether there exists any distinct chemical ratio between mordant and colouring matter, and whether the theory of equivalents has any place in dyeing. In our opinion each colour, *e.g.*, a logwood-black or an alizarin red is a definite chemical compound, just as much as chromate of lead yellow or Prussian-blue.

The circumstance that most dyestuffs are not sold in a chemically pure state, is probably the chief reason why, in this department of colour chemistry, our knowledge is still so limited. Probably the chemist of the calico printer, works in the most rational manner. In carrying out trials in printing colours, his first aim is to try a mordant qualitatively; the tests, for example, the action of aluminium in various forms, viz., as sulphate, chloride, nitrate, acetate, sulphocyanide, aluminate, basic salts, &c. Suppose for a moment that the compound $Al_2SO_4(C_2H_3O_2)_4$ has given him the best results, the second important point to determine is, what proportion of this mordant will give the best result, *e.g.*, the fastest, darkest, and brightest colour, with a given weight of the colouring matter (C).

If we call the amount of mordant fixed (M), we have at once the most essential elements of the receipt for the printing colour. If the colour obtained in the first instance happens to be a dark red, and the question is to produce the several pinks required say in a rose, the task simply consists in preparing a series of colours by diluting the standard colour, and the result is, that the different gradations of red and pink thus produced, are pleasing from an artistic point of view. Chemically, we are here only concerned as to the ratio between C and M being always the same, so that just as in 100 parts of $PbCrO_4$, the ratio between PbO and CrO_3 is exactly the same as in 10 parts, so here in $\frac{1}{10}$ red, *i.e.*, pink, there is contained $\frac{1}{10}$ C and $\frac{1}{10}$ M.

Now, in an extended and carefully conducted series of experiments of this kind, with different mordants, *e.g.*, Al_2O_3 (M), Cr_2O_3 (M^1), Fe_2O_3 (M^2), the amounts determined empirically as being the best with reference to one and the same amount of colouring matter, stand with respect to each other very nearly in the ratio of their molecular weights, hence we may conclude that the compounds CM, CM^1, CM^2 are of a truly chemical character. Exceptions to this rule do not occur, or they are only apparent and are traceable to secondary causes, *e.g.*, of an optical nature, &c. Every printer's chemist knows, for example, that in producing pale ultramarine-blues it is not sufficient merely to reduce the standard dark colour with albumen solution, but that one must at the same time add some white powder, *e.g.*, zinc-white, in order to obtain good shades. Here no one certainly would maintain that the ultramarine is at all altered by so doing. Again, it is found necessary to add a little tannic acid to the gum thickening used for making pale tannin colours, but the idea in so doing is certainly not to alter the ratio between tannic acid and colouring matter, but on the contrary to maintain it, because it has been discovered that the gum thickening used renders a portion of the tannic acid inactive. Similar corrections have to be made in reducing the strength of certain alizarin-red printing colours, &c. Whenever such secondary reactions are absent, as for example in the case of cotton dyeing, the law of chemical proportions appears in full force, and this may be well illustrated in the production of the above-mentioned series of rose pinks. If, for example, the mordants M, $\frac{1}{3}$ M, $\frac{1}{16}$ M, $\frac{1}{32}$ M, are printed on the calico, then fixed and dyed, the amounts of colouring matter taken up will be exactly in the ratio of C, $\frac{1}{3}$ C, $\frac{1}{16}$ C, $\frac{1}{32}$ C.

All this seems to the printer's chemist so self-evident that it would be unnecessary to bring the matter forward here, if it were not that the question is very much ignored in the practice of dyeing.

Suppose, for example, several pieces of wool are mordanted with 3 per cent. bichromate of potash, with or without such assistants as cream of tartar, oxalic acid, &c., and one dyes with 20, 10, 5, 2·5, 1·25 per cent. (called *a*, *b*, *c*, *d*, *e*, respectively) of colouring matter; in this case (M) the mordant remains constant, and only (C) the colouring matter is diminished in quantity.

If, now, we regard the matter quantitatively, and assume that the fixed amount of mordant (M) requires 20 per cent. colouring matter (C) as its chemical equivalent, then the following will represent the ratio of (M) and (C) in the different patterns dyed, just referred to:—

$$\begin{aligned} a &= \mathrm{M} + \mathrm{C}. \\ b &= \mathrm{M} + \tfrac{1}{2}\,\mathrm{C}. \\ c &= \mathrm{M} + \tfrac{1}{4}\,\mathrm{C}. \\ d &= \mathrm{M} + \tfrac{1}{8}\,\mathrm{C}, \\ e &= \mathrm{M} + \tfrac{1}{16}\,\mathrm{C}. \end{aligned}$$

so that the colour in the pattern (*e*), for example, will consist of 1 mol. (MC) + 15 mols. free (M), *i.e.*, a very basic compound. This error, however, may lead to the production of more or less dull colours, because, as in the case before us with *chromium* mordant, the normal colour-lake, the chemical compound (MC) is not diluted with *white* as in the above-mentioned pale ultramarine-blue, but with a dull browish-olive coloured body, viz., chromium chromate.

The difficulty experienced by many dyers in dyeing iron-mordanted wool a good alizarin-violet, a colour of such importance on cotton, is no doubt entirely due to the neglect of chemical proportions. Imagine the appearance of a lilac consisting of one part normal alizarin-violet mixed with 15 parts of free ferric oxide. There is indeed little doubt that few of the dyed colours of to-day are really *normal* chemical compounds; on wool, basic compounds are met with as a rule, whereas on cotton-yarn the opposite is the case. (See Weber's "Research on the formation of pigment lakes," Journal Soc. Ch. Ind. 1891, p. 89.)

Many of the complaints as to colours rubbing off and not being fast, would possibly disappear if dyers would endeavour to work more in accordance with the principles here referred to.

Another difficulty often met with by the dyer, is that of irregular or unlevel colours. Now, it would certainly be going too far to ascribe all cases of irregularity in colour to the employment of an excess of mordant, but it may certainly be due to this error in many cases, especially in the case of pale colours.

For the rest it may be freely admitted that some already do recognise the importance attached to the use of chemical proportions in matters of dyeing, for in recent years the colour manufacturers recommend, in their books of instructions published from time to time, that for pale shades one must use from ½ to ⅓ of the amount of mordant given for dark shades. Indeed every intelligent practical dyer finds himself compelled to reduce somewhat the quantity of mordant in the case of pale shades, although not always to a sufficient extent.

Already many years ago, when elaborating a good receipt for steam-alizarin blue on cotton, one of us noticed the great sensibility of this colour towards any excess of chromic oxide, *i.e.*, how the presence of a comparatively small amount of free chromic oxide causes the blue to loose its brilliancy and become greyish. One frequently hears too how in pale shades particularly, alizarin-blue can never be substituted for indigo, but although this may be true because of the purplish hue of the former, still, if the mordants employed are *saturated* with colouring matter, more pleasing and purer shades may be obtained than are usually met with.

Experiment shows that ⅛ per cent. bichromate of potash employed in mordanting wool requires 1·5 per cent. alizarin (20 per cent. paste); with these proportions both mordant and dye baths are totally exhausted, and the colour obtained is a bluish-pink; if, however, 3 per cent. bichromate of potash is used with the above amount of alizarin, the colour produced is an unpleasant looking yellowish brownish-pink, *i.e.*, an optical mixture of the normal pink, with the brownish-olive of the chromium chromate in excess.

It is well to point out, however, that in the mordanting of wool with small amounts of chromium decided difficulties are met with.

For example, if one diminishes the amounts of bichromate of potash and sulphuric acid employed together, as follows:—

$$\left\{\begin{array}{ll} K_2Cr_2O_7: & 3,\ 1{\cdot}5,\ 0{\cdot}75,\ 0{\cdot}375,\ 0{\cdot}1875 \text{ per cent.} \\ H_2SO_4: & 1,\ 0{\cdot}5,\ 0{\cdot}25,\ 0{\cdot}125,\ 0{\cdot}0625 \text{ per cent.} \end{array}\right.$$

and the patterns mordanted with these amounts are then dyed with corresponding amounts of a given colouring matter, one obtains a series of shades, which are by no means satisfactory in respect of purity and brilliancy; the colours are deficient in bloom and lustre, and all the pale shades appear saddened. With the green chromic oxide mordant the results are even more unfavourable.

Now in 1887, when occupied in determining the amount of sulphuric acid to employ with the acid azo-colours, one of us found, that in dyeing series of shades it is not necessary to vary the amounts of colouring matter and acid simultaneously, but that it is better to dye with *constant acidity*, although the acid may certainly be reduced to a certain extent in the case of the pale shades.

It occurred to us, therefore, that in the case under consideration this need for acid, which wool has been long known to possess, might also be the cause of the unsatisfactory appearance of the pale shades above alluded to, and which would thus represent the so-called "couleurs alcalines" of Havrez. Experiments showed indeed that by dyeing the above mentioned series of shades, but maintaining constant acidity of the bath by using throughout 1 per cent. sulphuric acid, the brighter and fuller shades expected were obtained. Further study of the question proved that it is best to determine by actual experiment with each proportion of mordant, the amount of acid or cream of tartar, &c., to employ.

In the above example the exact amounts to use cannot possibly be given, since the material, water, &c., employed may vary so considerably in different cases, but it is well for the dyer to remember that it is better to calculate the amount of acid with reference to the weight of wool rather than of bichrome mordant, although for the pale shades one may certainly reckon a somewhat smaller proportion. On the whole, however, the most rational plan is to determine once for all by actual experiment the best amounts of acid to use with 3, 2, 1, ½, ¼, ⅛, 1/16, per cent. of bichromate of potash, and then *cæteris paribus* to hold fast to the proportions thus fixed upon.

Possibly some practical dyers have already recognised the advantage of maintaining constant acidity in the mordant bath, but this point does not appear to have been hitherto published. Our main endeavour however for the moment has been to direct attention to the existence of chemical proportions between colouring matter and mordant, and that the simultaneous diminishing or reduction of both in an equal degree in the case of pale shades, is a natural consequence.

That it is best for the amounts of acid (*e.g.*, bisulphate of soda, tartar) used to have reference to the weight of wool, might almost have been inferred from the fact that it is impossible to mordant wool well in a neutral bath.

The exact determination of the ratio between mordant and colouring matter may form the subject of later experiments, meanwhile the following case only will be cited.

Without any knowledge of the above facts it has been repeatedly found by experiment that to produce a full claret-red with alizarin and chromium mordant the amount of alizarin (20 per cent. paste) required is 12 per cent. Theoretically 1 per cent. bichromate of potash would be required for this; the practical dyer uses 3 per cent. and analysis has shown that of this only 1 per cent. is fixed on the wool. Now it is very striking that when chrome alum is used, the amount fixed exactly corresponds to 1 per cent. bichromate of potash, and that with 12 per cent. alizarin a fine rich claret-red is also the result.

No doubt similar ideas have occurred to others, but the present was considered a good opportunity to bring this view prominently forward. The full solution of the problem is certainly very difficult, but the various qualities of the *normal* dyed colours will no doubt be immensely improved and probably the method of their production will be much simplified, when this has been attained.

Discussion.

The Chairman enquired if the results obtained with tartar justified its use, regard being had to the expense of the material; and also if bichromate was reduced by tartaric acid in solutions so dilute as those used in practical processes. He suggested that the difference in colour of the dyed products might be due in many cases to differences in the colour of the wools employed. He thought that the alkalinity of the bath noticed could hardly be due to the presence of free potash; this would surely never be formed in quantity more than sufficient to convert the excess of bichromate into chromate. Hitherto his opinion had always been that overchroming was due to over oxidation of the colouring matter. It was remarkable that with logwood some of the fibres should dye properly and others not at all; this was not so in the case of alizarin. No doubt those fibres which were dyed had less chromium on them, while the excess of chromium, present principally as chromic acid, on the other fibres oxidised the dye-stuff. Now alizarin, unlike logwood, was not affected by chromic acid, and hence this phenomenon of unequal dyeing was not noticed when this dye-stuff was used. Perhaps fastness of the colour to light was even more important than brightness, and it was known that, in the case of logwood, alizarin blue, gallocyanin, &c., the use of a large amount of bichromate caused an ultimate fading of the colour. If a light shade was required, a smaller quantity of mordant should be used. Was there any experimental proof that chromic chromate was formed, as such, on the fibre? It was desirable that an investigation should be made as to why some fibres received mordants and dyes so much more readily than others.

Mr. Wilkinson asked if overchromed wool could be re-dyed so as to get a good black. Professor Hummel had quoted an authority according to whom overchroming took place if 4 per cent. of bichromate were used; at what point did he himself consider that overchroming took place?

Dr. Knecht complained that Prof. Hummel in his previous paper had represented him as having stated that wool simply absorbed chromic acid, without reducing it. He had come specially from Manchester to the meeting in order to state personally that he had never held this view. Prolonged boiling invariably had the effect of turning the wool which was originally yellow, green. It was no doubt true that coloured compounds existed in mordanted wool in solid solution, for the colour of reduced chromium in wool was not that of chromium hydroxide. In the same way, when wool was mordanted with copper at the boiling temperature, no black colour of cupric oxide was obtained, but a green colour, showing that copper was present as a salt. It had been stated that the action of chromic acid on the dyeing properties of the wool was not the same as that of chlorine; he had himself, after over-chroming and reducing, been able to extract the chromium hydroxide by warming with hydrogen peroxide and ammonia, but, on dyeing with induline the fabric after this treatment, no beneficial effect was obtained. He considered that the formation of chromium-chromate on the wool was not yet satisfactorily proved; this compound was a very indefinite one, and had not yet been obtained pure. He agreed with Prof. Hummel with regard to the choice of the right proportion of mordant and colour. For example, in dyeing silk with B-amido-alizarin after mordanting with ferric nitrate solution of 1—2° Tw. bad results were obtained; when only a trace of iron was used, a fast and beautiful steel-grey colour resulted.

Mr. Fairley remarked that, for the perfect reduction of bichromate by oxalic acid, enough oxalic acid must be taken to combine with all the bases. Had the formation of formic acid been shown experimentally? What were the oxidation products of tartaric acid, and was it molecule for molecule, or weight for weight, that tartaric acid was a better reducing agent than oxalic acid or cream of tartar? (Prof. Hummel: When using equal molecules.) Possibly the different shades obtained were caused by different hydroxides of chromium; of these a green and a peach-coloured variety were known, and these might react differently with dyestuffs.

Mr. Bedford remarked that, in the case of over-chroming, some of the colouring matter was precipitated as an insoluble pigment which adhered mechanically to the wool, but could be removed by rubbing or scouring, and was actually removed in the process of milling, thus causing a loss of colour.

Professor Hummel, in replying, said that the expense of using cream of tartar with bichromate was, in his opinion, not justified by the results obtained. Some said that its use caused the wool to be softer; if this was so, it was probably because the tartar was more readily oxidised by the chromic acid of the chromium chromate than the wool, and so the latter was entirely protected from oxidation. Bichromate was not reduced by tartaric acid in very dilute solution, not even on boiling; only as the solution evaporated did reduction take place. It seemed to be a case of concentration. In the actual mordanting process the wool probably attracted both the chromic acid and the tartaric acid separately, and the two, in their concentrated condition on the fibre, reacted with each other, and reduction occurred. The alkalinity observed when using bichromate and cream of tartar was greater than could be ascribed merely to the production of normal chromate; how the alkali was formed was uncertain. As to the unequal dyeing of wool fibres, even alizarin exhibited this to some extent. As for the greater action of light on colours dyed on overchromed wool, it might be due to the chromic acid still left on the fibre oxidising the colouring matter; it was not to be supposed that excess of chromium hydroxide could be responsible for any fading of colour. If green mordanted wool was dyed yellow by means of auramine, various shades, from green to yellowish-green, could be obtained, according to the amount of dye used, but never the brownish-olive shade of chromium chromate. It was therefore reasonable to conclude, even from this experiment, that on chrome mordanted wool the chromic acid and chromic hydrate existed in a state of combination as chromium chromate, and not as a mixture. Moreover, as already stated, a substance was undoubtedly deposited on the wool of an olive-yellow or brownish-yellow colour, and from which hot water or aqueous sodium hydrate or carbonate solution removed chromic acid, leaving green chromium hydroxide behind. All these properties were characteristic of the precipitate of chromium chromate obtained by mixing solutions of chrome alum and neutral chromate of potash. The point of difference between Dr. Knecht and the authors was that, although the latter agreed with Dr. Knecht in thinking the chromic acid to be absorbed as such by the wool in the *first instance*, they asserted that under the ordinary conditions of mordanting it soon became reduced on the fibre to chromium chromate. He had never himself seen a good black obtained in practice by re-dyeing overchromed wool; the method proposed had to his knowledge never been adopted.

Mr. Sharp, and later Mr. Smithson, here interrupted the speaker, asserting that practical dyers obtained the best results by using the same mordanting bath over and over again, adding bichromate, &c., to it from time to time. Mr. Sharp also mentioned incidentally that bichromate, when first introduced as a mordant 50 years ago, was used at a strength of 1 per cent.; before that time a basic salt, known, however, as "tartar," was used.

The Chairman at last intervened, and, at his suggestion—

Professor Hummel was allowed to resume the thread of his reply. He agreed that when wool was mordanted with bichrome and tartaric acid, that it was probably not chromium hydroxide, but a basic salt that was fixed on the wool. It was indeed possible that the peculiar tint of the mordanted cloth was due to the presence of a special hydroxide of chromium, but it seemed to him more probable that it was caused by the presence of a basic salt. A process similar to the removal of chromium hydroxide with hydrogen peroxide, as mentioned by Dr. Knecht, had been long used in calico-printing; Guignet's green was removed from the "back-cloths" by treatment with very dilute bleaching-powder solution.

Glasgow and Scottish Section.

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R. R. Tatlock.
G. Watson.

Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Committee:* J. Clark, G. G. Henderson, W. I. Macadam, and D. R. Steuart.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Societies' Rooms, 207, *Bath Street, Glasgow, on Tuesday, April 4th,* 1893.

MR. CHAS. A. FAWSITT IN THE CHAIR.

ON THE ESTIMATION OF CHROMIUM IN STEEL.

BY JOHN CLARK, PH.D.

On a former occasion I laid before this Society Jour. Chem. Ind. XI. 581 several new methods for the estimation of chromium in its alloys with iron, depending on the conversion of the chromium into a soluble chromate without previous solution. So far as my former communication refers to alloys which dissolve with difficulty or are only partially soluble in acid, I have nothing further to add, as the methods described leave very little to be desired either on the point of accuracy or expedition, but for steels and alloys readily soluble in acid they are somewhat tedious, especially when the metal is not in a fine state of division, on account of the time required to convert the iron into sulphide before the oxidation process can be applied. I have, therefore, made further experiments with the object of shortening the time occupied in the estimation, without affecting the accuracy.

Of the methods in use for the estimation of chromium in steel, the most important, in addition to the ordinary precipitation process, are those of W. Galbraith and Arnold and Hardie.

Galbraith's process (Chem. News, Vol. 35, p. 151) is based on the solution of the steel in dilute sulphuric acid, oxidation with permanganate, and titration with a salt of iron. There can be no doubt this is a very rapid process, and when the separated oxide of manganese is filtered through asbestos it is fairly accurate, especially when the quantity of chromium present is small, but it is not suitable for rich alloys which are difficultly soluble, and in experiments made some time ago to apply a modification of this process to chrome ore, the results obtained were frequently so low that it was abandoned.

Arnold and Hardie's method (Chem. News, Vol. 57, p. 153) depends on the precipitation of the chromium as phosphate, and they state that good results are obtained with small quantities of chromium, but the process must occupy a good deal of time, as it involves the solution of the steel in acid, evaporation to dryness, fusion with nitrate of potash and carbonate of soda, and reduction of the soluble chromate. The precipitation as phosphate, although tedious, is in my opinion superior to precipitation as oxide with ammonia, as Wilm (Ber. Deut. Chem. 12, 2223) and Souchay (Zeit. 5, 66) have shown that in this way high results are invariably obtained when glass vessels are used, due more especially to silica and the difficulty of washing the precipitate free from impurities and to the tendency to oxidation when traces of lime are present.

In addition to these, a colorimetric method has been proposed by T. W. Hogg, (Jour. Chem. Ind. X., p. 340) which consists in dissolving the metal in acid, and comparing the colour with that given by a steel containing a known quantity of chromium. For comparative purposes, this is a rapid, and in certain cases a useful method, but the colour of the iron solution has to be taken into account, and it is only capable of limited application.

The methods which I have to propose involve the solution of the alloy in hydrochloric or sulphuric acid, and the subsequent precipitation of the chromium in a condition suitable for oxidation.

Phosphate Process.

When it is necessary to estimate chromium in presence of a large quantity of a ferrous salt, as is usually the case in steel, one of the best methods of concentrating the chromium, and obtaining it in a condition suitable for the oxidation process, is to precipitate it as phosphate. For this purpose from 2 to 5 grms. of the alloy are dissolved in dilute HCl. (sp. gr. 1·1), and to the solution, which does not require to be filtered or evaporated, ammonia is added till a slight permanent precipitate is obtained. A quantity of phosphate of sodium is then added (about 1 grm. is generally sufficient) in excess of what is required to combine with the chromium, and about twice this quantity of hyposulphite or sulphite of sodium, and the whole is boiled for about 10 minutes. The precipitate is then filtered off, washed, dried and ignited at a low heat to prevent the particles from agglomerating and becoming hard. When hyposulphite is used, the precipitate contains free sulphur, which renders it necessary to ignite it in a porcelain crucible. On that account, I prefer the sulphite, as the precipitate can be ignited in the platinum crucible in which the oxidation process is carried out, but in either case the whole of the chromium is precipitated. The ignited precipitate is crushed, if necessary, then mixed in a platinum crucible with about 8 times its weight of finely pulverised caustic soda and calcined magnesia, in the proportion of 3 of soda to 2 of magnesia. The crucible and contents are then exposed for about half-an-hour to a low Bunsen flame, when oxidation should be complete.

The contents of the crucible are now transferred to a porcelain basin and boiled gently with water, and a few drops of peroxide of hydrogen if there is any appearance of manganese. The insoluble is then filtered off, and the chromic acid is titrated with ferrous ammonium sulphate. As a little chromium sometimes escapes oxidation or is not completely dissolved, it is advisable to ignite the insoluble and re-fuse it with an equal bulk of the magnesia mixture, when every trace of chromium is extracted with water.

Three samples of steel from the Hecla Works, Sheffield, gave the following results by this process:—

A. *Sample.*

	Chromium. Per Cent.
3 grms. steel with phosphate and hyposulphite gave ..	1·44
3 grms. steel with phosphate and sulphite gave	1·45

B. *Sample.*

	Chromium. Per Cent.
2 grms. steel with phosphate and hyposulphite gave ..	5·35
2 grms. with phosphate and sulphite gave	5·37

C. *Sample.*

	Chromium. Per Cent.
2 grms. steel with phosphate and hyposulphite gave ..	5·40
2 grms. steel with phosphate and sulphite gave	5·39

Sulphite Process.

The chromium in steel and soluble alloys may also be precipitated as basic sulphite instead of phosphate.

When a neutral chromic salt is boiled with excess of sulphite of sodium, the whole of the chromium is precipitated as basic sulphite, and on ignition it is converted into oxide of chromium.

To ascertain whether this method could be applied to the quantitative estimation of chromium in solutions from which all the metals except chromium and alkaline salts had been removed, the following experiments were made :—

Known quantities of bichromate of potash were acidified with HCl reduced with sulphurous acid, the excess of which was expelled, then neutralised, and boiled with sulphite of sodium, and the precipitate of basic sulphite washed, dried, ignited, and weighed. When the free acid is neutralised with carbonate of soda, and no ammoniacal salts are present, excess of sulphite of sodium does no harm, but when ammonia is used for neutralisation, or when ammoniacal salts are present, it is necessary to add the sulphite cautiously, and to stop as soon as ammonia is given off, as the decomposition of the sulphite of ammonium is apt to re-dissolve a small quantity of the chromium. The precipitated basic sulphite is dense and easily filtered. Towards the end, however, the washings sometimes become slightly turbid, but the actual quantity of oxide of chromium which passes through the filter is very minute. To obtain this small quantity, the filtrate is boiled with a little ammonia, and the precipitate is collected on a separate filter, washed, dried, and ignited along with the other.

Experiments.

$K_2Cr_2O_7$ Taken.	Oxide of Chromium Found.	Oxide of Chromium Theory.
(A.) 1 grm.	0·5193	0·5186
(B.) 1 grm.	0·5200	0·5186

These results indicate that chromium can be correctly estimated in this way, and owing to the density of the precipitate, and the ease with which it is washed, the results are in my opinion more accurate than by the ordinary method of precipitation with ammonia. In applying this process to steel, from 2 to 5 grms. are dissolved in dilute HCl, and carbonate of sodium is added to the solution till a permanent precipitate is obtained. This precipitate is dissolved in a drop or two of HCl, and sulphite of sodium is then added gradually in small quantities at a time, and the solution boiled till there is no smell of sulphurous acid. As soon as the free acid is completely taken up, the basic sulphite of chromium is precipitated along with some iron. When the whole of the chromium has been thrown down, the further addition of sulphite of sodium is unnecessary, and the precipitate may be filtered, washed as far as necessary, dried, ignited in a platinum crucible, and the oxide of chromium converted into chromic acid with soda and magnesia, then dissolved in water and titrated as already described. Should there be any doubt about the completeness of the separation of the chromium, more sulphite of sodium may be added to the filtrate and the solution boiled till a small precipitate is obtained, which may be treated along with that already produced. The impure oxide of chromium got in this way is specially suitable for the oxidation process, as it is in a fine state of division and has no tendency to agglomerate when ignited at a low heat. The samples of steel above referred to gave the following results by this process :—

Quantity taken.	Chromium Found.
	Per Cent.
A. 3 grms.	1·46
B. 2 grms.	5·37
C. 2 grms.	5·39

The chromium in 3 grms. of A steel was also estimated gravimetrically by reducing the alkaline chromate obtained as above described, precipitating as basic sulphite and weighing as oxide, when 1·48 per cent. of chromium was obtained.

I have also tried to precipitate the chromium as acetate, without oxidising the ferrous salt, but I found this process more troublesome, and the results were lower than those obtained by the methods which I have described.

Discussion.

The Chairman said that the estimation of chromium had been made a subject of special research by Dr. Clark, and they must all have derived benefit from this explanation of this new analytical method. He would like to ask which of the methods, borax or soda-magnesia, gave the better results.

Mr. Kerr said that this method seemed specially applicable to the estimation of chromium in pig-iron.

Dr. J. Clark in reply said that the only point that had apparently been raised was with regard to the relative merits of the borax and soda-magnesia methods. The borax method was much more tedious and troublesome. He believed that they were capable of giving equally correct results, but he was certain that a trial of both methods would ultimately result in the adoption of the soda-magnesia process.

POINTS IN THE MANUFACTURE OF MINERAL WATERS.

BY W. ZINKEISEN, PH.D., B.SC.

The chemical and physical principles involved in the manufacture of aërated beverages—saline or saccharine solutions artificially charged with carbon dioxide—are well known to those trained in science. The actual production of these beverages is not always in the hands of individuals so trained, a fact which may be made to account for the differences, as regards purity and excellence, in the aërated waters submitted by the various manufacturers. The manufacture of an aërated water which owes its charms solely to certain bubbling and fizzing propensities, is not a difficult matter, being frequently engaged in by those who have little or no knowledge of any of the principles involved. The production of a really high-class beverage is not quite so easy; to attain this end certain points must be attended to in the manufacture, and it is to some of these points that I would draw your attention to-night. It not being my intention to enter into a detailed description of the various forms of machinery from time to time devised for the manufacture of aërated waters, I shall confine my remarks to a special type of mineral-water plant, which may be regarded as the most perfect, in so far as the manufacture of really high-class beverages is concerned; it is of special interest, moreover, as being the only system adapted for the accurate and scientific reproduction of natural mineral waters. This branch of the aërated water industry is one of considerable complexity, and its exercise must needs remain in the hands of those sufficiently versed in chemical methods to cope with its difficulty.

This system of machinery is by no means novel, on the contrary, it is one of the oldest, being practically the same as that originally adopted by Dr. Struve more than half-a-century ago, when he turned his scientific investigations in connection with the imitation of natural mineral waters to practical account. In Germany, where the production of artificial mineral waters has reached a high standard of efficiency, this type of machinery is still employed by all makers of standing. The system, apart from some trifling alterations, has thus remained the same: it has stood the test of time and no further testimony to its excellence is necessary. As far as I am aware its employment in Great Britain is limited to a very few firms, the majority of manufacturers giving the preference to a somewhat different system which has advantages of its own. There are, strictly speaking, three stages in the manufacture of aërated waters, in describing which I shall adhere to the class of machinery exemplified by the accompanying sketch. In order to enable you, however, to draw a comparison between this and the other system and to form an opinion with regard to their respective merits, I shall endeavour to make clear to you in what respects they differ. The three stages in the manufacture to which I have referred are :—

1. The generation of carbon dioxide.
2. The compression of the carbon dioxide.
3. The impregnation of water or saline solutions thereby.

The carbon dioxide required for the aeration of the water is almost invariably produced by the action of sulphuric acid on one or other of the natural carbonates, such as magnesite, dolomite, marble, or ordinary whiting. A given weight of the ground carbonate is introduced by the opening (Fig. 1 A) into the generator (Fig. 1), an iron vessel lined with pure lead and fitted with a pressure-gauge and safety-valve. It is there thoroughly mixed with water by means of an agitator, the shaft of which (Fig. 1 B) passes through the cover of the generator in a vertical direction. The arrangement for admitting the acid is so constructed that the necessary quantity is first introduced through the opening (Fig. 1 *a*) into a small drum-shaped vessel (Fig. 1 C) communicating with the generator by means of a pipe ordinarily closed by a screw-valve (Fig. 1 *b*) worked from the outside. The openings (Fig. 1 A and *a*) are now securely closed, and the screw-valve *b* preventing the entrance of the acid from the vessel C into the generator is gradually opened, the addition of the acid being so regulated as to maintain a constant stream of gas. In this system it is customary to maintain a considerable pressure of gas within the generator in order to prevent the entrance of any of the solutions contained in the purifiers through which the gas has to pass next. After the reaction is complete, the sulphate formed can be discharged by opening the tap of the waste-pipe P. The thorough purification of the carbon dioxide, only too frequently neglected, must be regarded as one of the principal features in the manufacture of high-class waters. The earthy carbonates employed almost invariably contain certain proportions of bituminous or other organic matters, which when acted upon by an acid give rise to various volatile products. Unless these are removed from the carbon dioxide the gas will have a foul and earthy taste in itself sufficient to render the beverages impregnated therewith unpalatable. Traces of sulphides frequently present in the natural carbonates evolve sulphuretted hydrogen, which is still more objectionable. By using a very pure carbonate, such as sodium bicarbonate, these contaminations might be avoided, but even then the gas would have to be passed through a purifier in order to retain any impurities carried over mechanically. The use of bicarbonate of soda for the purpose of generating carbon dioxide is, however, limited owing to its high price, and the regeneration of the sulphate formed in such quantity and quality as to be sufficient recompense, I mean financially, for the high initial expense of the bicarbonate is not so simple and convenient as many interested in this question seem to imagine. By using efficient purifiers a pure gas can easily be obtained from the natural carbonates. In order to effect this purification the gas after leaving the generator is passed through three or more cylindrical purifiers (Fig. 2 A, B, C), the first (C) and third (A) of which contain solutions of sodium carbonate, the centre one (B) being filled with charcoal. Should traces of sulphides be present in the carbonate employed, a cylinder containing an alkaline solution of ferrous sulphate would have to be added to this system in order to remove the sulphuretted hydrogen formed. Another impurity not so objectionable in ordinary aërated beverages, but one which should be reduced to a minimum in well manufactured waters, is atmospheric air. I may state that it would be impossible to manufacture a chalybeate water intended to keep for any length of time without removing the air both from the carbon dioxide and the water employed in its manufacture. But even a good aërated water ought to be charged with carbon dioxide containing only a trifling admixture of air. In order to procure air-free carbon dioxide the pipe leading from the generator to the purifiers is closed during the first few minutes after the acid has been allowed to enter. Whenever gas of a sufficient pressure has collected in the generator the mixture of carbon dioxide and air thus formed is allowed to blow off by slightly unscrewing the cover of the opening, a process which may

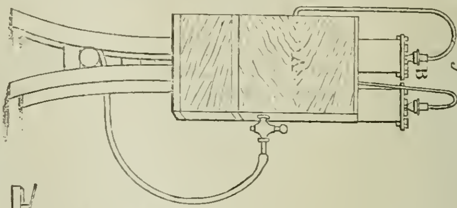

Fig. 6.

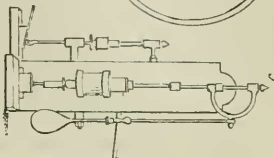

Fig. 7.

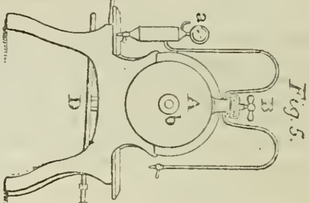

Fig. 5.

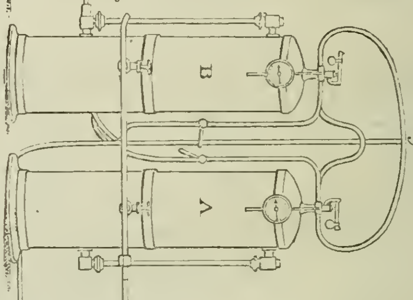

Fig. 4.

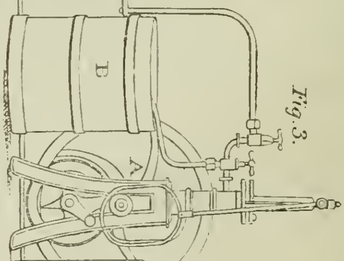

Fig. 3.

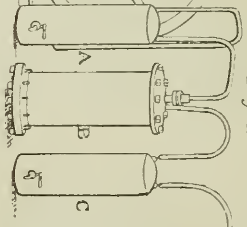

Fig. 2.

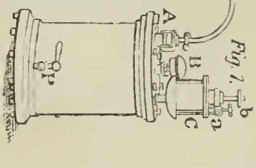

Fig. 1.

be repeated until all the air has been expelled from the generator. After passing through the purifiers the gas enters the gas holders, Fig. 4 (A, B), strong cylindrical vessels of copper lined internally with tin in which it is compressed by means of water driven into the cylinders by the force pump (Fig. 3 A), the water for this purpose being derived from the tank, (Fig. 3 B). I would at this point draw your attention to the fact, that the carbon dioxide at no time passes through a pump as in the other systems of machinery, no contamination is therefore possible. The gas contained in the holders is ordinarily maintained at a pressure of from about 4½ to 8 atmospheres according to the nature of the beverages which are to be charged. These gasholders, of which there may be any number, are each supplied with an independent system of piping in order that gas of different pressures may be collected in the separate holders. We have now arrived at the last stage of the manufacture, viz., the actual aeration of the water. The aeration is conducted in egg-shaped copper vessels lined with the purest tin procurable. This type of mixer or condenser (Fig. 5 A), consists of two parts bolted together in order that repairs in the interior of the vessel may be conveniently carried out by taking these parts asunder. The mixers are fitted with a pressure gauge (Fig. 5 *a*), and an agitator the shaft of which (Fig. 5 *b*), passes through them in a horizontal direction. The water taken direct from a tin lined cistern (Fig. 6 A), in which it has collected after passing through the double charcoal filter (Fig. 6 B), is introduced into the mixer at the orifice (Fig. 5 B), by means of an india-rubber hose connected with the cistern by a system of pure tin piping. When the mixer is full of water, the orifice B is firmly closed, and compressed carbon dioxide admitted from the gas holder by the pipe (Fig. 5 D) passing into the top part of the mixer, the tap of the discharge pipe (not shown) passing from the lower part of the mixer being opened simultaneously by which means a certain part of the water originally contained in the mixer is forced out, its place being taken by compressed carbon dioxide. This reduction in the quantity of water is necessary to allow a certain space for the gas with which it is to be impregnated. After sufficient water has been forced out, which is determined by measurement, the discharge pipe is closed, and the agitator set in motion, gas being admitted continuously. Owing to the absorption of the gas by the water the pressure, as seen by the indicator of the gauge, is gradually reduced. At a certain point, however, the pressure of gas inside the mixer again rises and continues to do so until as much gas has been absorbed by the water as it is capable of taking up under existing conditions of temperature and pressure. The supply of gas is now shut off, the agitator thrown out of gear, and the gaseous mixture consisting of carbon dioxide and air allowed to escape by slightly raising the cover of the opening B. This preliminary charge is necessary in order to free the water from air. In manufacturing mineral waters, in which all but minute traces of air are objectionable, this preliminary charging may have to be repeated. After blowing off, the orifice B. is finally closed, the gas again admitted and thoroughly incorporated with the water by means of the agitator until the indicator of the gauge remains constant at a pressure of from about 4½ to 7 atmospheres, the charge being varied according as the beverage is intended to be filled into bottles or syphons. Supposing a saline carbonated water is to be manufactured instead of a plain carbonated water, the solution of the salts accurately measured is introduced into the mixer by the opening B. after the preliminary discharge of the pure water previous to the process of aeration. The capacity of the mixer and the amount of the water let off being known with accuracy, the production of beverages of any given composition can be effected without difficulty. The advantage of the system in this respect will be apparent to you when the manufacture of mineral waters comes to be considered. After aeration is complete, the operation of filling into bottles or syphons is proceeded with, and no fresh charge of aerated water can be introduced into the mixer until the whole of the water has been bottled; this system of machinery is consequently termed the discontinuous or intermittent system to distinguish it from that ordinarily in use, in the employment of which no such interruption in the charging is necessary as the charging can proceed simultaneously with the bottling. Before I proceed to compare the system I have just described with the "continuous" system I would call your attention to the fact, that during the whole of the process the chances of metallic contamination are reduced to a minimum. All the vessels are lined with pure tin except the generator, whereas the pipes conveying the water and the finished beverages consist wholly of tin. Fig. 7 shows a common type of bottle-filling machine, into a description of which it will not be necessary to enter.

The system of machinery ordinarily employed in this country differs from that just described in so far as the intermediate stage, the compression of the gas in special gas holders, is omitted. The gas passes from the generator or purifiers into a gasholder similar to those employed in gas works, in which it is kept under little or no pressure. From this gasholder the gas is drawn by a pump, which forces it into the mixer, a vessel similar in construction to the mixer employed in the "discontinuous" system but being much smaller and devoid of the orifice (Fig. 5 B) through which water and solutions are introduced according to the procedure adopted in the latter system. Water or saline solutions are likewise forced into the mixer by means of a pump, the mixture of gas and water thus forced in being kept in motion by an agitator similar to that already described. In this system the filling into bottles can commence as soon as the charge is up and need not be interrupted, as the charge is being constantly renewed by the force pumps attached to the mixer. The continuous system has certain advantages; it is simpler and cheaper in its working, and well adapted for manufacturing ordinary aërated waters on this account. Its disadvantages are as follows: Both gas and water have to pass through pumps, there is consequently more chance of contamination; again, in working continuously it is not possible to remove the air from the water or saline solutions employed, thus the beverages aërated according to this method contain in addition to carbon dioxide considerable quantities of air Such beverages soon part with their carbonic acid whenever the pressure is released. The employment of Struve's system is likewise attended with certain disadvantages. The frequent blowing off of carbon dioxide would be considered wasteful if financial considerations alone were taken into account; the impossibility of filling the mixer during the process of bottling must likewise be regarded in the light of a disadvantage, as this circumstance in itself necessitates the employment of a much more extensive plant than is usual with the continuous system. It may be said then, that for the production of ordinary aërated beverages the continuous system will be adopted in preference to the other, affording as it does certain advantages in regard to economical and cheap working which will better enable manufacturers to meet the demand for a cheap article. The discontinuous system, on the other hand, stands unrivalled in as far as the quality of the finished product is concerned; it is capable of manufacturing beverages of the highest class when employed by men scientifically trained, and is the only system by means of which the waters of mineral springs can be reproduced artificially. Apart from the aëration, there is very little difficulty in producing the simpler forms of aërated beverages in use. Simple as these are, certain manufacturers have nevertheless taken it upon themselves to further simplify them by omitting what most people would regard as essential constituents. Much discussion has lately been raised with regard to the question what soda water actually is or should be, inasmuch as certain individuals were convicted for selling a beverage labelled soda water which on analysis proved to be devoid of soda. Convictions of this kind can only be regarded as furthering the interests of conscientious and reliable makers who actually supply what they pretend to supply. The want of discrimination shown by the public at large in regard to such matters must in a great measure be held liable for shortcomings of such a kind. Most people are satisfied as long as they get a beverage that "pops" and "fizzes," provided it be cheap enough; this fact, however, by no means justifies the adoption of a wrong precedent, viz., that soda water need not contain any soda. If such a precedent were once created there is no saying what advantage might be taken of it. The omission of soda in soda water has been defended in various ways by those concerned, some justify their action on the grounds that "it is always done," or, as in this case, "not done," with other words, that it is customary to sell plain carbonated water as soda water; others again, imbued with a feeling of universal benevolence, omit the soda entirely in the interests of humanity, as in their opinion people prefer plain aërated water to soda water. As regards the former defence, I can only say that soda is invariably added by conscientious and reliable manufacturers, and only the products of such firms can be taken as standards. The benevolence again in the latter defence appears to be of a somewhat questionable nature, leading, as it does, to the sale of goods under false pretences. Some other most amusing defences, disclosing an alarming amount of ignorance on the part of those offering them, have lately been put forward. One manufacturer of 12 years' standing stated that the soda was destroyed by the carbonic acid; he did not state what became of it. In another case of a similar kind, tried quite recently, the statement was put forward that soda water was manufactured in various ways, there not being any law regulating it; in the present instance the gas was prepared from bicarbonate of soda, which was injected into the water, and with the escape of the gas on the cork being withdrawn there would be an escape of bicarbonate of soda. The law having definitely decided that soda in the form of bicarbonate must be present in soda water, the question now comes to be how much must the water contain. The pharmacopoeal strength of 30 grains per pint, of sodium bicarbonate, would be unsuitable, and is only manufactured when specially requested. Half the pharmacopoeal quantity, 15 grains per pint, or 7½ per bottle, seems to provide a suitable beverage for ordinary wants; at least, I am aware of large quantities of such soda water being consumed. I am inclined to think that far too much has been made of the question, "how much soda must be present in soda water?" As far as I am aware no convictions have taken place for adding too little soda to the water, and in the absence of any official standard each manufacturer is perfectly justified in meeting the wants of his customers by regulating the quantity of soda in his soda water. Whether the presence of only a small quantity of soda, say 1 grain per bottle, would lay a manufacturer open to attack, I am inclined to doubt. The saline constituents of potash and lithia waters must, of course, be regulated in a similar manner. When so much discussion has arisen over the simple question as to the composition of soda water, what, then, can be say with regard to the constituents of that nondescript beverage "seltzer"? "Seltzer" means simply nothing; the term may be a corruption of the words seltz, selters, seidlitz; and the "seltzers" placed on the market vary more with regard to their composition than any other beverage of this class. People who drink "seltzer" instead of soda water no doubt think they are getting something special, but I am inclined to doubt whether they know what they *are* getting, or even what they expect to get, inasmuch as the beverages of the "seltzer" class may have any composition. I think there is little doubt, however, that it was the popularity enjoyed by the natural water of the celebrated spring situated at Niederselters, Nassau, exported in brown stone bottles, that originally gave birth to the empyrical "seltzers." On the continent, the "selters" water sold by reliable makers is an exact reproduction of the Nassau water, and, as such, is drunk in preference to soda water by by a great many. This water has special properties not possessed by soda water, and its composition, regulated by the analysis of the natural water, is a constant one, at least as far as the products of good makers are concerned. In addition to these genuine "selters" waters, numerous inferior waters, of similar designation, are placed upon the continental market by inferior makers, who do not follow the composition of the natural spring. Of the three springs, situated respectively at Niederselters, Okarben (the water of which is termed occasionally "selzerwasser)," and Seidlitz or Sedlitz, only the first mentioned yields a type of water suitable as an everyday beverage. In case, then, the "Seltzers" pretend to be imitations of a natural water, it is this spring that should serve as a model. The Selzer (Okarben) water, with which they would correspond in name, is not fitted for daily or frequent consumption, much less the seidlitz water. The composition of the three springs, given in parts per 10,000, is as follows:—

SALTS STATED AS ANHYDROUS.

——	Niederselters.	Okarben (Selzer).	Sedlitz.
Sodium iodide	0·00033	0·0001	..
Sodium bromide	0·0091	0·0017	..
Potassium chloride	0·200	0·279	..
Ammonium chloride	0·052	0·059	..
Sodium chloride	23·222	12·650	2·722
Lithium chloride	0·036	0·021	..
Potassium sulphate	6·435	0·616	9·194
Barium sulphate	0·027	0·047	..
Strontium sulphate	0·002	0·0005	0·024
Magnesium sulphate	..	..	169·133
Sodium sulphate	..	..	33·04
Calcium sulphate	..	..	7·936
Sodium bicarbonate	12·518	0·813	..
Magnesium bicarbonate	3·081	4·123	..
Calcium bicarbonate	4·438	18·518	16·627
Ferrous bicarbonate	0·042	0·132	..
Manganous bicarbonate	0·007	0·022	..
Sodium nitrate	0·061	0·012	..
Sodium phosphate	0·008	0·0066	..
Silicic acid	0·212	0·135	..
Alumina	0·0018	0·0004	..
Organic matter	..	..	0·104
Total solids	44·352	37·436	238·780

On comparing the constituents of these three springs we shall find that the first two are somewhat similar, whereas the third (Sedlitz) shows important deviations, being characterised by a very high proportion of magnesium sulphate and sodium sulphate, salts which render its use as an ordinary beverage undesirable. The Okarben spring is rendered obnoxious by a considerable proportion of lime salts, of which the Niederselters spring contains only a small percentage. The whole question as to the composition of the various "seltzers" is a somewhat unsatisfactory one, and I am inclined to think that manufacturers who produce the beverage should state according to what analysis the water has been prepared if one of the natural springs has seved as their model. In this case the beverage should be labelled correctly, *e.g.*, in case of an imitation of the Niederselters or Nassau spring as "selters" water in order to show the consumer what he is actually getting. The term "seltzer" affords absolutely no clue in this direction. The production of an aërated water containing the constituents of the selters spring is of course a much more complicated matter than the manufacture of simple soda water, and this applies equally to the reproduction of any of the natural mineral waters, especially those containing iron and manganese salts. For this branch of the aërated water manufacture chemical knowledge is indispensable; efficient machinery equally so. The continuous system is not adapted for this class of work, whereas the natural waters can be reproduced without difficulty by means of the discontinuous system. The difficulties attending this species of manipulation arise out of the fact that all the mineral springs contain salts which would not dissolve if simply introduced in the ordinary way. To take an example, the carbonates of the alkaline earths are not soluble in pure water, but require water impregnated with carbonic acid for solution. Supposing we were to introduce ordinary barium carbonate into our mixer charged with aërated water, a long time would elapse before complete solution could be effected. Freshly precipitated barium carbonate would, however, dissolve at once; it is customary on this account to take advantage of double decompositions in order to effect the solution of salts not ordinarily soluble. Manganese and iron salts are introduced in a similar fashion except when it is necessary to introduce metallic iron, a course which must be adopted when the double decomposition, say between ferrous sulphate and carbonate of soda would produce more sulphate of soda than was present in the natural spring. All the double decompositions must be carefully calculated out beforehand, and so arranged that nothing is present in the finished artificial mineral water beyond what is demanded by the analysis of the natural water. The salts are introduced into the mixer in different groups, each of which must be brought into solution before the next one is introduced. Metallic iron is rather difficult of solution and sometimes takes considerable time to dissolve even when the water and carbonic acid employed are free from air. It is customary to fill the bottles into which the mineral water is to be introduced with carbonic acid previous to bottling, so as to exclude the possibility of air being mixed with the water. The presence of air would lead to the precipitation of the iron as oxide since the ferrous bicarbonate is decomposed thereby. This may frequently be observed in the case of natural chalybeates which have been exported in bottle. I do not intend entering upon that much vexed question as to the relative merits of natural and artificial mineral waters, beyond drawing attention to the fact that an artificial mineral water skilfully manufactured will keep for a very long time, whereas many of the natural waters exported in bottle speedily undergo decomposition. I have examined natural chalybeates exported in bottle which did not contain a trace of iron, the whole of it having been precipitated as oxide. In order to avoid such contingencies, many natural waters are treated artificially in a manner which renders their claim to be considered as such, viz., natural mineral waters somewhat doubtful. Other waters, again, which contain constituents foreign to the composition of a table water are treated in certain ways to remove the objectionable constituents. Thus iron can be removed by forcing air into the water, and again charging the clear liquor drawn off from the ferric oxide with carbonic acid. When such manipulations have to be resorted to I think that it will in most cases be preferable to manufacture the water artificially from the beginning, seeing that its natural charms have to a certain extent fled. High prices are paid for many of these waters which could be provided more cheaply when manufactured artificially, and I am convinced that, provided the manufacture be carried on with the necessary skill, few people would be able to tell the difference between the natural and the artificial product. Strange to say, there is not much demand for artificial mineral waters, at least in Scotland, which may to a certain extent be due to the fact that the use of these mineral waters is as yet but imperfectly understood. I desire in conclusion to express my indebtedness to the British and Foreign Mineral Water Company, Glasgow, for their kindness in placing at my disposal the beautiful set of models illustrative of the machinery employed in the manufacture of mineral waters.

Discussion.

The Chairman, after stating that the practical experience of the author made his paper of special value, said he had been led to understand that soda-water, on account of the soda it contained, had a prejudicial effect upon the system. He would be pleased to hear Dr. Zinkeisen's views on the matter, and also if aërated water containing magnesia in solution would not have a more beneficial effect. He asked if there was any difference in the medicinal value of a natural and of a well-manufactured artificial mineral water. He considered that the waste carbonic acid gas from fermentation was specially suitable for the manufacture of aërated waters, on account of its sweet flavour. Lately a company had been formed in Ireland for the purpose of supplying the gas compressed. He would like to hear whether or not it had met with any degree of success, and if Dr. Zinkeisen regarded it as a likely source of supply. With gas made from earthy carbonates there was usually a faint but unpleasant flavour, due, no doubt, to minute traces of indefinable substances: for this reason bicarbonate of soda used to be specially prepared in Germany from fermentation carbonic acid gas.

Dr. J. Clark said, since the enactment of the Food and Drugs Act, the composition of a commodity required to be defined. Dr. Zinkeisen had referred to the fact that many waters were sold as "seltzers," which really were of indefinite composition. He thought that the public had a right to expect, when a water was called "seltzer water" that it should have approximately the composition of the natural water, and he thought that misrepresentation in a case of this kind ought to be regarded as constituting an offence under the Act. He had also heard the opinion expressed that the regular use of either soda or potash water had a depressing effect on the system; that, however, was a medical question which was apart from the subject.

Professor Mills said aërated water manufacturers had a very complicated problem to deal with when matching natural mineral waters. A few degrees difference in temperature, for instance, would entirely alter the statical balance between magnesic sulphate and sodic chloride. Theoretically, also, a newly made mixture in solution ought to change somewhat with time. Had Dr. Zinkeisen had any experience of this?

Dr. Zinkeisen in reply, said that he was unqualified to give an opinion as to the medicinal properties of soda-water. Magnesia-water was manufactured but did not seem much in demand, probably for the reason that it had a disagreeable chalky taste. A battle was still raging on the Continent with regard to the value of natural, as compared with artificial, mineral waters. For his own part he thought that a well-manufactured artificial water should have precisely the same effect upon the system as a natural water. The artificial might, in certain instances, be preferable to the natural, for the latter, in exportation, sometimes underwent chemical changes which rendered them unsuitable for use. He had examined natural chalybeate waters, after exportation in bottle, which did not contain a trace of iron in solution, the whole of the iron having been converted into insoluble basic compounds. In answer to Professor Mills he suspected that considerable change did take place in the relative constitution of the artificial solutions both by lapse of time and variation of temperature, but he had no specific data on which to found an exact opinion. He did not consider that, in this country, compressed fermentation carbonic acid gas would ever be largely employed by aërated water manufacturers; partly because of the conservatism of the trade and also from the fact that by using efficient purifiers a chemically pure gas could be obtained from earthy carbonates at a slightly cheaper rate.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

The supposed Formation of Lime Soaps in Steam Generators. A Vivien. Comptes Rend. **115**, 318—320.

It has been hitherto supposed that the oil used for lubricating the steam cylinder of an engine, finds its way into boilers into which the condensed water is fed, and that this oil, combining with the calcium carbonate contained in the remaining feed-water, forms a non-conducting film on the boiler plates. The author has analysed a number of boiler-deposits, which were supposed to be lime soaps thus formed.

The samples 4, 5, 6, and 7 are impervious to water, and sample 7 is so fine that no crystalline structure could be observed with the microscope; it floats on boiling water. In five samples the quantity of fatty matter is *nil*, and in the two others too minute to be objectionable The fact that these samples feel soap-like when touched, probably caused these deposits to be mistaken for lime soaps. Their formation is not due to the presence of oil in the condensed water, but solely to the composition of the feed-water. Similar powders were produced in the laboratory by mixing and evaporating pure distilled water with unfiltered waters containing lime.

A lime soap cannot be formed with calcium carbonate, and supposing it could, it would certainly be decomposed long before the boiler plates became red hot.—K. E. M.

—	From M. Tardieu, Engineer at the École Centrale. Boiler Deposits having caused Accidents.			Deposits called "Lime Soaps." Collected after a Series of Accidents.			Mud floating in Boilers of M. Maréchal, St. Quentin.
				Sugar Refinery, Origny.	Sugar Refinery, Senercy.	Sugar Refinery, Theil.	
	1.	2.	3.	4.	5.	6.	7.
Calcium carbonate	31·987	68·242	83·169	85·662	76·360	62·373	98·214
Magnesium carbonate	0·000	0·000	0·000	2·080	4·620	..	0·000
Calcium sulphate	0·272	0·000	0·000	0·450	0·280	3·394	0·000
Silica	29·800	10·400	3·800	2·042	6·600	5·445	0·620
Lime	2·180	5·184	4·825	3·098	6·460	11·384	0·000
Iron and Aluminium oxide	26·200	1·800	1·600	1·240	1·600	1·878	0·000
Soluble salts	0·516	0·550	0·450	0·433	0·280	0·169	0·000
Organic matter	6·876	12·074	4·356	4·200	3·700	11·754	0·390
Fatty matter	0·000	0·000	0·000	0·065	0·000	0·160	0·000
Various other compounds	1·069	0·920	1·550	0·730	0·100	3·443	0·776
Moisture	1·100	0·830	0·250	0·000	0·000	0·000	0·000
	100·000	100·000	100·000	100·000	100·000	100·000	100·000

PATENTS.

Improvements in the Process of and Apparatus for Evaporating or Drying. F. M. Robertson, H. S. Fearon, and W. S. Miller, London. Eng. Pat. 2895, February 13, 1892.

The inventors employ a cylindrical vessel *a* traversed by a shaft *b*, carrying a number of discs, *b* 4, the peripheries of which nearly touch the circumference of the cylinder. Between the discs are inserted slanting partitions *c*, secured at their upper ends to the inside of the vessel and reaching down to within a short distance of the level of the liquid or material to be concentrated or dried, and nearly touching the disc so as to scrape off any material adhering to them. The material is fed in through the opening *a* 1, and removed from the neck *a* 5 when the operation is completed. Through a number of openings *a* 7, air, either hot or cold, is led in between the discs, and after passing under the lower edges of the partitions leaves the vessel by the openings *a* 9, carrying with it any moisture

---

* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

or vapour extracted from the contents. The vessel may be surrounded by a jacket for keeping up any required temperature. The arrows in the figure (Fig. 1) indicate the direction of the air current, and of the motion of the discs.
—B.

Fig. 1.

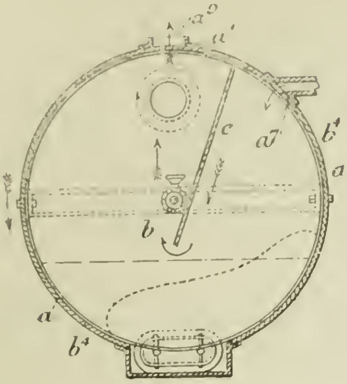
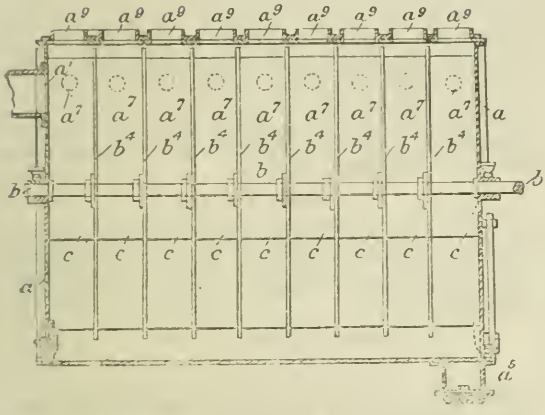


Fig. 2.

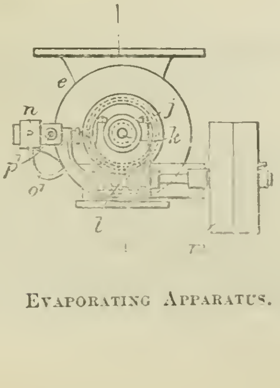

a⁹ a⁹ a⁹ a⁹ a⁹ a⁹ a⁹ a⁹ a⁹
a'
a⁷ a⁷ a⁷ a⁷ a⁷ a⁷ a⁷ a⁷ a⁷
a
b⁴ b⁴ b⁴ b⁴ b⁴ b⁴ b⁴ b⁴ b⁴
b
b
b
c c c c c c c c c
a
a⁵

Apparatus for Evaporating or Drying.

Improvements in Evaporating Apparatus. F. W. Scott, E. G. Scott, and F. W. Scott, jun., of London and Liverpool. Eng. Pat. 6478, April 4, 1892.

In connection with the evaporation of saccharine juices, brine, &c., under a vacuum, the patentees employ a rotary valve attached at the lowest point of the apparatus for the automatic and constant withdrawal of the deposited substances during the operation. The valve consists of a casing *e*, with conical plug *f*, having recesses *g*, which, on rotation, alternately present themselves to the filling and discharge openings. The plug is rotated by means of a spindle *k*, worm and wheel *i* and *j*, driven by the pulley *m*. As it was found that the air carried back through the recesses *g* into the pan after discharging the material injuriously affected the vacuum, the patentees describe a device for exhausting the air from the recesses after they are out of communication with the atmosphere and before they have effected communication with the interior of the pan. This is accomplished by means of a small spring valve in a box *n* attached to the side of the casing *e*, communicating through the pipe *o* 1 with the casing, and through the connection *p* 1 with a vacuum pump. The valve spindle is moved by two cams attached to the worm wheel *j*, which make the connection with the vacuum pump at the proper moments. For the latter part of the invention see also the previous patent, No. 20,595, of 1892.—B.

Fig. 1.



Evaporating Apparatus.

Fig. 2.

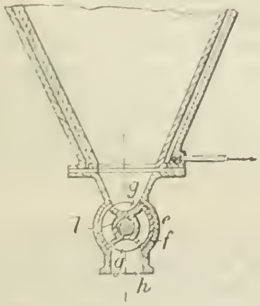


Fig. 3.

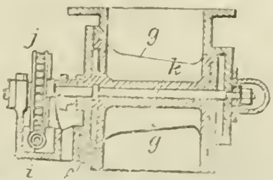
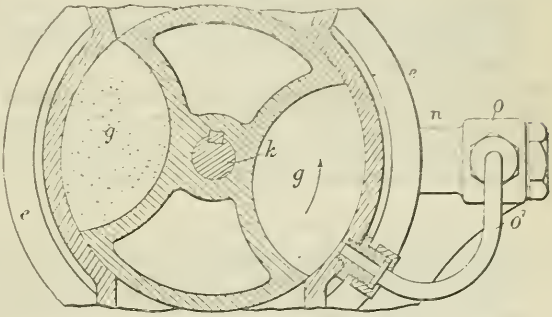


Fig. 4.



Evaporating Apparatus.

Improvements in Surface Condensing and Refrigerating Apparatus. C. D. Abel, London. From A. Theisen, Radolfzell, Baden, Germany. Eng. Pat. 6700, April 7, 1892.

In the case of surface condensing or refrigerating apparatus in which the fluid to be condensed is made to flow through vertical tubes, the outer surfaces of which are subjected to the combined action of water and air currents, the uniform distribution of the descending current of water is effected by helically winding around the tubes one or more wires at such an angle that water will readily flow down in a helical direction. The same may be done internally if the position of the cooling and the cooled liquor is reversed.

The tubes may be arranged in various ways with or without the addition of horizontal coils of tubes and of fans and pumps for propelling the air and the liquids. See also Patent No. 10616, of 1891.—B.

Improvements in Lagging for Steam Boilers and the like. G. J. Clarkson, Stockton-on-Tees. From The Mannheimer Gummi Gutta-Percha und Asbest Fabrik, Germany. Eng. Pat. 23,782, December 24, 1892.

In order to avoid the bagging or sagging by vibration of insulating material when applied to boilers in the shape of cushions, the inventor manufactures the material in the shape of ropes or strands of either round or square section, laying them close together, and securing them within an outer covering.—B.

Improvements in Process and Apparatus for Drying Brewers Grains and like Material. H. H. Leigh, London. From B. C. Batcheller, Philadelphia, Pennsylvania, S. D. Schuyler, New York, and W. M. Cramp, Philadelphia, Pennsylvania, U.S.A. Eng. Pat. 21,284, November 22, 1892.

See under XVII., *page* 369.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Improvements in Apparatus for Revivifying Gas Lime (Sulphide of Calcium) and other Analogous Materials. J. A. Yeadon and W. Adgie, Leeds. Eng. Pat. 5239, March 16, 1892.

The material is fed automatically into an externally-heated revolving retort provided with fixed blades. The escaping gases may be condensed, whilst the revivified lime is delivered at the outlet end into a box so constructed that ingress of air is prevented. (This Journal, 1890, 797.) —H. A.

Improvements in the Purification of Coal-Gas and in obtaining Products therefrom. W. Belton, Shrewsbury, and G. E. and A. R. Davis, Manchester. Eng. Pat. 6062. March 29, 1892.

The novelty of this improved process of purifying coal-gas consists in the employment of a solution of sodium carbonate, or of caustic soda, for washing the gas. This solution is introduced into the scrubbers, which are worked in a series in the ordinary manner, and when it is saturated, or nearly so, with impurities, it is heated in a still of the column form usually employed in the manufacture of sulphate of ammonia. The gases expelled from the solution are passed through dilute acid, which absorbs the ammonia, and the sulphuretted hydrogen is utilised in any convenient manner. The residual liquid is then concentrated by evaporation, and a portion of it, after having been strengthened by the addition of more soda-ash if necessary, is again used for the gas purification; the remainder is further concentrated, allowed to stand, the crystals of sodium carbonate separated, and the mother-liquors worked up for the preparation of carbonates, hyposulphites, sulphocyanides, cyanides, &c.—F. S. K.

Improvements relating to the Generation of Gas and to Apparatus therefor. H. H. Lake, London. From A. Kimber, New York, U.S.A. Eng. Pat. 23,498, December 20, 1892.

The communicator in his 21 claims endeavours to attain a point of perfection in the manufacture of a uniform illuminating gas, or fuel-gas, by a process continuous in its operation, free from the production of disabling deposits, and economical in labour and material.

The process consists in heating steam in a retort chamber so that it acquires the same temperature as the retorts, and then, with the aid of this steam under pressure, injecting oil or liquid hydrocarbon into the retorts already mentioned; the mixed gases and vapours pass backwards and forwards through the several sections of the retorts, which are maintained at a constant and very high temperature, and the fixed gas then immediately enters an expansion chamber, whence it is exhausted and passed to a condenser. A portion of the gas produced in the retorts is forced into a mixing chamber by means of an air jet; this mixture of air and gas is burnt on a perforated grate in a combustion chamber underneath the retort chamber, the products of combustion escaping through a series of openings in the latter.

One of the most important points in connection with the apparatus is the construction and arrangement of the retorts. Each retort consists of several lengths of pipe having an internal diameter of about $1\frac{7}{8}$ in.; these pipes are connected together at their rear ends by return bends, the connections in front being made by small junction pipes at a point some distance from the front ends, which are provided with plugs. The spray of steam and oil first passes through an unobstructed pipe; it then passes through a pipe in which is placed a core piece, provided with deflectors at frequent intervals of its length, so that the gaseous mixture is caused to flow in close contact with the red-hot sides of the pipe. The core piece is simply a pipe which, together with the deflector, is strung on to a central rod; in order that the rod may be readily inserted or removed, it extends to within a short distance of the plugged end of the pipe.—F. S. K.

Improvements in the Detection and Estimation of Combustible Gas or Vapour present in Air and Apparatus for that Purpose. B. Redwood, London, F. Clowes, Nottingham, and S. Waters, London. Eng. Pat. 187, January 4, 1893.

See under XXIII., *page* 375.

Improvements in the Process of Manufacturing Gas. W. P. Watson, New York, U.S.A. Eng. Pat. 555, January 10, 1893.

For producing illuminating gas from water-gas and hydrocarbon, a vertically elongated chamber, containing refractory brickwork above and a fire chamber below, is employed, the process being carried out as follows:—The fuel (coal) in the lower chamber is ignited, a blast of air admitted, and the products of combustion passed through the upper chamber containing the refractory material. As soon as the latter is sufficiently heated, the air-blast is turned off and steam is admitted under the grate; at the same time a spray of hydrocarbon, or oil, obtained with the aid of a steam-jet, is forced into the top of the upper chamber of refractory material, and the rich fixed illuminating gas issuing therefrom is mixed with the water-gas produced in the lower chamber.—F. S. K.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Petroleum Industry at Baku. N. J. Hahn. Zap. imp. russk. techn. obszcz. 1892, **26**, **6**, 1; and Chem. Zeit. Rep. 1892, **23**, 269—270.

The whole oil-bearing area at Baku at present amounts to 450 to 600 a., of which many parts are still unworked. The quantity of petroleum obtained in 1873 was $3\frac{1}{2}$ million poods (1 pood = 16·38 kilos.), and in 1891 $289\frac{1}{2}$ million poods. In recent years the increase has been fairly regular at about 16 per cent. of the output of the previous year. The cost of winning the petroleum has, however, increased in greater ratio than corresponds to the amount of the output, the former having risen 360 per cent. within the last five years, and the latter only 100 per cent. The cause of this poor result is that the sinking of new bore holes has been prosecuted with too much eagerness. The yield from the more recent bore holes is smaller than that from the old wells. The number of bore holes giving a comparatively poor yield now amounts to from 60 to 80 per cent. of the total number in use, so that the average yield of a bore hole is smaller than it was by about 40,000 poods, comparing the output of 1887 with that of 1891. This result becomes even lower when the petroleum obtained from the bursting out of oil fountains that has occurred during the last three years is deducted from the total, the figures then representing a diminution of 500,000 poods, or about 50 per cent. of the output of each bore hole. It is especially noteworthy that this is in spite of the use of better appliances for sinking wells, which should tend to increase the yield from each hole. It is also significant that the more recent bore holes have much shorter lives than their predecessors. Thirty to 50 per cent. of them require repairing or deepening in the first year of their existence, and when the alterations have been made scarcely a third of the bore holes gives a fair output. Outbursts of oil are the evil genius of the Russian petroleum trade. They only occur in some 5 to 6 per cent. of the bore holes, and, when they happen, they demoralise the trade by the sudden lowering of prices due to the temporary superabundance of oil. These outbursts take place in the deeper wells, and are apparently due to the tapping of an oil-bearing stratum underlying that worked by wells of ordinary depth. They have a bad effect on neighbouring shallow wells by lowering the level of oil in the latter, even if they are not directly adjacent. Oil from these occasional outbursts is intimately mixed with water and sand, and the separation of these impurities is accomplished by long subsidence in open vessels, a process which causes loss of the lighter hydrocarbons, and makes refining more difficult and the yield of burning oil smaller. Moreover, the mud is not completely separated, and may cause stoppages of the waste-cock of the still. The fact that outbursts of this kind happen, might be taken as an indication that the store of petroleum at Baku is not on the wane, were it not that their occurrence is less frequent than it used to be, and is almost confined to districts where the wells are not specially close together, and where the output of oil has therefore been less. The various disturbances of the ground that have taken place at Baku must be attributed to the immense quantity of material that has been removed from an area relatively inconsiderable. Since the year 1873, 1,600 millions of poods of oil, and at least 4 million poods of water, besides a quantity of sand of which no record exists, have been got out. The resulting collapse of the earth overlying the spaces thus formed, is shown by subsidences of conical shape, generally 9 to 15 m. deep and 20 to 24 m. wide, which take place with much suddenness. Deformation and disappearance of bore holes must be set down to the same cause. The prospect of the present bore holes failing, is in no way compensated for by the yield from deeper holes that have been tried, as these latter give a heavy oil which contains only 18 to 20 per cent. of burning oil.

Another deposit of oil has been found near Geran, a station about 200 kilometres from Baku on the Transcaucasian Railway, but it yields only 4 to 5 per cent. of burning oil and 80 per cent. of good lubricating oil. Three oil-bearing strata have been worked at Chidyrsinde, about 120 kilometres north of Baku, but the yield is not especially great; the oil is, however, very light (sp. gr. 0·841—0·858). The bore holes that have at present been made are only some 80 m. deep, and it is possible that when carried to a greater depth a larger quantity of oil may be obtained. At Naphta-Tschala, 150 to 160 kilometres south of Baku, considerable deposits appear to exist, to judge by such investigations as have been made. According to N. T. Kwiatkowski the crude oil has a specific gravity of 0·918, and yields only 9 per cent. of burning oil of sp. gr. 0·829.

—B. B.

Acids of Low Percentage of Carbon occurring in Petroleum from Baku. O. Aschan. Ber. **25**, 1892, 3661—3671.

This paper is a recapitulation of the results published by the author in previous communications. (This Journal, 1890, 597; and 1891, 997.) The author mentions that, owing to a claim of priority by Markownikow, who first isolated the most readily accessible acids of the naphthene series, he has decided to discontinue his further studies on this subject for the present, although he considers his researches on the constitution of the so-called naphthenic acids anything but complete. After giving a somewhat lengthy review of his previous work, the author concludes with the statement that if the naphthenes are considered to be identical with hexamethylene and its homologues, it is safe to assume that the naphthenic acids cannot be regarded as belonging to the same group of polymethylenes as the naphthenes.

—D. B.

Simple Method of Fractional Distillation. A. Tigerstedt. Ber. **26**, 1893, 172.

See under XXIII., *page* 375.

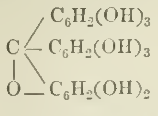
IV.—COLOURING MATTERS AND DYES.

Paraxylidine. R. Michael. Ber. **26**, 1893, 39.

The possibility of crystallising paraxylidine has not been previously known. After long-continued exposure to extreme cold the chemically pure base solidifies, forming large colourless tablets which are frequently found grown together in pairs. The crystals melt at 15·5°. The solid base boils at 213·5° (uncorr.) under a pressure of 762 mm. The acetyl compound crystallised from water, melts at 139·5°.—D. B.

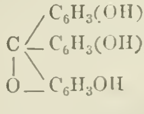
The Trihydroxyaurin from Catechol. N. Caro. Ber. **26**, 254—255.

The author has previously shown that, like aurintricarboxylic acid (Eng. Pat. 3333, 1889; this Journal, 1890, 172), the mono-, di-, and tricarboxy-derivatives of various hydroxytriphenylmethane compounds, provided they contain carboxyl and hydroxyl groups in the ortho position to each other, dye metallic oxide mordants. The property is most strongly evinced by the tricarboxy- and least by the monocarboxy-compounds, but it has been found to be independent of the presence in the aurin derivative of the carboxyl group, since the hexahydroxyaurin—



$$\begin{array}{l} C \begin{cases} C_6H_2(OH)_3 \\ C_6H_2(OH)_3 \\ C_6H_2(OH)_2 \end{cases} \\ | \\ O\text{—}C_6H_2(OH)_2 \end{array}$$

obtained from pyrogallol also possesses it. In view of this fact, tri-*o*-hydroxyaurin—



$$\begin{array}{l} C \begin{cases} C_6H_3(OH)_2 \\ C_6H_3(OH)_2 \\ C_6H_3OH \end{cases} \\ | \\ O\text{—}C_6H_3OH \end{array}$$

was also prepared, in order to discover if it exhibited the same property. The general method of formation of aurin derivatives adopted by the author in this research, namely, the simultaneous condensation and oxidation (with concentrated sulphuric acid and sodium nitrite) of phenols with methylene diphenols (produced by condensing phenols with formaldehyde) was found to be inapplicable for its satisfactory preparation, but it was readily obtained by heating catechol (5 parts) with zinc chloride (5) and formic acid (2) for 2 hours at 115°. It was isolated from the mass produced, by treating the latter with hydrochloric acid, extracting with absolute alcohol, and precipitating with ether, and was purified by redissolving in alcohol and precipitating. It crystallises in red plates; dissolves readily in alkalis and in alcohol with a rich red colour; is sparingly soluble in water and insoluble in ether. It dyes alumina and iron-oxide mordants similarly to peachwood.—E. B.

Benzene- and Toluene-azo-naphthalene. R. Nietzki and R. Zehnter. Ber. **26**, 143—145.

Benzene-α-azonaphthalene is formed from benzene azo-α-naphthylamine by eliminating the amido group by the diazo reaction. It melts at 63·5°. Alcoholic ammonium sulphide reduces it to the corresponding hydrazo compound $C_6H_5NH.NH.C_{10}H_7$, which is transformed by mineral acids into diamidophenylnaphthalene (m.p. 64°). The azo dyes, which are readily obtainable from this compound, in their affinity for cotton are intermediate between the corresponding benzidine and naphthidine compounds, possessing less affinity than the former but more than the latter, which do not dye well. In point of shade, however, they are much inferior to the benzidine and tolidine dyes.

o-Toluene-α-azonaphthalene is prepared similarly to the benzene compound, and forms plates melting at 52°. The tetrazo dyes yielded by the diamidotolylnaphthalene, which is readily prepared from it, are bluer in shade and duller than the corresponding tetrazophenylnaphthalene dyes, and of even less technical value.—E. B.

Estimation of Aniline and of Methylaniline. Zeits. Anal. Chem. 1893, **32**, 188.

See under XXIII., *page* 382.

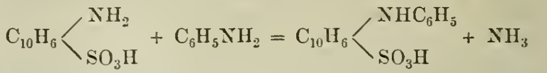
PATENTS.

Improvements in the Manufacture of Colouring Matters. C. D. Abel, London. From the "Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 6630, April 6, 1892.

This patent is an extension of Eng. Pats. 277 and 2408 of 1892 (this Journal, 1893, 36 and 142). In the foregoing patents, dyestuffs are described which have been obtained by combining the tetrazo compound of *p*-amido-benzene-azo-amido-α-naphthalene with amines and phenols, &c. It has now been discovered that it is possible to diazotise one amido group only of the above-mentioned substance and combine the diazo compound obtained with various amines and phenols. A solution of 26 kilos. of *p*-amido-benzene-azo-amido-α-naphthalene (or an equivalent quantity of one of its oxy-ethers, as described in Eng. Pat. 2408 of 1892) in dilute hydrochloric acid is diazotised by adding a solution of 7 kilos. of sodium nitrite. The solution of the diazo compound thus obtained is poured into an alkaline solution of 34·8 kilos. of the sodium salt of β-naphthol disulphonic acid R. A dark blue precipitate separates immediately, and after stirring some time the mixture is warmed and the colouring matter salted out. It dyes unmordanted cotton a greyish violet-blue from an alkaline or salt bath, and the latter bath may also be employed for dyeing wool. By substituting for the R salt other sulphonic acids of β-naphthol or the sulphonic acids of α-naphthol or of dihydroxynaphthalene, the shades range from violet-blue to greenish-blue, whilst those obtained from the naphthylamine sulphonic acids are brownish-violet and those from the amidonaphthol sulphonic acids are blue-black.—T. A. L.

Improvements in the Manufacture of Alkylated Naphthylamine Sulpho Acids. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 7337a, April 16, 1892.

By heating together 1 kilo. of (1·8) α-naphthylamine sulphonic acid, 3·5 kilos. of aniline, and 1 kilo. of aniline hydrochloride for about 10 hours to 160°—170° C. the following reaction takes place:—



$$C_{10}H_6\left\langle\begin{matrix}NH_2\\SO_3H\end{matrix}\right. + C_6H_5NH_2 = C_{10}H_6\left\langle\begin{matrix}NHC_6H_5\\SO_3H\end{matrix}\right. + NH_3$$

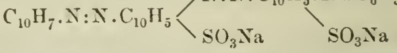
When cold, the melt is treated with dilute hydrochloric acid, and the phenyl-naphthylamine sulphonic acid which separates is filtered off, dissolved in sodium carbonate solution, boiled until all the aniline is driven off, and re-precipitated with hydrochloric acid. It can be further purified by means of the lime salt. Other phenyl and tolyl derivatives of the various naphthylamine sulphonic acids can be obtained by heating them with aniline, *o*- or *p*-toluidine, together with the corresponding hydrochlorides or sulphates of the latter, and in some cases the addition of a small quantity of benzoic acid appears to give better results. The most valuable derivatives would seem to be those of the (1·8)-α-naphthylamine sulphonic acids. By heating (2·5)-β-naphthylamine sulphonic acid or (2·8)-β-naphthylamine-α-sulphonic acid with aniline and aniline hydrochloride they are converted respectively into the phenyl-naphthylamine sulphonic acids A and B described in Eng. Pat. 10,934 of 1889 (this Journal, 1890, 853).
—T. A. L.

The Manufacture of New Colouring Matters. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 7337, April 16, 1892.

New dyestuffs for wool are obtained by combining with alkylated naphthylamine sulphonic acids the diazo derivatives of the amidoazo compounds, obtained by combining the diazo compounds of amines and their derivatives with α-naphthylamine, Clève's α-naphthylamine sulphonic acids (β and δ), α-naphthylamine *o*-sulphonic acid (Ger. Pat. 56,563), or with such amidonaphthol sulphonic acids, &c., in which the amido group in the resulting amidoazo compounds can be further diazotised. The following example is given for the production of a bluish-black dyestuff for wool. The diazo solution from 14·3 kilos. of α-naphthylamine and 7 kilos. of sodium nitrite is added to a cold solution of 24·5 kilos. of the sodium salt of Clève's α-naphthylamine sulphonic acid (β) and 48 kilos. of sodium acetate. After several days the liquid is heated for a short time to about 70° C. in order to complete the formation of the amidoazo compound, which has the formula—

$$C_{10}H_7.N:N.C_{10}H_5(NH_2)SO_3H.$$

The solution is then made alkaline, salt added, and the amidoazo compound filtered off, mixed with a solution of 7 kilos. of sodium nitrite in water and diazotised by gradually adding hydrochloric acid. When completely diazotised the mixture is added to 32·1 kilos. of phenyl-α-naphthylamine sulphonic acid (1·8) and 64 kilos. of sodium acetate dissolved in water. After some hours the temperature is raised to 70° C., and after making alkaline the dyestuff is salted out, filter-pressed, and dried. Its constitution is represented by the formula—



$$C_{10}H_7.N:N.C_{10}H_5\left\langle\begin{matrix}N:N.C_{10}H_5.NHC_6H_5\\SO_3Na\qquad\qquad SO_3Na\end{matrix}\right.$$

Other phenylnaphthylamine sulphonic acids or tolylnaphthyl amine sulphonic acids may be employed, and the α-naphthylamine and the Clève acid β may also be replaced by similar amines or their derivatives.—T. A. L.

Improvements in the Manufacture of Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 7298, April 16, 1892. (Second Edition.)

Dyestuffs of the rhodamine series were first described in Eng. Pat. 15,374 of 1887 (this Journal, 1888, 745). It was subsequently discovered (Eng, Pat. 14,723 of 1891; this

Journal, 1892, 740; see also Eng. Pat. 1231 of 1892, this Journal, 1892, 516) that the tetra-alkylated rhodamines could be partially de-alkylated, yielding colouring matters of a yellower shade, and hence the blueness of shade depends upon the number of alkyl groups present in the compound. If, therefore, the tetra-alkylated rhodamines be further alkylated, rhodamines are obtained of bluer shades than those hitherto known, and this forms the subject matter of the present patent. Two methods are given for the preparation of these so-called "ultra-alkylated" rhodamines. Either the tetra-alkylated rhodamine is heated with alcohol and a mineral acid, or the salt of a tetra-alkylated rhodamine is heated with alcohol, under pressure if necessary. About one kilo. of tetra-ethyl rhodamine of the phthalic acid series is added to 2 kilos. of ethyl alcohol, and the whole stirred into 1·5 kilos. of concentrated sulphuric acid and heated on the water-bath for about eight hours. The melt is then poured into about 20 litres of water neutralised with soda, and the dyestuff salted out as a pitch. It is purified by redissolving, precipitating with salt, and drying at 50° C., when it forms a hard mass. As it always contains more or less of the original tetra-ethyl rhodamine it may be further purified by dissolving in water, and after making the solution alkaline with soda, extracting the unaltered rhodamine with benzene or other suitable solvent. The ultra-alkylated product on account of its greater basicity remains in solution and is precipitated with salt in the usual way. The colouring matter thus obtained forms a bronzy powder, dyes bluer shades of red, and has a greater affinity for animal and vegetable fibres, and is also more basic than the original rhodamine. Dry hydrochloric acid may be substituted for the sulphuric acid as a condensing agent, and in place of ethyl alcohol other alcohols such as methyl, iso-amyl, or benzyl alcohol, or glycerol may be employed. By using a pressure vessel the operation is modified as follows:—About 1 kilo. of the hydrochloride of tetra-methyl rhodamine of the succinic acid series is heated with 3 kilos. of methyl alcohol in an autoclave for eight hours to about 160° C. The excess of methyl alcohol is then distilled off with steam, the hot aqueous solution of the colouring matter filtered and precipitated with salt. It may be used directly or purified by fractional precipitation with hydrochloric acid. These colouring matters have already been described under the name of "Anisolines" (see this Journal, 1892, 677 and 516).—T. A. L.

Improvements in the Manufacture of Triphenylmethane Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 8634, May 6, 1892. (Second Edition.)

By the action of carbon tetrachloride on certain secondary and tertiary aromatic amines in presence of aluminium chloride, dyestuffs of the triphenyl-methane series can be obtained. The reaction takes place at about 100° C. in a few hours, but a higher temperature must be employed if other condensing agents such as zinc or ferric chloride be used. Those bases which have given the best results are methyl-diphenyl-amine, diethyl-aniline and dimethyl-aniline. The two latter yield the dyes known as "Ethyl violet" and "Crystal violet," whilst the colouring matter obtained from methyl-diphenylamine is identical with that prepared from it by means of oxalic acid. It dissolves in alcohol to a blue solution, and on sulphonation yields a valuable acid dyestuff for wool. The following description is given for the preparation of ethyl violet:—About 180 kilos. of diethyl-aniline, 25 kilos. of aluminium chloride, and 32 kilos. of carbon tetrachloride are heated in a vessel provided with an agitator under an inverted condenser for four hours to 70°—80° C., and then for a further six hours to 100°—110°. After adding an excess of caustic soda solution the unaltered diethylaniline is distilled off with steam. The residue is dissolved in hot water and sufficient hydrochloric acid to neutralise the base, and after filtering is precipitated with salt, filtered off and dried.—T. A. L.

Production of New Colouring Matters Dyeing Cotton without Mordant. J. Rohner, Bâle, Switzerland. Eng. Pat. 24,081, December 30, 1892. (Under International Convention.)

These colouring matters, which are of the Congo type, are obtained by combining one molecular proportion of tetrazodiphenyl or ditolyl with one molecular proportion of the sodium salt of dimethyl-aniline *m*-sulphonic acid, and combining the intermediate compound so obtained with sodium naphthionate. The colouring matter dyes unmordanted cotton from a neutral or slightly alkaline bath a poppy-red which is very sensitive to acids, even acetic acid turning it deep blue.—T. A. L.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

The Theory of Dyeing. L. Vignon. Bull. Soc. Ind. Mulhouse, 1892, 563—580.

The author has obtained the following results from an investigation into the phenomena of dyeing:—1. Animal fibres, which readily absorb dyestuffs, possess acid or basic characters, whilst vegetable fibres, having but little attraction for ordinary colouring matters, are almost neutral and never possess basic properties. 2. Cotton takes up nitrogen when treated with ammonia, thereby acquiring a basic reaction and the power of absorbing acid colouring matters from acid baths. 3. According to the observations of Witz and Osmond, cotton behaves as a true acid when converted into oxycellulose; it then becomes capable of combining with bases and basic colouring matters. 4. Stannic acid absorbs basic colouring matters such as safranine, whilst metastannic acid, a polymeride of stannic acid having far less pronounced acid properties than the latter, has no power of taking up safranine. 5. All dyestuffs, without exception, are either acid or basic in character, or possess both acid and basic properties.

All the phenomena of dyeing exhibited either with textiles or with metallic oxides, require the fulfilment of two essential conditions—(1.) The possession of acid or basic characters by the absorbing agent, and (2) the possession of the same properties by the colouring matter absorbed. The only violation of these two conditions is found in the fact that the tetrazo-colours, which are both acid and basic in character, are absorbed by unmordanted cotton in an alkaline bath. With this exception the statement that all the phenomena of dyeing with soluble colouring matters are of a purely chemical nature, is a justifiable one. The combination of dyestuffs with textiles or metallic oxides is attended by changes of the same nature as those which accompany the formation of salts by the interaction of acids and bases.

The author has made calorimetric measurements of the changes occurring when different fibres, such as silk, wool, and cotton, are immersed in acid, alkaline, or neutral baths of known composition. The three fibres absorb neutral salts just as a liquid dissolves a soluble substance; the heat measurements made on silk and wool show that these fibres possess well-defined basic and acid properties comparable with those of amido-acids such as glycocoll. Cotton is chemically very inactive compared with animal fibres; its reaction is always acid, never basic. The great absorbent power of silk and wool, and the small affinity for colouring matters possessed by vegetable fibres, is thus satisfactorily explained. By treatment with ammonia under various conditions, cotton may be caused to take up as much as 2·86 per cent. of nitrogen, which is not extracted by dilute hydrochloric acid; the change is comparable with the formation of β-naphthylamine from ammonia and β-naphthol. Parallel experiments on the action of acid dyestuffs such as metanil-yellow, rosaniline-blue, roccelline, and acid-violet on cotton before and after treatment with ammonia, show that the amido-cotton takes up considerable quantities of the dyestuff, whilst under similar conditions pure cotton becomes but slightly tinted. Cotton therefore when acted upon by ammonia becomes comparable with animal fibres in its behaviour towards dyestuffs. Very similar considerations hold also for colouring matters. Azobenzene, although brilliantly coloured, is not a dyestuff; its amido-derivative (amidoazobenzene, acid-yellow) is absorbed by animal fibres, but does not give a fast colour; the disulphonic derivative of aniline-yellow (acid-yellow) is, however, a dyestuff of considerable value. Thus by the successive introduction of basic or acid radicles into azobenzene, the tinctorial properties of the substance become more and more accentuated. The experiments of Knecht and others on the absorption of dilute acids and alkalis by various fibres, and the work of Witz and Osmond (Bull. Soc. Chim. 1886, 309) on the acid properties of oxycellulose are quoted in support of the author's conclusions. The behaviour of safranine towards stannic and metastannic acids was also studied, with the result stated above.—W. J. P.

PATENTS.

Improvements in Aluminium, Iron, and Chromium Mordants. R. H. Pickles, Marple, Cheshire. Eng. Pat. 5197, March 16, 1892.

The new mordants are the sucrates and saccharates of the above metals. Calcium sucrate is first prepared by mixing together sugar, treacle, or glucose and milk of lime. From the solution of calcium sucrate the mordants are easily obtained by adding the sulphates of the metals. By using basic sulphates, basic sucrates are formed. For the new mordants it is claimed that—(1) a saving of dyestuff is effected by their use, a mixture of aluminium sucrate and acetate giving with alizarin a shade equal in depth to that produced with the acetate alone, with 25—33 per cent. less dye; (2) the mordants are free from tarry and empyreumatic substances; (3) they are obtained at less cost than the acetates, sulpho-acetates, &c.—R. B. B.

Improvements in the Production of Fast Colours on the Fibre for Printing and Dyeing Purposes. B. Willcox, London. From Farbenfabriken, vormals F. Bayer & Co. Elberfeld, Germany. Eng. Pat. 5815, March 24, 1892.

Certain azo dyestuffs containing a free amido group are capable of being fixed on the fibre by the aid of mordants. The colour-lakes so produced are then diazotised with a dilute acidulated solution of sodium nitrite and the product coupled with a phenol or amine, &c. Examples are given of the production of a claret-red from para-amido-benzene-azo-salicylic acid and beta-naphthol; a bluish-black from amido-naphthalene-azo-meta-benzoic acid and ethyl-beta-naphthylamine; and a bluish-green from the colouring matter got by combining diazotised amido-salicylic acid with alpha-amido-beta-napthol-ether, the product after printing and diazotisation on the fibre being coupled with beta-naphthol. In each case the original colour is first fixed as a chrome-lake. Similarly the colouring matter may be dyed up on to chrome-mordanted cloth, instead of being printed direct, and if desirable a pattern may be discharged on the chrome mordant in the usual way before the dyeing operation is carried out. It is claimed that a great variety of shades of great fastness to washing and soaping can thus be obtained.—W. E. K.

Improvements in Machinery or Apparatus for Coating with Gum, Size, Paste, Varnish, or the like, or Printing upon Paper or other Flexible Material in Continuous Lengths. W. B. Silverlock, London. Eng. Pat. 6090. March 29, 1892.

The paper is gummed whilst in the state of roll, by means of a roller which is kept constantly pressed against it by the action of a weighted lever. The paste is supplied by a second roller which revolves in a box containing the gum solution. After receiving the coating of gum the paper passes a weighted cleaning roller, and then, separating from the roll, is dried by passing through a hot-air chamber.
—W. E. K.

An Improvement in the Bleaching of Textile and Pulping Materials in Vacuo. E. Hermite, E. J. Paterson, and C. F. Cooper, Dalston. Eng. Pat. 6162, March 30, 1892.

The vacuum vessels are supplied with an electrolysed solution of a chloride, *e.g.*, magnesium chloride, or with a mixture of magnesium and sodium chlorides. It is claimed that the bleached materials are left in a much stronger and more supple condition than when calcium hypochlorite is the bleaching agent employed.—R. B. B.

Improvements in Treating Nitroso Compounds for use in Dyeing Animal Fibres. Read, Holliday and Sons, and L. G. Paul, Huddersfield. Eng. Pat. 6252, March 31, 1892.

It has been known for some time that certain nitroso compounds form insoluble lakes with ferrous salts, and this reaction has been used in dyeing, by mordanting with a ferrous salt and then applying the nitroso body. The improvement in this patent consists in applying the mordant and dyestuff in a single bath with the addition of oxalic acid. For example:—50 parts of dinitrosodioxynaphthalene (30 per cent. paste) are mixed with 23 parts of finely-ground ferrous sulphate and a little water. The paste thus formed is added to the dye-bath along with about $\frac{1}{12}$th of its weight of oxalic acid. Logwood, fustic, &c., can be added to the bath to modify the shade.—R. B. B.

A Combined Dyeing and Sizing Machine for Textile Yarns. R. J. Gillibrand, Darwen. Eng. Pat. 6325, April 1, 1892.

The improvement consists in placing the dyeing apparatus between the yarn beams and the size box of a sizing machine. The vessel thus placed is in three compartments; the first contains water for steeping the yarn, the second is the dye-bath, and the third is for washing or for applying a mordant after dyeing.—R. B. B.

Improvements in the Production of Fast Colours on Fibres. B. Willcox, London. From the Farbenfabriken vormals F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 7339, April 16, 1892.

Although many colours have been obtained on the fibre by diazotising primuline, polychromine, &c., and combining the diazo compound with various phenols and amines, only one of the colours so produced, viz., that formed with β-naphthol, is really fast to washing and fulling. The patentees declare that beautiful claret-red shades, perfectly fast to washing and soaping, may be obtained by combining the diazotised primuline with mono-alkylated-β-naphthylamines containing the alkyl group in the amido group. For example, after dyeing with 5 per cent. primuline and diazotising in the usual way the material is transferred into a slightly acidified solution of ethyl-β-naphthylamine hydrochloride. The claret-red colour is thus developed. Similar naphthylamines may be employed for the production of various greenish and bluish-blacks on the fibre by combining them with the diazo-derivatives of amido-naphthol-monosulphonic acid, &c., described in previous patents (Eng. Pat. 8530, 1890, and Eng. Pat. 9636, 1891).
—R. B. B.

An Improved Chemical Preparation to be used for Washing, Scouring, Fulling, Bleaching, Boiling, and other Purposes. H. H. Lake, London. From C. Castellani, Milan, Italy. Eng. Pat. 10,381, May 31, 1892.

This patent is for the "chemical preparation" obtained in a "liquid or pasty form," by slaking lime in a soda solution and mixing 100 parts of the slaked lime with 100 parts of sodium carbonate and water.—J. L.

Improvements in Printing Designs or Patterns in Two or More Colours upon Textile Fabrics. C. I. Edmondson, Stockport. Eng. Pat. 15,933, September 6, 1892.

A KEY or master-roller is engraved with the complete pattern and one or more additional rollers are engraved with portions only of the pattern in exact repetition, so that, on printing, layers of two or more colours are produced on those parts which are printed with the additional rollers. It is claimed that special effects and colour combinations can thus be obtained.—W. E. K.

VII.—ACIDS, ALKALIS, AND SALTS.

The Manufacture of Alumina. Industries, **14**, 1893, 326—327.

OF late years a demand has arisen for a true ore of aluminium from which to reduce the metal itself, and the most typical of ores—the oxide—was naturally that which was prepared in order to supplement a natural deficiency.

Bauxite, a hydrated oxide of aluminium, is always accompanied by an amount of silica never negligibly small and often very large, so that the poor kinds are not much better than many aluminous clays. To purify bauxite, advantage has been taken of the double character of alumina, which acts as a base or as an acid according to its environment. On fusing bauxite with sodium carbonate, both the alumina and silica act as acid oxides and form sodium aluminate and sodium silicate, the ferric oxide that is a constant impurity, being unattacked.

Silicate of soda, unless containing a considerable excess of base, is but little affected by water, and from the mass aluminate of soda can therefore be extracted.

With a greater demand for aluminate of soda and for pure alumina prepared from it, improved methods had to be discovered. When pure alumina was required, the aluminate was decomposed by treatment of its solution with carbonic acid, which precipitated the alumina and regenerated the carbonate of soda.

A further improvement has lately been made and is being largely introduced in the manufacture of alumina. A small quantity of crystallised alumina hydrate of the same composition as the mineral "Gibbsite" $Al_2O_3.3H_2O$ is prepared by precipitating a portion of the solution of aluminate by the action of carbonic acid in the cold, and is then added to the main bulk of the solution. This determines the precipitation of the remainder of the alumina without the use of any other precipitant, and thus much simplifies the process. The soda is also recovered in the caustic state, in which form it is now used in the place of the carbonate previously employed. The necessity for re-causticising is thus done away with.

The reaction of alumina already precipitated on a solution of aluminate of soda has been investigated by M. A. Ditte. Alumina forms several compounds with water, and the hydrates thus formed differ markedly in their physical and chemical properties. A solution of sodium aluminate may be regarded as containing amorphous hydrated alumina dissolved in caustic soda as described above. It is well known that the crystalline form in which a body crystallises from a solution is largely conditioned by the character of the crystal introduced to start crystallisation. When therefore the crystalline alumina prepared by treatment of a small portion of the solution of aluminate with carbonic acid is added to the main solution containing aluminate of soda alumina and caustic soda, the tendency of the alumina is to crystallise in the form of the already crystalline alumina that has been added. Seeing that amorphous alumina is more soluble than crystalline alumina in alkaline solutions, the quantity of alumina that was previously easily held up becomes, immediately its conversion to the crystalline form begins, greater than that which the caustic alkali can retain dissolved, that is, a supersaturated solution of crystalline alumina is produced, and immediately crystallises out in the manner proper to supersaturated solutions. Stirring naturally facilitates the separation by bringing the crystals already formed into contact with fresh portions of the liquid still containing alumina in solution. The reaction does not stop here. A portion of the aluminate of soda remains undecomposed by solution in water, and retains its condition, because it is surrounded by the products of its own reaction with water, viz., alumina and sodium hydrate; but once the alumina is removed no restraining influence remains, and a fresh portion undergoes decomposition with the production of dissolved amorphous alumina, in its turn converted into the crystalline variety, and then precipitated. The reaction thus proceeds till the whole of the aluminate of soda has been decomposed and all the alumina precipitated except that corresponding to the solubility of *Gibbsite* in caustic soda of the particular strength and at the particular temperature that prevail under the conditions of manufacture (this Journal, 1893, 263, and 1888, 625).—W. S.

The Conditions of the Formation and Decomposition of Nitrous Acid. V. H. Veley. Proc. Roy. Soc. **315**, 27—55.

THE general conclusions are summarised by the author as follows:—

(i.) The formation of the impurity of nitrogen peroxide in nitric acid, imparting to it the well-known yellow tint, takes place in the case of the more concentrated acid, even at a temperature of 30°, and of the less concentrated acids at from 100°—150°, even when the acid is not unduly exposed to sunlight.

(ii.) The reaction between nitric oxide and nitric acid may be regarded as reversible, thus:—

$$2NO + HNO_3 + H_2O \rightleftarrows 3HNO_2$$

provided that the acid be sufficiently dilute, and the temperature sufficiently low. Under these conditions equilibrium is established between the masses of nitric acids when the ratio of the former to the latter is about 9:1. The actual ratio varies slightly on the one side or the other, according to the conditions of the experiments. With more concentrated acids and at higher temperatures, the chemical changes taking place are more complicated, and the decomposition of the acid more profound.

(iii.) The decompositions of solutions containing both nitric and nitrous acids is also investigated; the rate of the change is shown to be proportional to the mass of the nitrous acid undergoing change. The curve representing the amount of chemical decomposition in terms of the mass present is shown to be hyperbolic, and illustrative of the law—

$$\text{(I.)} \quad \frac{dC}{dT} = -\frac{C^2}{M}$$

This holds good whatever be the method employed for the production of the nitrous-nitric acid solution. The observed values for C or the concentration of the nitrous acid are concordant with those calculated according to the above differential equation within the limits of experimental error.

The rate is dependent on the ratio of the masses of the nitrous and nitric acid, being the more rapid, the greater the proportion of the former to the latter.

In the particular case of the liquid prepared from nitric oxide and nitric acid, wherein the reproduction of solutions of similar concentration presents less difficulty, it is shown that as the temperature increases in arithmetical, the rate of change increases in geometrical proportion, in accordance with the equation—

$$\text{(II.)} \quad v_t = v, k^{(t - t_1)}$$

the value for k being 0·0158.

Finally, though the nitrous-nitric acid solutions behave in a similar manner as regards the diminution of the mass of nitrous acid, yet, in other respects, such as the evolution of gases and the action upon metals, they are dissimilar.

—J. C. C.

PATENTS.

Improvements in or relating to the Calcination of Limestone, Ironstone, or the like Substances. C. R. Cowens, Trimdon Grange, Durham. Eng. Pat. 3079, February 17, 1892.

The patent relates to the burning of limestone and the like by means of producer gas. The plant for this purpose consists of a producer using cheap fuel, such as inferior coal, bituminous shale, and similar carbonaceous waste matter, and connected with a conical kiln having the apex of the cone downwards and communicating with a second chamber into which the lime drops, and through which the air to burn the producer gases passes, so that it is thereby warmed, as well as by the usual method of regeneration. The advantage claimed is in the use of cheap fuel and the absence of any contamination of the lime or other product with ash, as would happen if an ordinary kiln, in which the fuel comes comes in direct contact with the material to be burnt, were used.—B. B.

Improvements relating to the Production of Pure Carbonic Acid from the Products of Combustion of Furnaces, Kilns, and the like, and to Apparatus therefor. H. H. Lake, London. From J. H. C. Behnke and the Chemische Fabrik, Billwärder, Germany. Eng. Pat. 6931, April 11, 1892.

The gases previously freed from sulphurous acid by passing through a furnace filled with limestone, and sufficiently scrubbed to reduce their temperature to about 60° C., are subjected to a pressure of 15—180 lb. per sq. in. and treated with water, in an absorber similar in construction to an ammonia still. The carbonic acid is absorbed, whilst the other gases collect on the top of the apparatus and are eliminated. The aqueous solution of carbonic acid is passed into a closed boiler, where, under greatly reduced pressure assisted by agitation, pure carbonic acid is given off. The water may be cooled and pumped back on the absorbing tower, whilst the energy contained in the inert gases from this tower may be utilised for driving the agitator and other machinery.—H. A.

Improvements in the Manufacture of Bleaching Powder and in Apparatus to be employed therein. F. Hurter, Liverpool. Eng. Pat. 7393, April 19, 1892.

In the manufacture of bleaching powder by the Deacon process or by other similar processes, difficulties are encountered owing to the temperature of the apparatus being too high in warm weather and too low in cold weather. The improvement consists in artificially lowering or raising the temperature of the chlorine gas before its introduction into the chambers, to suit the desired purpose. This end may be effected by cooling to a certain extent the vitriol employed for drying the gas, and further, if necessary, by passing the chlorine through pipes surrounded with brine. In like manner the temperature of the gas may be raised by employing tepid sulphuric acid and warm water instead of cold sulphuric acid and refrigerated brine.—H. A.

An Invention for the Application of a Bye-Product of the Manufacture of Acetates for Warming and Heating Purposes. G. Heslop, Sunderland. Eng. Pat. 7614, April 22, 1892.

It is proposed to heat up the mother-liquors from the manufacture of alkaline acetates, for use in footwarmers, footstools, &c., the said liquors possessing the property of retaining the heat for a considerable length of time.—H. A.

A Process for the Production of Phosphates of Potassium or Aluminium Soluble in Water. H. Precht, New Stassfurt, Germany. Eng. Pat. 7958, April 27, 1892.

Ordinary potassium metaphosphate is nearly insoluble in water and may be converted into a soluble compound by simple fusion in a reverberatory furnace and subsequent rapid cooling down. The best results are obtained by adding sufficient potash during fusion to produce a mixture of one part of potassium pyrophosphate to four parts of metaphosphate. An alternate method consists in fusing 1 mol. of metaphosphate with 2 mols. of potassium chloride in presence of aqueous vapour, but the product so obtained is chiefly pyrophosphate.

Any of these soluble compounds when fused with, at most, 65 per cent. of aluminium phosphate, yield a soluble aluminium phosphate.

For the preparation of potassium orthophosphate, two ways are given: (1.) The soluble metaphosphate is made up to a solution of about 50° Tw. and heated by means of high-pressure steam to about 120° C. (2.) The soluble pyrophosphate or its mixture with the meta-salt may be boiled with phosphoric acid in such proportion that 1 mol. of phosphoric acid be present to each mol. of potash.

—H. A.

Improvements in the Manufacture of Chlorine. H. W. Wallis, London. Eng. Pat. 13,822, July 29, 1892.

This process deals with the production of chlorine from aqueous solutions of hydrochloric, nitric, and sulphuric acids (see Donald, this Journal, 1887, 823, and 1890, 1130; also Davis, 1891, 463). The acids are brought in contact with one another in any desired order, preferably by passing solutions of hydrochloric and nitric acids or aqua regia into a "decomposer" charged with sulphuric acid. The reaction may be promoted by agitation, or by bubbling air through the liquid, or by addition of a further quantity of hot sulphuric acid. The products of decomposition consist of chlorine and nitrosylchloride which are passed into "absorbers" charged with sulphuric acid, the nitrosylchloride being thus decomposed into hydrochloric acid with formation of nitrous vitriol. The process is so conducted that this hydrochloric acid, as soon as formed, meets with a quantity of nitric acid sufficient to decompose it, and for this purpose the nitric acid is previously introduced in the absorber or enters the same along with the gases.

The chlorine is finally washed with hydrochloric acid and water, and if required may be passed through a solid metallic chloride such as common salt to free it from the last traces of nitrous compounds.—H. A.

A Process for Manufacture of Acetic Acid. E. Rotondi, Turin, and M. Michela, Florence, Italy. Eng. Pat. 22,817, December 12, 1892.

The object of this invention is the production of acetic acid by distilling a mixture of one equivalent of pyrolignites or acetates with two equivalents of sodium bisulphate, preferably after addition of water. The distillation may be carried on under reduced pressure, the receivers being inserted between distiller and vacuum pump; the acetic acid is collected in the first receiver, whilst the second contains a suitable base for absorbing the last traces of the acid. The decomposition may be accelerated by repeated addition of water or acetic acid, and agitation with steam. The residue in the still can be utilised for the manufacture of sodium sulphate.—H. A.

Improvements in the Manufacture of Ferric Chloride. P. Buisine, Lille Nord, France. Eng. Pat. 1298, January 20, 1893.

The object of this invention is the utilisation of "burnt ore" (from iron pyrites) for the production of ferric chloride, by passing hydrochloric acid gas from the saltcake furnaces or any waste hydrochloric acid vapours, through scrubbers charged with moistened layers of burnt ore and flint. If the material be washed with water, the ferric chloride is obtained as a solution.—H. A.

Improvements in the Manufacture of Potash Alum and Alumina. J. Heibling, Paris, France. Eng. Pat. 2148, January 31, 1893.

Potash alum may be manufactured from clay by adding to each mol. of alumina contained therein three mols. of ammonium sulphate and one mol. of potassium sulphate. The well-mixed ingredients are formed into hollow bricks and exposed to a temperature of 275°—300° C., when ammonia is given off and a double sulphate of alumina and potassium formed. The operation is finished when the evolution of ammonia ceases. The mass is then extracted with water, the iron contained in the solution precipitated with potassium ferrocyanide as Prussian blue, and the alumina precipitated from the clear solution by the addition of the whole of the ammonia condensed in the furnacing operation. The supernatant liquor is boiled down and may be used for treating a fresh quantity of clay.

In an alternate, but less advantageous method the mixture of the two sulphates is replaced with acid potassium sulphate.—H. A.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Determination of Calcium Carbonate in Slurry. C. Mann. Thonind. Zeit. 1892, **16**, 1055, and Chem. Zeit. Rep. 1892, **33**, 382.

The presence of caustic lime in the raw materials for the manufacture of cement may lead to errors in the estimation of the total amount of basic oxides by the usual methods. When therefore the presence of lime not as carbonate is suspected, the precaution should be taken to convert it into calcium carbonate by treatment with ammonium carbonate, after which its estimation can be effected in the ordinary manner.—B. B.

Strength of Composite Drain Pipes of Cement and Iron. Bauschinger. Thonind. Zeit. 1892, **16**, 1132, and Chem. Zeit. Rep. 1892, **33**, 382.

The cement pipes with an iron skeleton were made by the Zissler process, and withstood nearly six times the strain carried by good glazed stoneware pipes. A cement pipe, 0·5 m. wide, 1 m. long, and 25 mm. in the walls, bore an evenly distributed load of 11,130 kilos. A similar pipe, but of elliptical section, the axes being 20 cm. and 30 cm., bore a load of 15,340 kilos. A good stoneware pipe, with a flange, 103 cm. long, 180 mm. in diameter, and 33 mm. in the walls, showed no appreciable alteration with a load of 1,530 kilos., but snapped with one of 2,930 kilos.—B. B.

PATENTS.

Improvements in or relating to the Calcination of Limestone, Ironstone, or the like Substances. C. R. Cowens, Trimdon Grange, Durham. Eng. Pat. 3079. February 17, 1892.

See under VII., *page* 354.

A Process for the Treatment of Raw Materials to be used in the Production of Portland Cement. J. T. Knowles, London. From Die Actiengesellschaft "Cimbria," Copenhagen, Denmark. Eng. Pat. 4131, March 2, 1892.

The raw materials, such as chalk and clay, in their natural moist state, are passed through smooth rollers moving at different speeds, whereby they are broken up. The space between the rollers is about ½ mm., and the difference in speed of the rollers about 10 or 20 revolutions per minute. The mixing is completed in pug mills, and the material is then ready for drying and burning in the ordinary way.
—B. B.

A Fireproof Composition or Cement for Boilers, Flues, Furnaces. J. C. Taylor, Helsby. Eng. Pat. 11,226, June 15, 1892.

The invention refers to a composition or mixture of three parts by volume of clean sharp sand with two parts of asbestos fibre and two parts of silicate of soda, containing about 10 per cent. of the syrupy silicate of soda of commerce. This mixture when heated hardens and can be used as a fireproof, non-conducting coating, or as a heat-resisting cement.—C. O. W.

Improved Process and Apparatus for Vulcanising Wood. S. E. Haskin, Avoca, U.S.A. Eng. Pat. 23,866. December 27, 1892.

The specification relates to improvements in connection with Eng. Pat. 3875, 1889 (this Journal, 1889, 463). The process of vulcanising wood as understood by the patentee consists in exposing it to heat and pressure while preventing the escape of its volatile constituents. The apparatus patented consists of a chamber into which the timber to be treated is run on rails and in which are pipes with numerous perforations for the admission and withdrawal of air. The air is supplied from a compressor and is heated by passage through a chamber heated by a coil conveying superheated steam. Storage reservoirs are provided to regulate the flow of air to the vulcanising chamber, and the whole system is worked by a circulating pump. The object of these arrangements is to allow of the gradual action of the hot air on the timber and its even distribution in the vulcanising chamber, as well as the gradual cooling of the chamber by the regulated admission of cold air into one or other of the storage reservoirs and the subsequent circulation of the cold air thus introduced throughout the system in company with the remaining hot air. Repetition of this admission of cold air, combined with the escape of a corresponding quantity of the heated air, allows of a gradual reduction of the temperature of the vulcanising chamber.
—B. B.

X.—METALLURGY.

Experiments with the Cyanide Process. G. E. Kedzie. Eng. and Mining J. 1892, 606.

The following series of experiments were made with the view of determining whether the gold-bearing pyritic ores in the immediate vicinity of Ouray, Colo., could be successfully treated by the cyanide process, also to learn the conditions under which the most complete extraction could be obtained, together with the amount of cyanide consumed. The results are given herewith, in the hope that they will be of benefit to others pursuing similar investigations.

Description of Ores Treated.—A, raw ore, iron pyrites with some copper pyrites and magnetite; B, tailings from lot A after laboratory amalgamation; C, raw ore iron pyrite with quartz gangue; D, concentrates, iron pyrites with magnetite; E, raw ore, iron pyrites, with a limestone and actinolite gangue; F, tailings from lot E after laboratory amalgamation; G, raw ore, iron pyrites and copper pyrites with a quartz gangue; H, tailings from lot G after laboratory amalgamation; I, raw ore, iron pyrites, partially oxidised with a clay gangue; J, concentrates, iron pyrites with a limestone gangue; K, concentrates of tailings after battery amalgamation, iron pyrites with magnetite; L, concentrates of tailings after battery amalgamation, iron pyrites with magnetite.

Manner of Conducting the Experiments.—The ores were weighed into beakers of from 150 to 300 cc. capacity, the measured quantity of the potassium cyanide solution added, and the beakers covered with convex glasses. Once in 12 hours the contents of each beaker were thoroughly agitated with a stirring rod. The temperature of the solution during the tests varied between 22° and 27° C. After treatment, the cyanide solution was poured upon a filter, the tailings twice washed in the beaker with warm water, then transferred to the filter and again washed.

The gold and silver values in the high grade ores and tailings were determined by three scorification assays. With the low grade ores and tailings the gold and silver contents were determined by two crucible assays of one-half assay ton. The percentage of potassium cyanide in the

Lot.	No.	Assay Value per Ton of Ores treated.		Grms. of Ore treated.	Cyanide Solution added.		Hours of Treatment.	Extract per Cent.		KCN added per Ton.	KCN consumed per Ton.	Total Value extracted for each Lb. of Cyanide consumed.
		Gold.	Silver.		Cc.	KCN.		Gold.	Silver.			
		Oz.	Oz.			Per Cent.				Lb.	Lb.	Dols.
A	1	1·75	1·65	25	25	0·9	12	25·71	21·21	18	9·6	0·58
	2			25	50	0·9	12	54·28	33·33	36	11·4	0·72
	3			25	25	0·9	48	37·14	21·21	18	15·8	0·85
	4			25	25	1·5	48	40·00	27·27	30	27·4	0·53
	5			20	20	0·5	48	52·14	15·15	10	7·4	2·55
	6			20	10	1·0	48	45·73	33·34	10	8·4	2·00
B	1	0·93	1·37	25	25	0·9	12	46·24	2·98	18	..	..
	2			25	25	0·9	48	84·62	29·10	18	14·6	1·10
C	1	145·90	458·00	25	25	0·9	12	9·49	2·06	18	13·2	21·70
	2			25	50	0·9	12	12·13	3·24	36	14·0	26·48
	3			25	25	0·9	48	10·58	1·50	18	12·8	24·67
	4			25	25	1·5	48	12·16	3·78	30	14·8	25·16
	5			25	50	1·5	60	25·09	8·27	60	37·4	20·61
	6			25	20	0·5	48	7·16	1·28	10	4·0	53·72
D	1	46·10	69·20	25	25	0·9	12	6·32	0·00	18	6·6	9·40
	2			25	50	0·9	12	15·73	2·24	36	12·6	11·71
	3			25	25	0·9	48	18·20	2·74	18	15·8	10·62
E	1	0·47	1·35	25	25	0·9	48	78·72	88·88	18	8·6	1·00
	2			25	25	1·5	48	83·00	59·30	30	24·0	0·36
F	1	0·30	1·30	25	25	0·9	48	83·33	69·23	18	14·0	0·42
	2			20	20	0·5	48	50·00	42·31	10	7·8	0·45
	3			20	10	1·0	48	2·31	3·40	10	7·4	0·47
G	1	4·84	32·10	25	25	0·9	48	9·50	0·81	18	16·0	0·63
	2			25	25	1·5	48	15·29	3·12	30	27·6	0·57
	3			25	50	1·5	48	18·39	5·45	60	50·8	0·39
	4			20	20	0·5	48	16·32	2·95	10	8·0	2·19
	5			20	10	1·0	48	18·18	1·09	10	6·2	1·95
H	1	3·10	31·18	25	25	0·9	48	19·35	0·26	18	15·8	0·77
	2			20	20	0·5	48	11·29	1·06	10	7·6	1·23
	3			20	10	1·0	48	11·23	2·98	10	8·8	0·90
I	1	3·18	1·10	20	20	0·5	48	41·82	18·18	10	6·8	3·04
	2			20	20	1·5	48	73·27	45·45	30	20·0	2·35
	3			40	20	1·0	48	22·95	22·72	10	8·4	1·77
J	1	5·40	73·50	20	20	1·5	48	4·63	3·61	30	27·6	0·28
	2			40	20	1·0	48	2·77	0·48	10	8·6	0·39
K	1	0·27	0·65	50	25	1·0	48	70·37	18·46	10	7·0	0·56
	2			50	25	1·0	48	74·07	13·84	10	8·1	0·51
	3			50	25	0·5	48	40·74	7·70	5	3·7	0·61
	4			50	25	0·5	48	48·15	7·70	5	4·2	0·63
L	1	0·38	0·98	50	25	1·0	48	23·68	28·57	10	7·4	0·28
	2			50	25	1·0	48	36·84	22·44	10	7·8	0·30
	3			50	25	0·5	48	15·80	14·28	5	3·2	0·42
	4			50	25	0·5	48	23·68	18·36	5	3·3	0·60

lixiviating solution and that remaining uncombined in the filtrates were determined volumetrically by a neutral decinormal solution of silver nitrate.

When potassium cyanide is mentioned, reference is made to the chemically pure reagent.

The tabulated experiments given, show that the following deductions may safely be made with reference to the ores treated. 1. The gold is more readily extracted than the silver. 2. Under the same conditions the percentage of extraction is increased (*a*) by the fineness of the pulp, (*b*) by the duration of treatment, (*c*) by the strength of the cyanide solution. 3. The greater the amount of cyanide added to the ore the higher will be the percentage of extraction, but in this case the total values extracted for each pound of the cyanide consumed are less than when a smaller amount of the cyanide is added. 4. When the same amount of cyanide is used for each ton of ore treated, the percentage of extraction is greater when the weight of the solution is equal to that of the ore taken.

Conclusions.—It will readily be observed that there are no flattering indications of this process being a metallurgical success with the pyritic ores under consideration.

With the high grade ores, which are under no circumstances adapted to this process, the percentage of extraction under the most favourable circumstances is low; lower even than the results obtained by amalgamation. However, the total values extracted for each pound of cyanide consumed are relatively high.

With the low grade ores, even where the low value of the tailings will admit of their being thrown away, the total values extracted in a majority of instances are less than the cost of the cyanide consumed, to say nothing about other milling expenses.

To those interested in a further investigation of this process as regards its adaptability to ores of a different character, the author would make the following suggestions: the strongest solution used should not contain more than one-half of 1 per cent. of potassium cyanide, and good results are anticipated with a much weaker solution. Arrangements should be made for the slow percolation of the cyanide solution so that at all times the ore will be in contact with a solution of nearly normal strength. Finally the period of lixiviation should be extended to 96 hours if necessary in order to secure a more complete extraction.

Hunicke's Process for Smelting Silver Lead Ores containing Zinc. Eng. and Mining J. 1892, 607.

The problem of finding an economical process for smelting zinc-bearing silver lead ores in which the galena and zinc blende are intimately mixed is attracting a good deal of attention among metallurgists at the present time. The process recently devised by Mr. H. A. Hunicke will therefore be of considerable interest.

The process consists in heating up separately the roasted ore and the coke to about the temperature at which zinc oxide is reduced to metallic zinc by carbonic oxide, and then charging thin layers of each alternately into a cupola furnace. The lead is reduced to the metallic state and runs, together with the silver, to the bottom of the furnace. The zinc is reduced to the metallic state and volatilised, and after escaping from the heated mass, is rapidly oxidised again by the gases. The vapour thus formed is led to a condensing chamber, where it is deposited as zinc oxide powder. The reduction of the lead and zinc is effected almost immediately after the introduction of the ore into the cupola furnace, owing to the smallness of each charge, and also to the fact that the ores have been previously heated to the temperature at which the zinc ore is reduced by carbonic oxide. Thus the zinc vapours have no opportunity to clog up the coke and prevent further combustion.

This process differs from the usual one in the previous heating of the ore and fuel, and in the smallness of each charge. Apart from more ready freeing of the zinc and prevention of clogging, the chemical process is the same all through, and the chemical losses of lead and silver are practically the same. There will, however, be more heat expended in heating the two separately and charging them hot, and more labour will be necessary in charging them often and in small quantities. If the ores are brought to the cupola furnace direct from the roasting furnace, some expenditure of heat would be saved, but there would be considerable difficulty in making the output of the two furnaces correspond.

The condensation of the zinc oxide can be carried out to as great a stage of perfection as is commercially profitable. Hunicke estimates that it is quite feasible to obtain 60 per cent. of the metallic zinc when ores containing 16 per cent. are worked with.

An objection which may be urged against the process is that it requires a constant uniformity in the chemical composition of the ores. So far no such difficulty has arisen in actual practice, as all ores can be treated satisfactorily. On whatever ores Hunicke has worked good results have been obtained, and an extra $5 or $10 per ton of ore has been realised by the recovered zinc oxide. No doubt the process will have to be adapted to each separate ore on which it is employed, but there is little doubt of its applicability, for it attains an end hitherto unattained—the separation of zinc without fouling the coke.—W. S.

The Chemistry of Gossan. S. H. Emmens. Eng. and Mining J. 1892 (December), 582—583.

The outcrop of a mineral vein containing sulphuretted ores must inevitably, by the combined action of air, moisture, and iron, pass into the condition of gossan; that is to say, it must become a porous honeycombed mass of gangue and ferric hydrate. This gossan must, as compared with the original outcrop, be very much poorer in copper, zinc, nickel, and lead, and very much richer in gold and silver. "Very much poorer" in the case of the base metals, because it can rarely happen that these are entirely dissolved and washed away. The iron remains as ferric oxide. The lead, which in the first place forms an almost insoluble sulphate upon the surface of the galena, becomes largely protected, in the form of residual galena, against further attack. The zinc and copper, by secondary reaction with carbonic acid, sulphurous anhydride, and lime, will, to some extent, form comparatively insoluble oxides or carbonates; and part of the copper will assume a metallic condition. The nickel alone will, as a rule, almost entirely disappear, being the first, and most easily, attacked by ferric sulphate. Accordingly, we are justified in deducing the following conclusions from the examination of a gossan:—

1. It proves the prior existence of a body of sulphuretted ore.

2. If we see that it is the outcrop of a vein or lens, and not an isolated fragmentary mass, we know that in depth it will, if it continue, change to unaltered sulphides.

3. If we find it to contain particles or patches of copper, lead, or zinc compounds, we know that in depth the mineral deposit will yield chalcopyrite, chalcocite, bornite, galena, or blende, with a probability of these being the predominating ores.

4. If we find it practically free from copper, lead, or zinc compounds, we are warranted in regarding the unaltered ore in depth, as composed mainly of iron sulphides.

5. If we find residual particles of iron sulphides, some or all of which are pyrrhotite and on analysis show traces of nickel, we may infer that the gossan will at no great depth lead to bodies of nickeliferous pyrrhotite.

6. If we find silver or gold, or both, and also copper lead, or zinc compounds, we expect to find the deposit in depth to carry argentiferous sulphides.

7. If we find gold without any appreciable copper, lead, or zinc, we may properly infer that the deposit in depth will consist mainly of auriferous pyrites.

8. Whatever may be our deduction as to the character of the vein in depth, we must not expect the vein, as a whole, to be so rich in the precious metals as is the gossan; for the latter, while being much lighter, bulk for bulk, than the unaltered vein, carries an equal average weight of gold and silver, and will, therefore, yield a larger number of ounces per ton.

9. On the other hand, the *concentrates* from the unaltered vein in depth will almost certainly be richer in precious metals than an equal weight of the gossan.—W. S.

A Crystalline Iron-Tungsten Alloy. T. Poleck and B. Grützner. Ber. **26**, 35—38.

The authors have examined an iron-tungsten alloy obtained from Bohemian wolframite, by an electrolytic method. The specimen weighed 600 grms., was crystalline in structure, and permeated with drusic cavities, in which were some very small but well-defined crystals; these, as well as the mass, were silver-grey in colour, strongly lustrous, exceedingly hard, and of high specific gravity. The crystals had the composition FeW_2, and consisted of triagonal prisms with a base, the prismatic angles being 60° and the inclination of the prism to the base 90°; as no other faces could be determined and as no cleavage was observed, the exact form is uncertain, but the crystals were symmetrical and possessed a hardness approaching 9. The mass of the specimen was nearly of the same hardness as the crystals, had a specific gravity of from 12·92 to 13·04, and a composition of $Fe_2W_3C_3$: it is interesting to record the separations of the crystals free from carbon from this carbonaceous matrix.

For analysis the finely-pulverised alloy was ignited in a platinum crucible and fused with fusion mixture, the mass being subsequently decomposed with water. The solution was neutralised with nitric acid and treated with mercurous nitrate; after 24 hours the yellowish-white flocculent mercurous tungstate was separated, washed with a dilute solution of mercurous nitrate, dried, ignited, and weighed as tungstic oxide. The iron oxide left after extracting the melt with water was dissolved in hydrochloric acid and a little potassium chlorate and estimated as ferric oxide. The carbon was determined by burning in a stream of oxygen.
—D. A. L.

Brass Colouring. O. Pfeiffer, Bad. Gewerbe-Zeit. 1892. **25**, 447, and Chem. Zeit. Rep. 1892, **30**, 344.

A fine black colour which can be varied to a light brown can be produced on brass by treatment with an ammoniacal copper solution made by dissolving one part of copper nitrate in two parts of ammonia of sp. gr. 0·96 while keeping the solution cool. The brass articles, which must be carefully cleaned, acquire a light tone on first being immersed, but on exposure for some hours become deep black. The treatment can be interrupted when the desired tint is reached. A lustre can be put on the articles by rubbing with a little wax or vaselin. The process can be varied and other colour effects obtained by treatment of the article after the development of the black colour with very dilute hydrochloric acid, which dissolves the coating gradually and thus modifies the tint. The composition of the brass also has an influence on the result, and the colouring produced recalls that seen on Japanese bronze, which has possibly been obtained by a similar method.
—B. B.

The Purification of Arsenical Zinc. H. Lescoeur. Comptes rend. **116**, 1893, 58—60.

Three methods have been proposed for the preparation of zinc free from arsenic, antimony, sulphur, and phosphorus for analytical purposes. These methods involve fusion with—1. Potassium nitrate; 2. Ammonium chloride; and 3. Magnesium chloride. Neither of these processes is, according to the author, satisfactory. Repeated fusion with nitre fails to remove all the arsenic from zinc, although sulphur and phosphorus are completely expelled. On the other hand, treatment with ammonium or magnesium chloride removes the arsenic and antimony, but fails to remove sulphur and phosphorus. A combination of the above methods is, therefore, strongly recommended. Commercial zinc is fused first with nitre and then with one of the above chlorides or, preferably, zinc chloride. The zinc thus purified may still contain lead, copper, and iron, but these cause no inconvenience in most cases, and facilitate the solution of the metal in hydrochloric acid.—H. T. P.

Electrolytic Preparation of Chromium. E. Placet. Comptes rend. 1892, **115**, 945.

An aqueous solution of chrome alum is added to a solution of an alkaline sulphate and a small quantity of sulphuric acid or other acids; on electrolysing, pure chromium of a beautiful brilliancy is deposited at the negative pole. The process, it is stated, works well practically. The metal possesses great durability and a beautiful white colour with bluish shade. It resists atmospheric influences and is not attacked by concentrated sulphuric acid, nitric acid, or by concentrated solution of potash.

In addition to the preparation of batches of pure chromium the process has been applied to the deposition of chromium on various metallic surfaces, brass, copper, bronze, iron, &c., with considerable success. The author considers this process will form the basis of a new industry, and numerous alloys are producible which he intends now to study.

As a deposit on metallic surfaces the effect is beautiful, resembling that produced by oxidised silver.—T. L. B.

Action of Hydrochloric Acid on Antimony. A. Ditte and R. Metzner. Comptes rend. 1892, **115**, 936—939.

Judging from the statements made in the various treatises on chemistry, opinion is divided in regard to the action of hydrochloric acid on antimony. According to some authorities antimony is dissolved by the strong acid, whilst acid somewhat diluted is stated to be inactive; according to others the metal must be in a finely-divided state for action to ensue. Such diversities of opinion are judged to be the result of experimenting with antimony containing traces of impurities.

The authors have made a series of experiments with antimony precipitated from an acid solution of chloride by means of tin. Before use the antimony was washed with hydrochloric acid, then hydrochloric acid and water, and finally water containing very little hydrochloric acid; furthermore, care was taken to remove any hydrogen. The metal thus purified was treated very thoroughly with hydrochloric acid of varying strengths and at various temperatures, but no trace of hydrogen was evolved, not even on addition of chloride of gold or platinum, for instance; so that it may be concluded that hydrochloric acid has no action on pure antimony under ordinary pressures. Furthermore, it was shown that no hydrogen was evolved when the experiment was carried out in a vacuum. A trace of antimony certainly goes into solution, but this is accounted for by oxidation of the metal caused by oxygen enclosed in the liquids used.—T. L. B.

Action of Hydrochloric Acid on Bismuth. A. Ditte and R. Metzner. Comptes rend. **115**, 1892, 1303—1305.

The resemblance between bismuth and antimony leads one to expect a similarity in their behaviour towards hydrochloric acid, and this the authors find to be the case. Hydrochloric acid gas, even at a temperature approaching the melting-point of glass, has no action on bismuth; and the aqueous acid, whether concentrated or dilute, is apparently also inefficacious, since under no circumstances can any evolution of hydrogen be detected. Nevertheless, bismuth can always be detected in solution, unless special precautions be taken to entirely exclude free oxygen during the course of the experiment. Aqueous solutions, however, always contain more or less dissolved oxygen, and there is no doubt that this element is indirectly responsible for the partial solution of the metal, thus:—

$$2Bi + 3O + 6HCl = 2BiCl_3 + 3H_2O.$$

The authors conclude, therefore, that bismuth is not soluble in hydrochloric acid, except in presence of oxygen, and that the amount thus dissolved is proportionate to the quantity of oxygen present. They are also of opinion that the comparative facility with which bismuth, antimony, and arsenic dissolve in hydrochloric acid, depends on the heats of formation of their respective oxides.—H. T. P.

Determination of Phosphorus in Iron and Steel. A. Carnot. Comptes rend. **116**, 106—108.

See under XXIII., *page* 378.

Method of Estimating Calcium in Thomas-Phosphate. A. F. Holleman. Chem. Zeit. 1892, **16**, 1471.

See under XXIII., *page* 376.

The Limits of Accuracy of Gold Bullion Assaying, and the Losses of Gold incidental to it. T. K. Rose. Proc. Chem. Soc. [122], 1893, 73—74.

Some of the causes of the errors in the assay of gold bullion by the ordinary method are referred to, and it is shown that—

1. A higher degree of accuracy is attained if the weighings be made with the precautions recommended by Kohlrausch and others on a balance indicating differences of 0·01 per 1,000 ($\frac{1}{2}$ grm.), instead of 0·05 per 1,000, which is the smallest difference shown on ordinary assay balances.

2. Differences either in the amount of copper present to the extent of only 16 parts per 1,000 of alloy, or in the amount of silver added to the extent of 3 per cent., produce alterations in the "surcharge" of about 0·05 and 0·1 per 1,000 respectively, the "surcharge" being the difference in weight between the gold existent in the assay piece originally taken and the cornet finally obtained; it is the algebraical sum of the gold lost and the silver remaining undissolved by the acids. The reduction in the surcharge due to the presence of antimony, zinc, tellurium, iron, or nickel is also given.

It therefore follows that, in order to ensure accuracy check assays must be made on alloys of the same composition as those under examination.

3. The want of uniformity of temperature ordinarily prevailing in the muffle furnace during cupellation causes variations in the surcharge. The temperatures of the different parts of a muffle at the Royal Mint were taken during cupellation by a thermoelectric pyrometer—consisting of a platinum and rhodioplatinum couple—on three occasions, from which it appears that the mean temperature of the muffle was 1063·7°. At this temperature, a rise of about 5° is found to be accompanied by a reduction in the surcharge of about 0·01 per 1,000.

If attention be paid to these points, the gold in bullion of a high degree of purity can be determined within a range of $\pm$ 0·02 per 1,000, the limits of accuracy having been previously considered to be $\pm$ 0·10 per 1,000. This extreme degree of accuracy is only possible if the check gold be pure.

In the second part of the paper, the losses of gold in bullion assaying are estimated. They are due to (1) absorption by the cupel; (2) volatilisation in the muffle; (3) dissolution in the parting acid.

The results of a number of assays are given, the gold having been in each case recovered from the cupels and acids, and, after the gold so recovered has been allowed for, the loss by volatilisation is estimated by difference. The losses, in parts per 1,000, observed in the assay of standard gold (916·6 fine) were—

——	A.	B.	C.
In cupel	0·513	0·36	0·51
In first acid	?	0·01	0·03
In second acid	0·012	0·02	0·04
Volatilised	0·075	0·05	0·06
Total loss	0·60	0·44	0·64

A and B are means of four, and C a mean of three determinations. Other results are also given.

The determination of the amount of gold volatilised is only approximate, as the result obtained represents the algebraical sum of the errors in several estimations added to the true amount. However, it probably usually lies between 0·05 and 0·1 per 1,000.

The Volatilisation of Gold. T. K. Rose. Proc. Chem. Soc. [122], 1893, 75.

The loss of gold involved in the fusion of the pure metal and its alloys was investigated by subjecting small test pieces of from 0·5 to 2 grms in weight to a high temperature under varying conditions on bone-ash cupels placed in a muffle. The work may be considered to be a continuation of the researches of James Napier (J. Chem. Soc. **10**, 229; **11**, 171). The temperatures varied from 1045 to 1300°, and were measured by either a platinum and rhodioplatinum couple or the optical pyrometer devised by M. le Chatelier (this Journal, 1893, 290—291). The losses of gold could not be measured by the alteration of the mass of the test pieces in the muffle owing to absorption of gases, which sensibly augment the weight of the gold buttons. The true loss was found by assaying the buttons after fusion.

A considerable number of results are quoted. The chief points of interest to which attention is drawn are that—

1. An increase in the loss of gold takes place when the temperature is high, pure gold losing four times as much at 1245° as at 1090°.

2. A large amount of gold is volatilised in an atmosphere mainly consisting of carbonic oxide, while a small amount is lost in coal-gas.

3. A comparatively small amount of gold is carried away by the more volatile metals, copper appearing to exert an exceptional action; metals which are easily volatilised do not appear to be completely driven off by the highest temperatures attained in the experiments.

4. A large proportion of gold is lost in the case of alloys which form flat buttoms on the cupel, and, conversely, a small proportion is lost from spherical ones, although the surface actually exposed is greater in the latter case than in the former. A current of air or gas passing over the buttons does not seem to increase the loss, provided the surface of the molten metal remain at rest. These results point to the conclusion that the conditions which lower the surface tension of the gold button simultaneously raise the vapour pressure of the gold.

The Dissolution of Gold in a Solution of Potassium Cyanide. R. C. Maclaurin. Proc. Chem. Soc. [122], 1893, 81.

The study of the conditions contributory to the dissolution of gold in solutions of potassium cyanide is become of importance, owing to the recent use of this agent in extracting gold from poor ores (this Journal, 1890, 267 and 1891, 93—98). The nature of the changes is disputed; Elsner originally expressed the interaction by the equation—

$$4Au + 8KCN + O_2 + 2H_2O = 4AuCN{\cdot}KCN + 4KOH,$$

but McArthur, in a recent paper, has called in question the necessity of oxygen being present. It is a remarkable fact in connection with the process that the rate of dissolution of the gold decreases as the concentration of the cyanide solution increases.

It is shown that dissolution of the metal is conditioned by oxygen, and that the amounts of oxygen absorbed and of gold dissolved are in the ratio O:2 Au. Furthermore, it is shown that the rate of dissolution varies with the strength of the solution, and that it passes through a maximum in passing from dilute to concentrated solution; this variation is traced to a decrease in solubility of oxygen in solutions of potassium cyanide as the concentration increases.

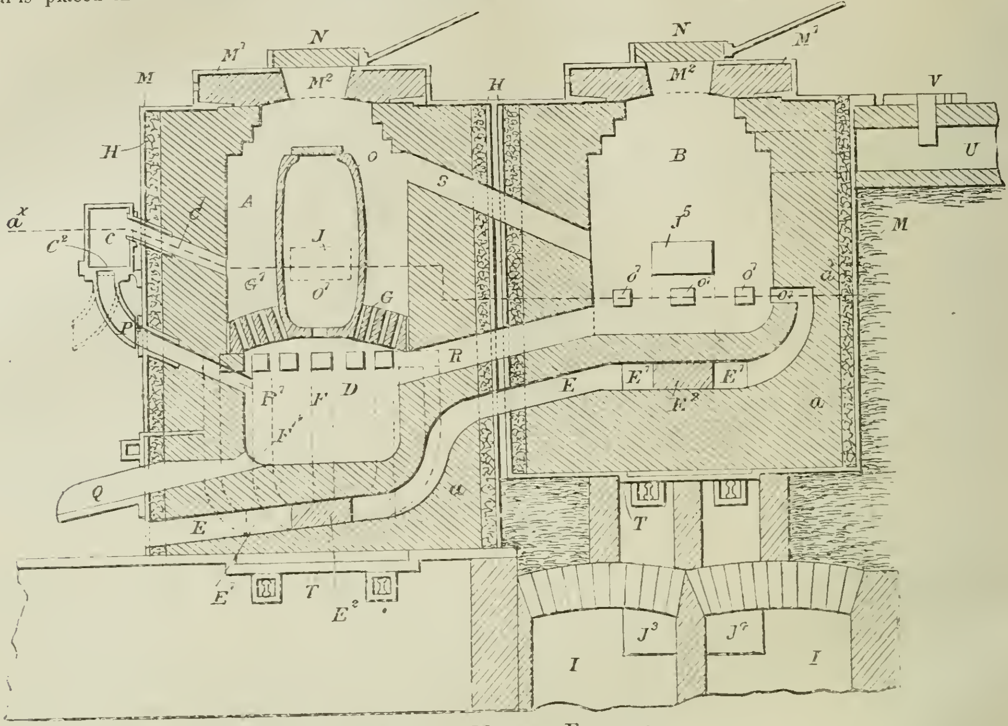
PATENTS.

Improvements in Galvanising Iron and Steel. W. K. Greenway, Bradley. Eng. Pat. 2590, February 10, 1892.

The pot or vessel containing the galvanising metal is either placed in a larger vessel or is constructed with two walls one within the other with a convenient space between them. Molten lead or other metal with a lower melting-point than zinc is placed in this intervening space and transmits the heat from the fire on the outside to the metal in the inner bath. By this means the burning of the galvanising metal is prevented, the loss of heat reduced, and the pots made more lasting.—A. W.

Improvements in Melting Furnaces. F. H. Mallaband, Kirkcaldy. Eng. Pat. 5026, March 15, 1892.

This is a furnace for general melting purposes, and can be used either with coke or gaseous fuel. If the former is used the metal is placed in a crucible O, which is then packed round with coke. An air blast passes from the box *c* through tubes c^1, of which there are several, into the furnace A. It also passes through P and P^1 into a lower compartment F which receives the metal as it melts. The tube P can be deflected as shown by the dotted lines, to allow of the removal of samples from F and for rabbling. The products of combustion from the furnace A pass through S into B, and finally escape to the chimney through U. The furnace B contains scrap, or metal receiving a preliminary heating before being transferred to A. Any metal which may be melted in B passes through R into F. The openings D, D^1 in the two furnaces communicate with a channel E, and are for the escape of slag. The channel E is kept hot by the gases passing from A to B. The metal is drawn off through the spout Q. If gaseous fuel is to be used the crucible is removed, the arch G completed, and the body of the furnace filled with the metal to be melted. The blast in C is cut off, the flue U closed, and two ports J, J^5 are opened. Each of these communicates with a pair of regenerators, conveying gas and air respectively, and the flame is passed from A to B and from B to A as the pairs of regenerators respectively become heated and cooled down.—H. K. T.



Improved Melting Furnace.

Treatment of Cast Iron. F. Sugden, Nottingham, and T. Sugden, London. Eng. Pat. 4333, March 22, 1892.

Bone or bone dust, which preferably has been "steamed and freed from fatty matter, dirt, sand, and the like," is placed in a ladle, the molten cast iron is poured on to it, and the whole well stirred and thoroughly mixed. The proportion of bone to metal is from 3 to 10 per cent. It is claimed that cast iron thus treated can be softened, machined, and again hardened in a manner similar to steel.—A. W.

Improvements in or Relating to Cupolas and Blast Furnaces. A. P. Rushforth, London. Eng. Pat. 6558, April 5, 1892.

The molten metal from the cupola or blast furnace is run into a receiver, whence it is withdrawn when desired. A coil of pipe of cast iron or other suitable material is supported in the upper part of this receiver above the molten metal, and is connected at one end with the main from the blowing engine, and at the other with the main supplying the tuyeres, so that the blast passing through the coil is heated partly by radiation from the molten metal, while it remains in the receiver, and partly by the hot gases therefrom.—A. W.

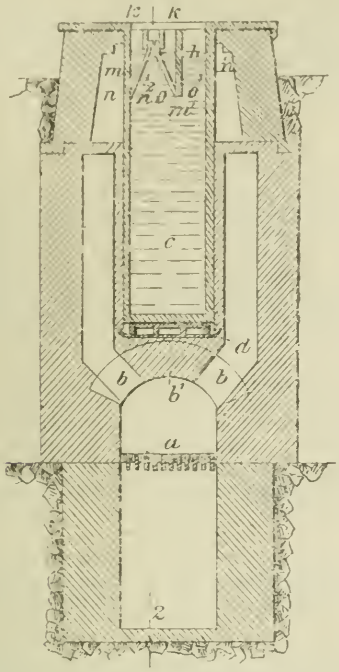
Improvements in the Manufacture of Iron and Steel. T. Twynam, Chiswick, London. Eng. Pat. 6612, April 6, 1892.

In order to render pig iron which is high in silicon and low in phosphorus suitable for the basic Bessemer process, basic slag or ferruginous phosphoric cinder is added in suitable quantity to the metal. The silicon of the pig iron reacts with the phosphoric acid with the production of silica, which passes into the slag and phosphorus which combines with the iron. The iron and basic slag must be well mixed by rocking the vessel, or they may be transferred to the converter and blown. In the latter case the highly silicious slag produced by the reaction must be first poured off. Ferruginous phosphoric cinder is used in the same way. The basic slag, high in phosphorus, is advantageously obtained when oxides of iron, such as tap cinder, re-heating furnace cinder, &c., are added at the commencement of the blow for the purpose of shortening the afterblow. One ton of pig iron containing 1 per cent. of silicon requires $1\frac{1}{2}$ cwt. of cinder.—H. K. T.

Improvements in Galvanising Iron and Apparatus therefor. G. Retterer, Paris, France. Eng. Pat. 7332, April 16, 1892.

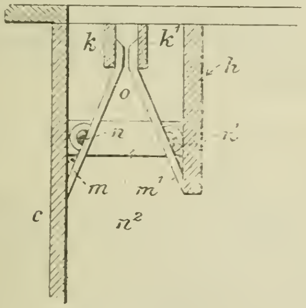
In the ordinary manufacture of galvanised iron by dipping there is a considerable production of hard spelter and excessive volatilisation owing to the necessity of uncovering the metal whilst the sheet is being withdrawn. This invention consists in mechanical means for overcoming these difficulties. The apparatus (Fig. 1) consists of a bath *c* divided above into two compartments by the partition *h*. The bath *c* and compartment o^1 are filled with lead, the compartment *o* contains spelter, which floats on the lead. In the compartment *o* at the surface of the spelter are two moveable bars *k*, k^1 (Fig. 2), supported by rods *m*, m^1 pivoted at *n*, n^1. In order to coat a plate it is thrust into the compartment *o*, and submerged until its upper edge is below the partition *h*. It is then released and floats upwards, pushing apart the bars *k*, k^1, which in their turn push aside the powdered coke with which the metal is covered. A small clear space is thus produced sufficient for the removal of the sheet. The surface of the lead in the compartment *o* is covered with sal-ammoniac.—H. K. T.

Fig. 1.



Apparatus for Galvanising Iron.

Fig. 2.



Apparatus for Galvanising Iron.

Improvements in the Separation of Gold from its Chloride Solution. J. W. Sutton, Brisbane, Queensland. Eng. Pat. 24,144, December 31, 1892.

This patent relates to the use of oils for separating precipitated gold from the solution in which it is suspended. As an example, if the solution contains 10 grains of gold to the gallon, 150 grains of a saturated solution of borax, or a similar quantity of a 50 per cent. solution of an alkali, are added, and then 300 grains of a hydrocarbon oil such as kerosene. The whole is well agitated and 150 grains of saturated ferrous sulphate solution poured in, when, after further agitation for three minutes, it is run into a vat where, on standing, the gold and precipitated iron rise with the oil to the surface. The underneath waste liquor is run off, and dilute sulphuric acid added to the remainder, by which the precipitated iron is dissolved, and the oil allowed to rise freely to the surface, carrying the gold with it. The mixture is filtered, and the acid and oil afterwards separated for use over again. A volatile oil or a resin may be used in place of the kerosene, in which case the solution is warmed to 180° F., and the use of ferrous sulphate dispensed with.—A. W.

Improvements in the Manufacture of Manganese and Manganese Alloys free from Carbon. W. H. Greene and W. H. Wahl, Philadelphia, U.S.A. Eng. Pat. 82, January 3, 1893.

Manganese ore is purified from iron by digesting it with sulphuric acid (sp. gr. 1·84), diluted with two or three times its volume of water, and is then washed free from acid and dried. The dioxide is then reduced to monoxide by heating in a rotating horizontal cylinder in a current of reducing gas, such as petroleum vapour or water-gas. The lower oxide thus obtained is then introduced into a crucible lined with lime or magnesia, and metallic aluminium added in the proportion of 55 parts to 213 parts of the monoxide. A flux of fluorspar or cryolite is mixed in and the whole heated. Metallic manganese is thus obtained free from carbon, and containing only very small quantities of iron, silicon, and other impurities. To avoid contamination with aluminium it is advisable to use less of that metal than is theoretically necessary to completely reduce the manganese oxide. When the presence of silicon in small quantity in the resulting manganese is not objectionable the reduction may be performed in siliceous crucibles and a readily-fusible siliceous flux used.—A. W.

Improvements in the Art of Producing Metallic Zinc. P. C. Choate, New York, U.S.A. Eng. Pat. 530, January 10, 1893.

These improvements are for the purpose of obtaining zinc from complex ores or "blendous galena." Hitherto the separation of zinc from these ores by the ordinary process of distillation has not been possible, as metals such as iron, copper, &c., pass over with the zinc. A preliminary production of zinc fume is also ineffective owing to the difficulty of reducing this substance. The patentee finds that the latter operation can be effected if the fume contain about 5 per cent. of metallic lead or lead fume. In order to carry out the process the ore is first desulphurised if necessary. It is then mixed with coal screenings and roasted in a suitable furnace for the production of zinc fume, which is collected in the usual way. The residue in the furnace contains the copper and gold and most of the silver. The fume is next heated to 300°—800° F. to drive off arsenic, antimony, cadmium, &c., and is then mixed with carbon and heated in a vertical retort, down the centre of which a perforated tube passes, terminating in a narrow aperture through which the molten zinc and lead pass. The retort is not attacked owing to the purity of the fume. The lead is allowed to settle out by gravity from the molten metal. This consists of zinc containing $1\frac{1}{4}$ per cent. to $1\frac{3}{4}$ per cent. of lead, and is free from other metals. It can be used for desilverising lead bullion, and is also well adapted for purification by the electric current owing to its freedom from copper and tin. If the ore does not contain sufficient lead, the latter may be added to the fume in the form of metal or of lead fume.—H. K. T.

Improved Process of Producing Metallic Alloys. W. H. Greene and W. H. Wahl, Philadelphia, U.S.A. Eng. Pat. 2066, January 31, 1893.

In order to avoid the introduction of carbon into alloys, these are produced by heating a silicide of one metal with the oxide of another in the presence of a strong base such as lime or magnesia. An alloy and a fusible silicate of lime and magnesia are then produced. This process is chiefly useful for introducing a large proportion of manganese

into steel without a proportionate amount of carbon, and is carried out by heating a ferro-silicon, silico-spiegel, or silico-ferro-manganese high in silicon and low in carbon with manganese monoxide or "proto-sesqui-oxide" and lime on a basic hearth. Useful proportions are:—Ferro-silicon (containing 10 per cent. of silicon and 1 per cent. of carbon), 100 lb.; manganese monoxide, 70 lb.; lime, 50 lb. These will produce an alloy containing iron, 70 per cent.; manganese, 29 per cent.; carbon 0·7 per cent.; and silicon, a trace, which can be added to decarburised iron in the usual way. Calculations showing the comparative amounts of carbon introduced by this ferro-manganese as compared with those introduced by ordinary ferro-manganese accompany the specification. In a similar manner ferro-tungsten and other alloys free from carbon may be produced.
—H. K. T.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improvements Relating to the Coating of Articles with a New Metallic Alloy by Electro-Deposition. The London Metallurgical Company, Lim., and S. O. Cowper-Coles, London. Eng. Pat. 1391. January 23, 1892. (Second Edition.)

According to this invention articles are coated by electrolysis with an alloy of silver containing from 25 to 35 per cent. of cadmium, or when less costly coatings are required 40 to 90 per cent. of the baser metal may be employed. The bath is formed by dissolving cyanide of cadmium in a solution of cyanide of potassium so as to form a double salt having a slight excess of the latter. To this solution is added a small quantity of the double salt of the cyanides of potassium and silver, the two together forming the electrolytic bath. The anode is composed of an alloy of cadmium and silver in the same, or approximately the same, proportions as are desired in the alloy to be deposited.
—G. H. R.

Improvements in Precipitating and Collecting Metals from Solutions Containing them. A. G. Brookes, London. From B. C. Molloy, Johannesburg, South Africa. Eng. Pat. 3024, February 16, 1892.

According to this invention the solution of gold or other metal is contained in a tank the bottom of which is covered with a layer of mercury, which forms the cathode of the electrolytic cell. On the passage of the current an amalgam is produced, from which the gold or other metal can be recovered by the action of heat in the ordinary manner.
—G. H. R.

Improved Means for the Recovery of Tin and Iron from Tin-Plate Scrap or other Waste Material from Tinned Goods. J. G. H Batchelor, Penarth, and C. T. Batchelor, Cardiff. Eng. Pat. 5255 March 17, 1892.

Tin-scrap is rammed into narrow moulds, and the compressed slabs so obtained are suspended in a solution rich in tin by copper slings connected with the positive pole of an electric current generator. A plate connected with the negative pole is suspended between each pair of slabs, and a current of low voltage removes the tin from the latter to the former.—A. W.

Improvements in Electrical Secondary or Storage Batteries. G. E. Heyl, Berlin, Germany. Eng. Pat. 6465, April 4, 1892.

The grid or frame is formed of a series of horizontal bars or ribs secured to an outer frame, and preferably composed of lead, aluminium, or a combination of lead and aluminium. These bars or ribs are placed at a short distance from one another, and are shaped so that they taper towards the edge. The horizontal bars are crossed by slotted vertical bars, the edges of which are slightly bent towards the adjacent horizontal bars; and auxiliary vertical bars, which need not be slotted, may also be added. The grid so formed may be filled with any suitable composition employed in the construction of electrodes.—G. H. R.

Improvements in Electrodes for Storage Batteries. G. E. Heyl, Berlin, Germany. Eng. Pat. 6637. April 6, 1892.

The improvement consists in using electrodes composed of compounds of chromium or tungsten mixed with oleic or resinic acid, or with a mixture of these acids, or the chromate or tungstate of lead may be employed and compressed into a compact mass in moulds of the required shape with or without the addition of a cementing material. When compounds of oleic or resinic acid are employed the method preferred is as follows:—The compound of chromium or tungsten, for instance, chromic acid, is finely ground and brought into a kneading machine, which is heated up to 285° F., and just as much resin or heavy oil as is requisite for complete combination with the chromic acid is added in small quantities. When the mass has been thoroughly kneaded, it is pressed into frames as usual, and electrodes consisting of insoluble resinates or oleates of chromium are the result.—G. H. R.

An Improved Method of Producing Zinc from Blende by Means of Electrolysis. G. E. Cassel and F. A. Kjellin, Stockholm, Sweden. Eng. Pat. 21,193, November 22, 1892.

Zinc is produced from blende by means of electrolysis, the ore being first converted into a soluble salt of zinc, which is electrolysed in a bath in which the cathode consists of zinc or other suitable metal which is not corroded in the process, and is separated from the anode by a porous partition. Iron, or some analogous metal, is used for the anode, and the electrolyte round the cathode consists of a soluble salt of zinc, and that round the cathode of a solution of a salt the positive component of which consists of the metal used as an anode, and the negative of the same acid as that contained in the salt of zinc to be electrolysed. If the acid set free during the operation forms insoluble salts with the anode, the porous partition may be dispensed with and the cathode and anode are both surrounded by the salt of zinc to be electrolysed.—G. H. R.

Improvements relating to Storage Batteries and Electrodes therefor. G. W. Harris, New York, U.S.A. Eng. Pat. 140. January 3, 1893.

The invention consists in constructing the electrodes for a storage battery of alternate layers of sheet lead and blotting paper, the alternate layers of lead extending over the lateral or opposite edges of the blotting paper and united in each instance into one mass, and bound by a strip of cloth or analogous pliable non-conducting material of good tensile strength and preferably possessing absorbing qualities.
—G. H. R.

Improved Process and Apparatus for the Electrolytic Production of Porous Finely Sub-divided Lead for use in Secondary Batteries. W. P. Thompson, London. From E. Correns, Berlin, Germany. Eng. Pat. 1502. January 24, 1893.

According to this process any suitable lead compounds are mixed with sulphuric acid or sulphates, or water and a suitable binding material (such as gelatin, glue, &c.), and first plastered into waffle-like plates, and then exposed to the action of the current in an electrolytic bath until all the lead salts are reduced. The reduced mass is then ground and inserted in a moist condition into the lattice work, which serves as a support for the active substance. Metallic salts soluble in sulphuric acid may also be added to the liquid which serves as a reducing bath, or to the lead compounds inserted into the waffle-like cathodes, so that these metals may be electrolytically deposited with the finely-divided lead and subsequently dissolved out, thus forming very porous plates. In addition, mercury, or mercurial salts may be added to the bath so as to form an amalgam with the lead and prevent oxidation. An apparatus is described by means of which the process may be carried on continuously, the lead salts being pressed on to the waffle-like plates where they enter the bath, while the finely-divided lead or lead amalgam drops off them where they leave.

—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Researches on the Localisation of Fatty Oils during the Germination of Seeds. E. Mesnard. Comptes rend. **116**, 111—114.

The author has examined oleaginous seeds under the microscope, and is led by his observations to the following conclusions; (1.) Except in the *graminaceæ*, the fatty oils are not localised in special tissues. The oils disappear according to the nutritive requirements of the tissues, and behave in this respect like the albuminoid substances which they always accompany. (2.) Hydrolysis of the oils under the influence of a diastatic substance does not occur. No glycerol, which might have been expected to result from a saponification of the oils, had been found, nor was the quantity of fatty acids appreciable to any extent. The presence of the minute quantities of free fatty acids can be easily explained by certain changes of the albuminoid substances. (3.) In every case, the occurrence of the oils is independent of the starch and of the glucose; but these oils seem to be superimposed on the albuminoid layers in the reserve substances of the ripe seeds.—J. L.

Hübl's Iodine Method for Oils. E. Dieterich. Helfenberger Annalen, 1891.

See under XXIII., *page* 381.

Hübl's Iodine Method for Oils. W. Fahrion. Chem. Zeit. 1892, **16**, 1472.

See under XXIII., *page* 381.

Soap Analysis. E. Dieterich. Helfenberger Annalen, 1891.

See under XXIII., *page* 381.

PATENTS.

Improvements in Strainers for Oil and similar Presses. M. P. A. Tollin, Paris, France. Eng. Pat. 8559, May 5, 1892.

To prevent the passing of any solid particles through the strainers the patentee arranges in the inner sides of the filtering surfaces of these strainers special metallic strips, which are easily interchangeable and prevent any alteration in the size of the slits, through which the oil is strained, during the process of compression.—J. L.

Improvements in the Treatment or Solidification of Mineral Oils and other Liquid Hydrocarbons. C. H. Ridsdale, Guisborough. Eng. Pat. 14,383, August 9, 1892.

The solidification is effected by mixing the oils with resin-lime soap (this Journal, 1892, 445).—J. L.

An Improved Method of and Apparatus for Brightening Rape, Linseed and similar Oils. A. Teal, Wilmington, near Hull. Eng. Pat. 18,744, October 19, 1892.

In order to brighten the oils the patentee exposes them in a finely-divided stream to the atmosphere after they have been heated up to about 160° F.—J. L.

A New Process for making Consistent Fish-fat, Train, and other Oils by Means of Compressed Oxygen. E. Opderbeck, Cologne, Germany. Eng. Pat. 24,153, December 31, 1892.

A material of requisite consistency is obtained by intimately mixing the oils, previously heated to 90°—100° C., with compressed oxygen.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Detection of Rosin in Gum-Dammar. E. Hirschsohn. Pharm. Zeit. Russl. 1892, **31**, 609.

See under XXIII., *page* 381.

PATENTS.

Improvements in or relating to Bronze or other Metallic Paints. E. C. Williams and M. E. Williams, Rushmoore, and C. May, Liverpool. Eng. Pat. 4169, March 2, 1892.

This invention refers to an improved bronze paint consisting of a menstruum which is a solution of $4\frac{1}{2}$ parts of gun cotton, in $95\frac{1}{2}$ parts of amyl acetate. By adding to this solution a suitable quantity of bronze or other metallic powder the bronze paint is obtained.—C. O. W.

Improvements in Colour Cakes, Blocks, or Sticks for Marking or Colouring Purposes. J. A. Carruthers, Glasgow. Eng. Pat. 5862, March 25, 1892.

The invention consists in coating, colouring, or marking materials or pigments in the form of cakes, blocks, or sticks with any suitable cementitious, coagulable, gummy, waxy, or setting substance; or with some adherent fibrous pulp, or pitch, or other resinous substance. By this treatment the colour blocks or sticks are better suited for packing and sending away, and are more cleanly to handle.

—C. O. W.

Improvements in the Production of White Lead and Chrome Pigments. S. Ziani de Ferranti, Hampstead, and J. R. Noad, East Ham. Eng. Pat. 6009, March 28, 1892.

A solution of lead acetate is prepared by immersing lead electrodes in a 10 per cent. solution of acetate of ammonia. These lead electrodes are arranged in suitable tanks containing porous pots or porous partitions formed of porous slabs. A convenient number of sets of tanks are connected in series in proportion to the voltage, so as to provide about $2\frac{1}{2}$ volts for each cell. On passing a direct current through these cells lead acetate is formed in the outer solution and ammonia set free in the porous cell. The lead acetate and the ammonia so formed are run into two separate vessels and the latter by treating it with gaseous carbonic acid is converted into carbonate of ammonia and is then mixed with the lead acetate. A white precipitate consisting of a hydrated carbonate of lead, commercially known as white lead, is thus formed, the supernatant liquid being essentially a solution of acetate of ammonia. The precipitate is then separated from the solution by means of a filter-press. Traces of lead which remain dissolved in the solution of acetate of ammonia are precipitated with chromic acid, whereby chrome yellows are formed. The clear solution of acetate of ammonia is subsequently returned into the electrolysing tanks. Instead of acetate of ammonia acetate or nitrate of soda or potash may be used.—C. O. W.

Improvements in the Manufacture of Pyroxiline Solutions and Compounds for Varnishes and Coatings. J. S. Fairfax, London. From F. Crane, New Jersey, U.S.A. Eng. Pat. 6542, April 5, 1892.

The invention refers to the preparation of pyroxiline varnishes by means of such solvents as will rapidly volatilize and at the same time will not absorb moisture. As a solvent of this description acetone and some of the lower ketones are recommended. The following mixtures are recommended :—

15 gallons methyl alcohol or acetone.
50 gallons petroleum naphtha.
35 gallons volatile ketones or acetone oil.
25 pounds soluble pyroxiline.

Or for a solution to be still more non-hygroscopic :—

50 gallons volatile ketones or acetone oil.
50 gallons petroleum naphtha.
25 pounds soluble pyroxyline.

—C. O. W.

Improvements in the Spreading and Treating of India-Rubber Waterproof Fabrics. J. Frankenburg, Salford. Eng. Pat. 7582, April 21, 1892.

This invention relates to a new form of spreading machine. The machine is constructed with a gauge, gauge roller and back drum as the present machines, but there is no intermediate drying apparatus. Below the back drum or in any other suitable position there is placed an enclosed chamber into which the fabric as it passes from the spreading roller can enter. The chamber, which is heated to about 180° F. is fitted with rollers over which the fabric passes in zig-zag fashion. All the naphtha and petroleum spirit contained in the proofed fabric is evaporated and the cloth leaves the chamber with a perfectly dry coat of india-rubber. The naphtha vapours in the chamber may be drawn off by means of a fan, subsequently to be condensed in a refrigerator, or they are passed direct into the atmosphere. —C. O. W.

Improvements in the Manufacture of White Lead for Use as a Pigment. Z. Waller and C. A. Sniffin, New York, U.S.A. Eng. Pat. 7631, April 22, 1892.

This invention relates to precipitation processes of making white lead, where solutions of basic lead acetate are treated with carbon dioxide. By mixing these solutions with water charged with carbon dioxide a highly amorphous lead hydro-carbonate of great covering power is obtained, or the carbon dioxide is forced under a pressure of from 5 to 10 pounds into the mixture of carbonated water and basic lead acetate, whereby a greater percentage of precipitate is produced in proportion to the volume of water in the precipitating vessel.—C. O. W.

Improvements relating to Compounds suitable as Protective Coatings or Paints for Iron and Steel. P. Lehmann, Berlin, Germany. Eng. Pat. 12,728, July 11, 1892.

The invention refers to a new material called "Siderosthen" for the coating of iron and steel surfaces, with a view to prevent the formation of rust upon them. The compounds used for the manufacture of this paint are the tar obtained from works producing fat gas, "goudron" which is a mixture of about 85 parts of refined Trinidad asphalte and 15 parts of refined asphalte oil, or instead of the "goudron" sulphur may be used. If "goudron" be employed, this is dissolved in the gas tar in suitable quantities and this mixture can then forthwith be employed for the purpose in view. If sulphur be used, 8 per cent. of it is mixed with the gas tar and this mixture is then heated to about 100° C.—C. O. W.

An Improved Composition Paint. J. S. P. Stutley, Adelaide, South Australia. Eng. Pat. 21,932, November 30, 1892.

This invention refers to a composition paint which will not corrode when subjected to the action of water and further renders the material coated waterproof. The paint consists of :—

1 gallon of spirits of wine.
4 lb. of shellac.
1 lb. of resin.
½ lb. of steatite.
2 lb. of lamp-black.

Instead of lamp black any other desirable pigment may be employed. The ingredients are thoroughly mixed together and for 30 minutes subjected to a heat of 212° F., and then allowed to stand for 48 hours. The mass is subsequently strained and ground in an ordinary paint mill.—C. O. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Mangrove Tannin. H. Trimble. Contributions from the Bot. Lab. of the Univ. of Pennsylvania, 1892, **1**, 50—55.

Mangrove bark from *Rhizophora Mangle, L.*, does not appear to have come into use in the tanning industry except in the localities where it grows. The probable reasons for this are: (1) The fact that almost all parts of the world are able to supply tanning material for home consumption; and (2) that the mangrove produces a leather of a bad colour and spongy texture.

The powdered bark contains 12·04 per cent. of moisture and 6·10 per cent. of ash, in which sodium salts, chiefly chloride, predominate. Fat and wax were present in insignificant amount; stronger ether removed 0·40 per cent. of a substance insoluble in water, but giving a green colour with ferric chloride. Gallic acid was absent.

Absolute alcohol extracted 20·32 per cent. of a very astringent substance with a narcotic odour. Of this an amount equal to 13·42 per cent. of the bark was soluble in cold water, and the remainder was almost completely soluble in hot water. The alcoholic extract consisted largely of tannin, red colouring matter, and a small quantity of glucose.

The other more important constituents were determined to be :—Mucilage, 1·72 per cent.; glucose, 0·81 per cent.; albuminoids, 7·02 per cent.; starch, 4·27 per cent.; cellulose, 27·49 per cent. Tannin was determined by gelatin and alum, and found to be, in the air-dried bark, 23·92 per cent., and in the absolutely dry bark, 27·19 per cent.

To isolate the tannin, the finely-powdered bark was extracted with commercial ether (sp. gr. 0·75), the bulk of the ether was distilled off and the rest evaporated under reduced pressure. The filtered aqueous solution of the residue was carefully treated with neutral lead acetate and filtered. The yellow filtrate was agitated successively with three portions of acetic ether, which removed the tannin. The precipitate was suspended in water, decomposed by hydrogen sulphide and filtered, the filtrate was heated under reduced pressure to remove hydrogen sulphide and treated with lead acetate and acetic ether as described above. The acetic ether solutions were mixed and distilled to dryness; the residue was dissolved in aqueous ether and again distilled to dryness under reduced pressure.

The tannin thus obtained was a light, reddish-yellow porous substance, readily soluble in water, alcohol, and commercial ether. It gave the following reactions in 1 per cent. solution; these are compared with those of gallo-tannic acid :—

Reagent.	Mangrove Tannin.	Gallo-Tannic Acid.
Sulphuric acid (1 : 9)	Red deposit on cooling.	No change.
Bromine water......	Yellow precipitate.	No precipitate.
Ferric chloride..... and	Dirty green precipitate.	Blue-black precipitate.
Ammonium hydrate	Purple precipitate.	Purple precipitate.
Tartar emetic ...... and	No precipitate.	White precipitate.
Ammonium chloride	" "	" "
Calcium hydrate ...	Pink precipitate.	" "
	Red on surface.	Turning blue.
Concentrated sulphuric acid.	Deep-red colour.	Yellow colour.
Lead nitrate........	No precipitate.	White precipitate.
Cobalt acetate	Faint cloudiness.	Flesh-coloured precipitate.
Uranium acetate....	Red-brown colour and precipitate.	Crimson colour.
Potassium bichromate	Brown precipitate.	Brown precipitate.
Ferric acetate.......	Olive-green colour and precipitate.	Blue-black precipitate.

These reactions agree closely with those given by Procter (*Text Book of Tanning*, 113) for the tannin of *Mimosa* or wattle-bark.

Sugar was not detected in the tannin.

By heating the tannin in glycerine to 215°, shaking out the products of decomposition with ether, and, after removing the latter, dissolving in water, and applying the usual reagents, a catechol tannin was indicated. By hydrolysis a red insoluble decomposition product, and a substance capable of reducing Fehling's solution to an extent equivalent to 10·35 per cent. of glucose, were obtained. The red product gave reactions which indicated the presence of gallic acid, ellagic acid, and phlobaphenes.

The ultimate analysis of the tannin is in accord with the formula $C_{25}H_{25}O_{11}$, but the numbers deviate very slightly from those calculated for, $C_{20}H_{20}O_9$, the formula ascribed by Dragendorff to rhatania tannin, and from those calculated for $C_{26}H_{24}O_{11}$, the formula given by Rochleder for horse-chestnut tannin.

The author concludes that mangrove tannin is identical with those from horse-chestnut, rhatany, and tormentil, and possibly also with that from mimosa or wattle-bark.

—A. G. B.

XV.—MANURES, Etc.

The Loss of Nitrogen in Dung. A. Muntz and A. Ch. Girard. Comptes rend. **116**, 108—111.

The authors have determined the loss of nitrogen incurred in the stable, and find it to be for straw litter, 63·6 per cent. of the nitrogen consumed by the animal, and for peat litter only 48·3 per cent. A comparison of the usefulness of a light soil in the stable, contrasted with straw litter, gave for the former a loss of 25·7 per cent. of nitrogen, whilst for the latter the loss amounted to 50·3 per cent. The ammonia is all the more easily absorbed the more humic substances the soil contains.

For the retention of the ammonia in stables the use of copperas, gypsum, superphosphates, &c. has been recommended. The authors, however, found the losses of nitrogen for—

	Per Cent.
Straw litter alone	46
Straw litter mixed with copperas............	48
Straw litter mixed with gypsum.............	46

and they explain the inefficiency of the added chemicals by the alkalinity of the animal excreta, which has to be saturated before any ammonia can be retained.

An examination of dung of various domestic animals gave the following amounts of bases, measured by the quantity of SO_3 required to neutralise them :—

	Grms. SO_3.
1 kilo. of horse-dung required................	1·352
1 " cow-dung "	3·646
1 " sheep-dung "	4·200
1 " swine-dung "	2·022

In practice the use of straw litter mixed with peat and, perhaps, a soil rich in humic substances, seems to be the cheapest means of checking the enormous losses of ammonia occurring in stables.—J. L.

Method of Estimating Calcium in Thomas-Phosphate. A. F. Holleman. Chem. Zeit. 1892, **16**, 1471.

See under XXIII., *page* 376.

XVI.—SUGAR, STARCH, GUM, Etc.

The Melassigenic Substances of the Manufacture of Sugar from the Sugar Cane. Prinsen-Geerlings. Chem. Zeit. 1892, **16**, Rep., 280; from Mededeelingen van het proefstation voor suikerriet in West Java, te Kagok-Tegal, Samarang, 1892.

The author has investigated in detail 17 samples of cane sugar molasses. The sugars present included sucrose, dextrose, and levulose; no others (for example, raffinose) were detected. The dextrose and levulose were present in varying proportions, so that the reducing sugars were often optically inactive. Since the rotation of the reducing sugars was the less laevogyrate the older the products, it would seem that the levulose of invert sugar gradually undergoes fermentation and oxidation.

The percentage of ash in the molasses did not lead to the establishment of a factor similar to that used in the case of of beetroot sugar (viz. 5); the factor deduced was 1·2 — 8 or 6·5 — 10·7, according as the ash is referred to the sucrose, or to the total sugars.

The other organic substances isolated were citric acid (not previously found), succinic acid, lævo-malic acid, and Reichardt's saccharumic acid. The pure acid

$$C_{14}H_{16}O_{13} + H_2O$$

crystallises in transparent leaflets, melts at 175° C., and is soluble in water, alcohol, and ether, but insoluble in chloroform. The aqueous solution exhibits neither optical rotation nor reducing power. All the salts are insoluble in alcohol; the iron, aluminium, lead, and barium salts are insoluble also in water.

The molasses contains 0·098—0·35 per cent. of volatile acids (acetic, butyric, and valeric acids); lactic acid was not present. Dextran, galactan, and Peligot's saccharin were also absent. Metapectic acid was isolated; it dissolves in water forming a turbid solution of feeble lævo rotation, and it only exhibits slight reducing power before and after inversion. The *barium* salt $C_{12}H_{15}O_{11}Ba_2$ is sparingly soluble in water. On oxidation the acid yields much mucic acid and a little oxalic acid. Glucinic acid was also present.

It is observed with respect to the formation of molasses that whereas at 27° C. 100 parts of water dissolve 213·5 parts of sucrose, a less relative quantity of sucrose (instead of a greater as in beetroot molasses) is present in the molasses. By agitating the cane sugar molasses with crystals of sucrose a separation of sucrose from the molasses can be brought about. Small quantities of the salts present, diminish the solubility of sucrose, whilst large quantities increase it; coefficients could not therefore be determined for their actions. When certain salts, especially organic alkali salts, are present simultaneously with reducing sugars, the solubility of sucrose is very considerably diminished; *i.e.*, sucrose is less soluble in solution of these substances than in pure water. The specific behaviour of cane sugar molasses is, according to the author, conditioned by the simultaneous presence of organic alkali salts and invert sugar. Gunning has already shown that organic potassium salts form compounds resembling molasses when sucrose is added to their alcoholic solutions. The author finds that similar compounds are formed from invert sugar and the potassium salts of malic, succinic, and saccharumic acid; the calcium salts, however, exhibit this property only slightly. A smaller relative amount of sucrose is present in these syrupy liquids than in a saturated solution of pure sucrose.

Invert sugar has of itself no power of holding back sucrose from crystallisation; in practice, however, it is to be regarded as a melassigenic substance, for by slow oxidation especially in feebly alkaline solutions, it gives rise to acid, which invert the sucrose, producing fresh quantities of invert sugar.

Since almost all the acids produced by the oxidation of invert sugar form insoluble barium salts, it is recommended to precipitate them with baryta, either alone or in conjunction with lime. The poisonous nature of barium salts necessitates the greatest caution. Whether it be possible and advisable to destroy the invert sugar from the fresh cane juice by heavy liming and saturation is not yet settled. The easily-soluble potassium salts are always found in the molasses, and to them may be imputed the formation of a certain amount of molasses.

The syrupy compounds of sucrose and organic potassium salts which were first discovered by Gunning, are soluble in alcohol. The sucrose can neither be isolated by concentrating their aqueous nor their alcoholic solutions.—A. R. L.

The Strontia Residue obtained in the Process for the Desaccharification of Molasses by Strontia. G. Reinhardt. Chem. Zeit. 1892, **16**, 1472, and 1520—1521.

Frühling and Schultz recommend the following method for the determination of strontium hydroxide in the above-named residue:—20 grms. of the moist substance are boiled six or eight times with successive quantities of water, and the combined extracts made up to 500 cc. A portion (250 cc.) of the clear filtrate is titrated with $\frac{3}{4}$ normal acid. The number of cc. required gives approximately the percentage of $Sr(OH)_2 + 8H_2O$. The results so obtained are, however, too high, as a certain variable quantity of calcium hydroxide also passes into solution. Better results are obtained by boiling 20 grms. of the moist material with 200 cc. of water, filtering and titrating while hot 100 cc. of the filtrate. Still closer results were obtained when 100 cc. only of boiling water were employed; but the volume occupied by the solid substance, when so small an amount of water is used, is liable to vitiate the results.

The following complete analysis of one of the strontia residues is given:—SrO 4·13, $SrCO_3$ 25·34, SrO 1·35, $SrSO_4$ 12·02, insoluble siliceous matter 7·43, $Ca(OH)_2$ 10·56, $CaCO_3$ 0·41, Fe_2O_3 and Al_2O_3 1·80, and soluble silica 0·08 per cent.—A. R. L.

Tabular Comparison of Degrees Brix and the Amounts of Sucrose in Saturated Solutions at the Temperature of Saturation. Herzfeld. Zeit. Rübenz. Ind. 1892, **42**, 772.

The author rejects on practical grounds the normal temperature of 15° C. recently proposed, and retains Gerlach's temperature, 17·5° C. The specific gravities which he adopts are those determined by Gerlach, and the solubilities those determined by himself. The tables extend to 65° C. and 75·18 per cent. of sucrose. The following values are taken from them:—

Degrees C.	Percentage of Sugar or Degrees Brix at 17·5° C.	Specific Gravity at 17·5° C.	Degrees Brix at the Temperature of Dissolution.	Specific Gravity at the Temperature of Dissolution.
0°	64·18	1·31490	65·41	1·32392
5°	64·87	1·31910	65·76	1·32454
10°	65·58	1·32353	66·14	1·32687
15°	66·33	1·32804	66·53	1·32907
20°	67·09	1·32272	66·93	1·33174
25°	67·89	1·33768	67·37	1·33445
30°	68·70	1·34273	67·81	1·33718
35°	69·55	1·34805	68·28	1·34011
40°	70·42	1·35353	68·73	1·34292
45°	71·32	1·35923	69·21	1·34591
0°	72·25	1·36515	69·72	1·34912
5°	73·20	1·37124	70·23	1·35227
60°	74·18	1·37755	70·77	1·35574
65°	75·18	1·38404	71·30	1·35910
70°	76·22	1·39083	..	..
75°	77·27	1·39772	..	..
80°	78·36	1·40493	..	..
85°	79·46	1·41225	..	..
90°	80·61	1·41996	..	..
95°	81·77	1·42778	..	..
100°	82·97	1·43594	..	..

—A. R. L.

The Reducing Sugars Present in Beetroot Juice. Claassen. Deutsche Zuckerind. 1892, **17**, 1372.

The estimation of the invert sugar in the expressed beetroot juice gives no indication of the amount present in the roots themselves. For the latter purpose a direct method must be employed; for example: Digestion with warm water, the use of an excess of basic lead acetate being avoided. By either cold or warm digestion much less invert sugar is found than in the expressed juice, and no reducing substances other than sugars are extracted.—A. R. L.

Saccharification of Starch by Means of Blood Serum. F. Röhmann. Ber. 1892, **25**, 3654—3657.

Bial (Archiv. ges. Physiol. **53**, 157) has recently shown that human blood serum and lymph serum, as well as that of certain of the lower animals, contains an enzime which converts starch into dextrin maltose and glucose. The diastatic action of the blood of newly born infants was found to be extremely feeble or to fail altogether.

The author finds that when potato starch (100 grms.) is mixed into a paste with water (5 litres), and, after cooling, bullock's blood serum (1 litre) and 10 per cent. alcoholic solution of thymol (100 cc.), to prevent the action of bacteria, added, on allowing the action to proceed at 32° for 24 hours glucose and acroodextrin are the chief products. After 10 hours' action, or less, glucose and probably maltose, and a mixture of dextrins giving a brown iodine reaction, which the author designates porphyrodextrin, together with soluble starch, are formed. The so-called erythrodextrin is not a mixture of soluble starch and acroodextrin (compare Schifferer, this Journal, 1893, 368), mixtures of these in every proportion give blue iodine reactions. A mixture of porphyrodextrin and soluble starch gives, however, an iodine reaction varying from reddish-blue to bluish-red.—A. R. L.

PATENT.

Improvements in Evaporating Apparatus. F. W. Scott, London. E. G Scott and F. W. Scott, jun., Liverpool. Eng. Pat. 6478, April 4, 1892.

See under I., *page* 347.

XVII.—BREWING, WINES, SPIRITS, Etc.

Notes on Glucase. G. H. Morris. Trans. Inst. Brew. **6**, 5, 132—142.

The author has confirmed Géduld's results (this Journal, 1892, 627) in so far as they relate to the action of this enzyme on starch and its transformation products, showing that his conclusion, that the starch derivatives are the more readily attacked by glucase the further they are removed from starch, is correct. Géduld, however, following Cuisinier (this Journal, 1887, 829), from the result of an experiment, stated that glucase is evidently very widely distributed in cereals and plays as important a part as diastase. C. J. Lintner (this Journal, 1892, 1021) and Jalowetz (Woch. für Brau. 1892, 1264) have also stated that glucase occurs in barley and in other cereals besides maize. The author, however, in a series of experiments made on maltose solution with cold-water extracts of maize, barley, rye, oats, and wheat, both malted and unmalted, found that no production whatever of dextrose took place, save in the case of maize and maize-malt, and shows that Lintner's and Jalowetz' results were due to their having ignored the existence of the ready-formed dextrose and other sugars in the cold-water extracts of the grain they employed. These sugars are the products of assimilation, formed during the growth and development of the grain, and are not the result of the action of an enzyme upon the starch of the ripe seed. The author concludes that glucase is an enzyme peculiar to maize and possibly other unexamined cereals, and that it does not form a normal or frequent constituent of barley or barley-malt.—J. G. W.

On the Influence of some of the Saline Constituents of Malting and Brewing Waters. C. G. Matthews. Trans. Inst. Brew. **6**, 5, 109—131.

The author has collated the various published opinions on the chemical action of the saline constituents of the water used for steeping barley in the process of malting, upon the saline constituents of the barley. The average amount of matter extracted from barley during steeping in hard waters is 0·55 per cent. of which one-half is organic matter; but, with softer waters, the amount of both nitrogenous and mineral matter extracted increases, and the percentage of phosphoric acid in the mineral matter also increases. This is shown to be due to the action of the various waters on potassium phosphate, which is the chief mineral constituent of barley. With hard waters, containing calcium and magnesium sulphates, double decomposition takes place, potassium sulphate and calcium and magnesium phosphates being produced, the greater portion of the two latter of which remains undissolved in the grain. With softer waters, containing alkaline or earthy carbonates, phosphates of those bases are formed, together with potassium carbonate, whilst the potassium phosphate remaining will be dissolved out. The formation of potassium carbonate would, in its turn, effect an increase in the amount of albuminoid matter dissolved. Owing to some rather obscure agency, the bases are withdrawn in larger proportion than is the phosphoric acid, which phenomenon the author considers, may be the cause of the existence of free acid in malt. A fairly hard water, containing only a moderate amount of earthy carbonates, is considered to be the best for malting purposes. Sodium chloride, when present to the extent of more than 10 grains per gallon, has a retarding effect upon the germination of the grain, but the author considers that the evidence as to nitrates having a similar action is not conclusive.

Mineral matter is also removed from the grain in the separation of the "malt-combs," the predominant constituents of which are again potassium and phosphoric acid. Of the original 2·55 per cent. of ash in the barley, 0·26 per cent. is removed by steeping, and 0·24 by the malt-combs, leaving 2·05 in the malt, or 2·5 per cent. on the dry weight of the malt. Of this amount, 1·4 per cent. remains in the grains, chiefly in the form of calcium and magnesium phosphates, leaving 1·1 per cent. in the wort, principally as potassium phosphate (K_2HPO_4).

The author also gives the opinions of various writers on the influence exerted by some of the salts of brewing waters upon the nature and quantity, which enters into solution, of the saline, nitrogenous and carbohydrate constituents of malt, but confines himself to an investigation of the possible interaction of the saline constituents of the brewing liquor with the saline constituents of the malt. He finds, that with waters of the Burton type, the salts they contain effect the fixing of a considerable amount of insoluble phosphates in the grains and also the separation of a by no means inconsiderable quantity of phosphoric acid (as calcium and magnesium phosphates) in the mash-tun, the copper, the cooler, and the fermenting square. An analysis of cooler grounds gave tricalcium phosphate, 56·2 per cent.; trimagnesium phosphate, 13·4; and calcium sulphate, 26·8.

Experiments made as to the relative effect of calcium and magnesium sulphates on the precipitation of coagulated albuminoids and insoluble phosphates, when wort is boiled, showed that the calcium salt lowers the amount of coagulated albuminoids but increases the amount of ash to practically double the quantity, as compared with a wort made with distilled water, whereas magnesium sulphate does not increase the ash at all and but slightly diminishes the amount of coagulum. This difference is due to the solubility of magnesium phosphate in wort being much greater than that of calcium phosphate.

Burton worts contain the greater part of their potassium as potassium sulphate, a form of potassium readily assimilable by yeast, as indicated by the analysis of the ash of the beers, which shows but little unconsumed potassium.

Worts should not contain an excess of phosphates because they have not only a crippling effect on the yeast, but also because the yeast only removes a relatively small portion, even when heavily cropped, and would thus leave a beer, containing a large amount of phosphoric acid, which would offer a fertile soil for the growth of bacteria. The author is of opinion that the general tendency of the Burton process is to eliminate phosphoric acid in such a way as to leave the yeast less of this form of nutriment, but existing in greater variety.—J. G. W.

Salt in Beer. E. R. Moritz. Trans. Inst. Brew. **6**, 27—64.

The question having arisen whether the addition of salt to the water used in brewing beer is an adulteration or not, the author brings forward evidence to show that the amount of salt commonly added by certain brewers does not provoke thirst, and is not harmful, but that this addition of salt produces a more marketable beer. He considers that the limit might be placed at 125 grains of salt per gallon; whereas many public analysts have considered that the limit should be 50 grains to the gallon; the latter is too low, as many beers brewed from malt, hops, and a natural water contain more than this. Some public analysts have been in the habit of calculating the amount of salt present from the amount of chlorine found; this gives a wrong result, as potassium chloride is always present. It is recommended that the alkalis be determined separately, and it will be found in all cases that there is more chlorine present than is required to saturate the sodium. The following analytical methods are recommended:—

Alkalis.—50 cc. of beer are evaporated and ignited at a low red heat. The black ash is crushed, digested with dilute hydrochloric acid, powdered baryta added, the whole filtered, and the residue well washed. Excess of ammonium carbonate is added to the filtrate, and the precipitate filtered out. The filtrate is evaporated, ignited, and weighed. The residue is washed out with water and filtered; the precipitate and filter are ashed and returned to the dish, which is then weighed again; the difference in weight represents the amount of potassium and sodium as chlorides. The potassium is estimated in the solution by precipitation with platinum chloride in the usual manner.

Chlorine.—50 cc. of beer are evaporated with 0·5 grm. sodium carbonate and ignited. The chlorine is determined in the ash in the usual way.—A. L. S.

The Analysis of Black Beer. B. W. Valentin. Trans. Inst. Brew. **6**, 85—93.

The ordinary method of determining the carbohydrates of wort or beer depends on three factors—the total solid matter, the cupric reducing power, and the optical activity. In a black beer the determination of the optical activity is difficult, and the author proposes to substitute for this, the determination of the amount of matter fermented in the presence of diastase and yeast. Under these circumstances at a temperature of about 80° F., the whole of the dextrin and the greater portion of the maltose is fermented away in about a week.—A. L. S.

On Certain Functions of Hops used in the Dry-Hopping of Beers. H. T. Brown and G. H. Morris. Trans. Inst. Brew. **6**, 94—106.

It is well known that dry-hopping induces an earlier and more persistent cask fermentation in beer. This may be due to several causes, viz., the hops contain a fermentable sugar, the presence of wild yeasts adhering to the hops, the presence of diastase in hops.

There is no doubt that these three causes are present; but the amount of sugar is only about $3\frac{1}{2}$ per cent. of the weight of hops present, and this is not sufficient to cause the vigorous fermentation that takes place; the development of the wild yeasts introduced with the hops does not take place until long after the after-fermentation has started; hops contain sufficient diastase to account for the whole of the after-fermentation. Although the diastase cannot be extracted from hops, yet when hops are added to a solution of soluble starch maltose is produced equal to 60 to 80 per cent. of the weight of the hops, and if amyloïn solution be substituted for soluble starch a weight of maltose equal to about 90 per cent. of the weight of the hops is produced.

The diastase is found in the greatest quantity in the seeds, but is also present in the cones freed from seeds and in the foliage leaves. The reason that the diastase cannot be extracted from hops by water, is the presence of tannin, which makes the diastase insoluble.—A. L. S.

The Non-Crystallisable Products of the Action of Diastase on Starch. A. Schifferer. Neue Zeit. Rüb. Zuck. Ind. 1892, **29**, 167—170; from Inaug. Diss. Kiel. 1892.

The author states that he has made endeavours to prepare Brown and Morris's and Herzfeld's so-called maltodextrins, following the directions given by these chemists, but without success (this Journal, 1889, 716 and 717; 1890, 533; 1892, 764). Under these conditions isomaltose is invariably formed, but practically no maltose. Full experimental details are given in the paper, and in no case was a compound isolated, resembling in any way the so-called amyloïns. Brown and Morris's maltodextrin was probably a mixture of dextrin (67 per cent.) and isomaltose (33 per cent.); whilst Herzfeld's maltodextrin consisted perhaps of dextrin (26 per cent.) and isomaltose (74 per cent.). The last-named chemist must indeed have actually isolated isomaltose unwittingly in his attempts to obtain crystalline maltose by fractionating his so-called maltodextrin with alcohol.

The author's conclusions may be summed up as follows:—The sole products of the action of diastase on starch are dextrin or dextrins, isomaltose, and maltose. The so-called amyloïns, having properties intermediate between maltose and dextrin, appear to be non-existent.

The dextrins reduce Fehling's solution (compare Scheibler and Mittelmeier, this Journal, 1890, 1140), and are non-fermentable. Their number is limited, there being perhaps not more than two; indeed, a certain amount of evidence is adduced showing that only one dextrin—that giving no iodine reaction (acroodextrin)—exists, the other dextrins being mixtures of this one with soluble starch (compare Röhmann, this Journal, 1893, 366). Experiments failed however to finally settle this point.

The limit of reaction in the mashing process is not as Brown and Morris and others believe, when a reducing power corresponding to 80—81 per cent. of maltose is attained, but at one corresponding to a percentage of 60—68 per cent. of maltose. The specific rotatory power then approximates $[\alpha]_D$ 151—154. Isomaltose is a never-failing product of the transformation of starch, and is formed as long as any dextrin is present. The whole research may therefore be taken as in the main confirmatory of Lintner and Düll's results (this Journal, 1892, 766 and 1021).
—A. R. L.

The Influence of Hop Resins on the Fermentation of Beer. M. Hayduck, Wochensch. f. Brauerei, 1892, **9**, 617.

The author's results point to the view that the soft resins extracted from hops by boiling them with wort, and which are partially reprecipitated on cooling the liquor to the fermentation temperature, are exclusively the cause of the *"*Kräusenbildung* stage" in the fermentation of the beer.
—A. R. L.

Influence of Diastase on Beer. W. Windisch, Wochenschr f. Brauerei, 1892, **9**, 621.

To remove turbidity from beer arising from incomplete transformation of the starch in the original wort, malt extract is generally added to the cask or vat. The opinion has, however, often been expressed that such an addition of diastase saccharifies the dextrins, which subsequently ferment, giving rise to a beer rich in alcohol, but poor in extractive. The author finds that diastase readily and rapidly saccharifies the suspended starch and abnormal dextrins, but how far the normal dextrins are affected cannot be exactly stated; it depends, however, on the quantity of diastase added, the duration of its action, and the temperature.—A. R. L.

The Estimation of the Fermentable Matter in Beer Worts. A. Bau. Chem. Zeit. 1892, **16**, 1473—1474 and 1520.

The author's experiments conducted with 16 varieties of pure yeast cultures show that yeasts of the type of Saazer yeast cannot be employed for the estimation of the total fermentable matter in beer worts. All ordinary yeast cultures give, however, about the same result, and worts which have been fermented with both high and low fermentation yeasts may be analysed equally well with either of the two kinds of yeast.—A. R. L.

The Chemical Conditions which Influence the Action of Diastase. J. Effront. Comptes rend. **115**, 1892, 1324—1326.

The author has investigated the influence of various substances on diastase, and finds that there are three classes of bodies which distinctly favour its saccharifying action on starch. These are, the salts of aluminium and of phosphoric acid, asparagin, and certain albuminoids. The results of a number of experiments are given below. In each case, 1 cc. of malt infusion (1:40) and 200 cc. of starch solution (starch paste treated at 75° C with a small quantity of malt, cooled and diluted to a density of 1·015) were employed.

Variations in the temperature of saccharification do not affect the result. It was found, however, that the favourable influence of chemical agents is only apparent

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* The German brewer divides his fermentation into four stages, from the various appearances of his yeasts, for example:—I. Ankommen. II. Das Wegschieben. III. Kräusenbildung. IV. Durchbruch. There are no English words equivalent to these technical terms.

Reagent used.	Maltose formed per 100 Parts of Starch.
Starch alone	8·63
Starch solution + 0·7 of ammonium phosphate	51·63
+ 0·5 of calcium phosphate	46·12
+ 0·25 of ammonia alum	56·30
+ 0·25 of potash alum	54·32
+ 0·25 of aluminium acetate	62·40
+ 0·02 of asparagin	37·0
+ 0·05 of asparagin	61·2

during the earlier stages of the transformation; *i.e.*, if sufficient diastase be added to produce 60 per cent. of maltose, the influence of the added salts becomes nil. The author remarks on the fact that bodies which favour the development of organised ferments also favour the action of soluble ferments. Although the nature of the two classes of ferments is totally different, the author is of opinion that the mechanism of the action is the same in each case. The mineral salts, and possibly also certain nitrogenous bodies act as intermediate or catalytic agents, forming, with the carbohydrates and albuminoids present, compounds, which are subsequently decomposed by the soluble or organised ferment.—H. T. P.

Separation and Estimation of Acids in Beer, Wort, Malt, and the like. E. Prior. Bayer, Brauer Journal, 1892.

See under XXIII., *page* 380.

The Detection of the Denatured Spirit in Wine. K. Portelle. Zeits. Nahrungsmittel Unters. und Hygiene, 1892, **6**, 357.

See under XXIII., *page* 379.

PATENTS.

Improvements in the Manufacture of Beer. W. L. Wise, London. From A. Antheaume, Lille, France. Eng. Pat. 3798, February 26, 1892.

The invention has for its object the use of raw grain in conjunction with malt in the manufacture of beer. The raw grain is washed, steeped under a pressure of one and a half atmospheres, and again washed. The grain is thence conducted to a steam cooker where it is heated with its own weight of water at 128°—135° C. for from 40 minutes to one hour.

The malt used for converting the starch of the raw grain is prepared as follows:—

A green malt is taken, crushed between rollers, and mixed with water at 15°—16° C. in the proportion of 4 to 6 litres water per kilo. of malt. The mixture is passed on to a close-meshed sieve, the clear portion led into a gauged receiver, and the solid portion collected separately. The cooked raw grain is led into a mash tun and its temperature reduced to 80° C.; the solid portion of the malt is added and mixed with it; when the temperature has sunk to 70°—72° C., about one half of the clear malt extract is added. After standing the wort is drawn off into the saccharification boiler. The grains are mashed with hot water to produce a temperature of 70°—72° and one-tenth of the remaining malt extract added. After standing, the clear wort is drawn off and added to that first obtained. The grains are used for cattle feeding. The remainder of the malt extract is added to the wort in the saccharification boiler. A temperature of 54°—55° C. is maintained until the starch is all dissolved, when the temperature is raised to 62°—64° and maintained at that for 15 to 20 minutes; the temperature is then raised to boiling and air pumped through the boiling wort.

The above temperatures may be varied to suit different qualities of beer. The remainder of the brewing is carried out in the usual way.—A. L. S.

Improvements in or relating to the Purifying of Spirituous Liquor and other Liquids, applicable also to the Separation of Cream from Milk. A. J. Boult, London. From F. L. Hume, Hamilton, Ohio, U.S.A. Eng. Pat. 13,980, August 2, 1892.

The liquor to be purified is placed in a vessel surrounded by a freezing mixture. A current of electricity is passed through the liquor and the impurities which rise to the surface skimmed off.—A. L. S.

Improvements in Drying Apparatus for Brewers' Grain and the like. H. W. Rappleye, Philadelphia, Pennsylvania, U.S.A. Eng. Pat. 19,149, October 25, 1892.

The apparatus consists of a rotating cylinder containing perforated tubes arranged parallel to its axis. The material to be dried is placed in the cylinder and hot air passed into it through the perforated tubes. The tubes are so arranged with valves that as the cylinder rotates the hot air passes only through those tubes which are lowest and which are consequently immersed in the material to be dried.
—A. L. S.

Improvements in Process and Apparatus for Drying Brewers' Grains and like Material. H. H. Leigh, London. From B. C. Batcheller, Philadelphia, Pennsylvania; S. D. Schuyler, New York; and W. M. Cramp, Philadelphia, Pennsylvania, U.S.A. Eng. Pat. 21,284, November 22, 1892.

The apparatus consists of a rotating cylinder into one end of which the wet material is fed, and a stream of hot air introduced, so that where the two meet there is a free open space for the air current to carry the material onwards without danger of meeting a heated surface in its course. The air current is heated to a temperature of about 700° F., so that the grains are immediately dried on the outside and so prevented from sticking together. The cylinder is provided internally with a number of longitudinally extending and radially projecting curved blades or buckets; these catch the externally dried material which has fallen to the bottom of the cylinder and carry it upward, allowing it to drop in streams constantly across the centre of the cylinder and through what is naturally the hottest portion thereof. The material as it becomes dried and consequently lighter is carried forward by the air current and finally is discharged from the apparatus.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

The Filtration of Water by means of Stone Filters. E. von Esmarch, Centralbl. f. Bacteriol. 1892, **11**, 525.

The author's experiments show that the filtration through porous sandstone, lava-tuff, or the like is not sufficient to remove microbes; in fact at the commencement of the filtration there is frequently observed an increase in the number of bacteria. Water supplied in Berlin, which is poor in the amount of germs it contains, was mixed with a cultivation in broth of a bacillus which produced a red colouring matter. On preparing a culture from the filtrate on gelatin, it was found that the putrefactive bacteria resulting from the presence of the broth had completely overwhelmed the bacillus. The author admits, however, that no great increase of germs ought to occur when the unfiltered water, *à priori, is poor* in organic matters.
—A. R. L.

Estimation of Theobromine in Cocoa Beans. R. Süss, Zeits. Anal. Chem. 1893, **32**, 57.

See under XXIII., *page* 382.

PATENTS.

A New or Improved Manufacture of Meat Extract. J. F. Boesen, Copenhagen, Denmark. Eng. Pat. 2421, February 8, 1892.

The object of the inventor is to produce an extract of meat containing the albuminous bodies of the meat and also possessing a delicate real meat taste. Although the use of chemical preservatives is avoided the product retains its qualities for a great length of time.

The pieces of flesh, weighing about 10 or 20 lb. each, after being well washed, are put into a boiler containing a little water. After putting on the lid the contents are heated to a temperature of 140°—190° F. by the outward application of steam. The higher temperature is necessary when dealing with the flesh of old animals.

The juice is now run into bottles, which are corked, put into the boiler or similar receptacle, and kept for a couple of hours at 140°—190° F. They are then allowed to cool down to about 77° F., and so kept during the night. Any microbe germs will develop at this temperature, but by once more raising the heat they will be completely destroyed.

If it is desired that the extract shall contain less or no albumen, a higher temperature should be used during the extraction.—L. de K.

An Improved Process of and Apparatus for Producing Aërated Beverages. J. Pullman, London, and H. Lane, Birmingham. Eng. Pat. 4637, March 9, 1892.

The invention aims at rapidly preparing single bottles of aërated water.

A cylinder containing compressed carbonic acid is connected by means of a flexible tube and a three-way cock with a hollow stud upon a swinging frame. The usual bottle filled with sufficient water is introduced into its place in the latter, and is firmly closed and held in its place by forcing down the hollow stopper by means of a screw.

Gas is then admitted by opening the valve in the cylinder and is maintained at the desired pressure by means of a gauge and regulator. The swinging frame and bottle are then swung and revolved backward and forward, and after the desired aëration is obtained the swinging frame is turned until the mouth of the bottle is downward, and by means of the three-way cock the supply of gas is shut off and the hollow stopper is connected with the air. The pressure of the carbonic acid in the bottle instantly forces the ball into its seat. The stopper is then unscrewed and the beverage is ready for use.

By using a corresponding number of swinging frames and appliances, two or three bottles may be aërated simultaneously.—L. de K.

Process of Making Food Compounds. H. J. Allison, London. From J. Miner, Detroit, U.S.A. Eng. Pat. 4948, March 14, 1892.

The object of the inventor is to produce a food product from vegetables, of greatly reduced weight and bulk, that will remain sweet and wholesome for a long time in any climate or temperature.

The vegetable, potato for instance, is first peeled, then sliced or grated, after which it is immersed in a preserving solution composed of water (98·7 per cent.), salt (1 per cent.), and boracic acid (0·3 per cent.). When thoroughly saturated with this liquid it is removed and drained. It is then subjected to the fumes of burning sulphur, which render it clear and white. The moisture is finally removed by means of an evaporator or drier. Potato chips, prepared by this process, will, when placed in water, reabsorb their normal amount of moisture, return to the condition of the raw potato, and possess the full taste and properties thereof.

—L. de K.

Improvements in Cases used for Holding, Treating, and Preserving Foods and other Materials. A. Baker, Indiana, U.S.A., and F. D. Bittinger, Ohio, U.S.A. Eng. Pat. 17,625, October 4, 1892.

The invention relates to improvements in hermetically sealing cases containing food, &c. The inner cases are provided with three covers, secured by packing material and sealing-wax. Between the covers are chambers, which may be filled with water, oil, or antiseptic fluids.

There are several cases, some of which may be porous, to allow the substances in them to act, by osmose or otherwise, on the contents of the other cases. Around the whole is a jacket through which fluids may pass.—L. de K.

Improvements in or relating to the Preservation of Farinaceous and other Food Products. A. J. Boult, London. From L. Fromm, Kötzschenbroda, Germany. Eng. Pat. 22,922, December 13, 1892.

The invention consists in the preservation of flour and farinaceous products by the addition of hazel-nut flour to the extent of 5—25 per cent.

In preparing the hazel-nut flour, the kernels are first removed from the shells, and then, after being roasted, ground or reduced to powder, the white substance of the kernel only being taken. It is important that the hazel-nut fat shall pervade the whole of the farinaceous mixture.

—L. de K.

An Improved Self-Raising Flour Composition for the Manufacture of Buns, Scones, and other Articles of Confectionery. S. Wager, Winsford. Eng. Pat. 752, January 12, 1893.

The inventor prepares a mixture of 280 parts of flour, 5 parts of rice-flour, 10 parts of golden flour (prepared from maize, the outside portion of the corn alone being used), 1 part of corn-flour, 10½ parts of cream of tartar, 5 parts of carbonate of soda, and 50 parts of powdered sugar.

This composition is, however, too rich for pastry-making, and requires mixing with some more ordinary flour.

—L. de K.

Manufacture of a Compound Suitable for Alimentary and Medicinal Purposes. C. D. Abel, London. From C. F. Boehringer and Sohne, Waldhoff, Germany. Eng. Pat. 818, January 13, 1893.

The inventor has succeeded in preparing an albuminous iron compound readily absorbable in the organic system, and as such a valuable addition to milk or other food in the nourishment of children and persons poor in blood. The preparation may be advantageously used as a 10 per cent. solution by dissolving it in water with the aid of a very small quantity of ammonia or in the solid form. The solid compound is prepared as follows:—100 parts of egg albumen are shaken with 2,000 parts of distilled water, and to this solution are added in succession 25 parts of neutral tartrate of iron dissolved in 250 parts of water, 100 parts of a 10 per cent. solution of sodium tartrate, and 38 parts of a 10 per cent. soda lye. The solution is heated to 90° C. until a perfectly clear brown-red solution is obtained. To remove the great excess of alkali, the solution, after cooling, is acidified with a 25 per cent. solution of tartaric acid, and then again rendered distinctly alkaline with ammonia. The solution is kept for 48 hours at 90° C., and after cooling it is again acidified with tartaric acid, which will precipitate the iron albumen derivative. After washing until the filtrate shows no iron reaction, the precipitate is purified by dissolving it in 1,400 parts of water and 20 parts of 25 per cent. ammonia, and after heating for 48 hours at 90° C. it is re-precipitated by cautious addition of tartaric acid.

The compound contains from 7 to 10 per cent. of iron but not in the form of a salt. Ammonium sulphide does not readily precipitate its ammoniacal solution.—L. de K.

(*B.*)—SANITARY CHEMISTRY.

Poisoning by Sulphuretted Hydrogen. Uschinsky. Zeits. f. physiol. Chem. 1892, **17**, 220; and Chem. Zeit. Rep. 1892, **30**, 338—339.

The author does not consider that the toxic effects of sulphuretted hydrogen are due to its causing asphyxiation, nor does he trace them to any action on the blood. Such alteration of the blood as sulphuretted hydrogen is capable of producing, occurs only after death. Further, blood which has been treated with sulphuretted hydrogen possesses no poisonous properties; and, moreover, blood containing so much sulpho-met-hæmoglobin as to be easily recognisable when in circulation, can be injected without causing injury to the animal operated upon. He has also failed to observe the alleged narcotic effect of sulphuretted hydrogen in either small or large doses. He is unable to confirm Schulz's observation of the elimination of sulphuretted hydrogen from sulfenol by moribund tissue.—B. B.

PATENTS.

Improvements in the Method of Purifying Sewage by Means of Lime in conjunction with a Salt of Iron. H. Lockwood, Manchester. Eng. Pat. 2560, February 10, 1892.

It is found that if sewage containing dye-stuffs, organic colouring matters or other organic impurities, be treated with a soluble iron salt and then with hot milk of lime, precipitation ensues almost instantaneously, and the value of the process is thus much enhanced. The novelty claimed is addition of an iron salt followed by that of hot milk of lime for the purpose of precipitation.

Improvements in or Relating to the Sterilising or Rendering Antiseptic of Materials used for Surgical Purposes. A. Dührssen, Berlin. Eng. Pat. 5117, March 15. 1892.

Surgical dressings, which are now invariably sterilised before use, are generally packed up in cases containing a considerable amount of each article, so that before the whole quantity is exhausted the packet is opened a great number of times, with the result that the latter portions lose their antiseptic value.

The improvement effected by the patentee consists in packing enough of the various materials required for performing one surgical operation only, in a tin air-tight case, so that the lint, bandages, &c., are perfectly fresh, the box being only opened at the last minute. The materials are sterilised *in situ*, and they are packed up in such proportions as experience has shown to be the most useful for the different varieties of wounds to be dressed.—F. H. L.

New or Improved Apparatus for Disinfecting Clothes, Rags, and other Fabrics or Fibres. J. Illingworth, Batley, Yorkshire. Eng. Pat. 5448, March 19, 1892.

A metal oven, set in a brick casing well packed with some non-conducting composition, is fitted with a long coil for the circulation of steam at a temperature of 250° F., together with another pipe for the introduction of live steam or water. Into this apparatus the articles to be treated are run on a trolley. The oven is provided with jacketted doors at each end, the infected articles being introduced by the first door and withdrawn by the second, so that no subsequent contamination can take place. The doors are made to fit steam-tight.—F. H. L.

Improvements in the Treatment of Sewage. J. Price, London. Eng. Pat. 6211, March 31, 1892.

The precipitant consists of two parts of potassium permanganate, one part of sulphuric acid, and 13 parts of gypsum or kaolin, or both, in varying proportions, mixed up with 64 parts of water. The inventor claims that this process disinfects and deodorises both the effluent and the sludge without destroying the manurial value of the latter. Filtration may with great advantage be conducted in the apparatus described in Eng. Pats. 8191, 1888 (this Journal, 1889, 563), and 6861, 1889 (this Journal, 1890, 593).—F. H. L.

Improvements in Apparatus for the Treatment of Noxious Gases. F. W. Lacey, Bournemouth Eng. Pat. 6396, April 2, 1892.

The waste gases emanating from town refuse destructors are at times very offensive in character. To render them odourless the inventor causes them to pass through a long furnace fitted with baffle-plates and heated with liquid fuel. —F. H. L.

XX.—FINE CHEMICALS, ALKALOIDS. ESSENCES AND EXTRACTS.

Tropacocaïne and its Value as a Local Anæsthetic. A. P. Chadbourne. Therap. Monatsh. 1892, **16**, 471.

Tropacocaïne (Liebermann's benzoyl-ψ-tropeine) is the base isolated by Giesel (this Journal, 1892, 177). The free base is sparingly soluble in water, but it forms well crystallised salts, of which the *hydrochloride* is readily soluble in water. The author finds that it resembles cocaïne in its physiological action, but it is only half as poisonous as the latter The hydrochloride in 3 per cent. solution exerts a quicker and more complete anæsthesia on the eye than does a cocaïne solution of equal concentration. The anæsthesia is, however, of shorter duration than that of cocaïne, but can be prolonged by repeated application. Injurious or toxic effects were not observed, and according to the author's observations tropacocaïne serves equally well, and in some cases better than cocaïne.—A. R. L.

Para-ethoxy Derivatives of Hydracetine and of Antipyrine. Altschul. Pharm. Zeit. 1892, **37**, 448.

The advantageous effect on the action of antipyretics which is produced by the introduction within the molecule of an ethoxy-group in the position para to the characterising group, was first observed in the case of acetanilide and *p*-ethoxyacetanilide (*phenacetine*).

p-Ethoxyhydracetine, $\overset{(1)}{OC_2H_5}.C_6H_4.\overset{(4)}{N_2H_2}COCH_3$, forms colourless prisms or leaflets, melts at 141·5° C., and is soluble in 20 parts of boiling water; it dissolves in concentrated sulphuric acid, forming a dark red solution, which changes to yellowish-green on addition of a drop of nitric acid, whereas hydracetine (acetylphenylhydrazine) forms a colourless solution in concentrated sulphuric acid, which becomes blood-red on addition of a drop of nitric acid.

p-Ethoxyantipyrine, $\overset{(1)}{OC_2H_5}.C_6H_4.\overset{(4)}{N_2C_4H_7O}$, crystallises from ethyl acetate in colourless prisms, melts at 91°, and is readily soluble in water and chloroform, less so in alcohol. The *salicylate* melts at 131°.—A. R. L.

Preparation of Pure Iodine. C. Meineke. Chem. Zeit. 1892, **16**, 1219—1220 and 1230—1233.

Two methods were employed by Stas for the preparation of pure iodine. One consisted in the precipitation of iodine, dissolved in a solution of potassium iodide, by the addition of an excess of water, and the other in oxidising a solution of potassium iodide by iodic acid; the iodine is dried over sulphuric acid or calcium nitrate and the product sublimed from barium oxide. Both methods give equally satisfactory results, but the second is to be preferred, as practically the whole of the iodine is obtained as such.

The author finds that fractional precipitation, as employed by Stas, is unnecessary in the second method, and that the separation from chlorine, bromine, and cyanogen is complete. Arsenic, antimony, and tin are either not precipitated or are rendered non-volatile by the presence of the barium oxide in the subliming process. For the oxidation of solutions of potassium iodide, according to the author, potassium permanganate gives the best results. By subliming impure iodine mixed with potassium iodide, cyanogen is not removed, but a complete separation is effected by the addition of barium or calcium oxides. Bromine and chlorine are completely separated by the above process, but when their relative amounts are large several fractionations are necessary. When impure iodine is boiled for five minutes with calcium chloride solution of sp. gr. 1·35 and boiling-point 114°, with the further addition of potassium iodide and hydrochloric acid, cyanogen is removed completely, but the separation of bromine and chlorine is less complete. The amounts of these latter are, however, so far minimised that their complete separation is effected after one sublimation with barium oxide and potassium iodide. The product thus obtained is then sublimed *per se* to free it from non-volatile matter.—A. R. L.

The Preparation of Benzoic Acid. A. Starting. Arch. Pharm. 1892, **231**, 342; and Chem. Zeit. Rep. 1892, **23**, 266.

In order to obtain a good yield of benzoic acid from gum benzoin it is necessary to use a small vessel from which to conduct the sublimation and a proportionately very large one to receive the sublimed product. Gum benzoin which complies with the requirements of the German Pharmacopœia, yields on an average 25 per cent. of benzoic acid. —B. B.

Amyl Nitrite. C. O. Curtmann. Pharm. Runds. 1892, **10**, 179, and Chem. Zeit. Rep. 1892, **23**, 266.

No quantitative method of testing amyl nitrite is given by the German Pharmacopœia. The usual requirements, that it shall have a boiling-point of 97° to 99° C. and a specific gravity of 0·870 to 0·880, permit the presence of a not inconsiderable amount of unaltered isoamyl alcohol to pass undetected. The examination by the author of a number of commercial samples showed that the content of amyl nitrite ranged from 33 per cent. to 93 per cent. Seeing that amyl nitrite is a potent drug, it is essential that its strength should be definitely ascertained and fixed.—B. B.

The Production of Perfume in Flowers. E. Mesnard, Comptes rend. **115** (1892), 892—895.

The micro-chemical methods of examination hitherto employed have not established with sufficient clearness the nature of the processes by which the perfume in flowers is produced; the following method, devised by the author for investigations of this kind, has enabled him to localise the fatty oils in flowers.

Sections are placed in a drop of pure glycerol strongly saccharised, on a round cover-glass, which, when inverted, serves as the cover of a small chamber, formed by a glass ring gummed on to a microscope slide. This chamber contains a glass ring of smaller diameter, and not quite so high, the outer annular space thus formed constituting a receptacle for the reagent. The inner circle of glass may also serve as a support to a smaller cover-glass on which are placed those sections which have to be exposed for a long time to the action of the reagent, as is the case with those containing fatty oils.

The reagent employed is pure hydrochloric acid, the vapours of which are readily absorbed by the glycerol, so that the sections are submitted to a slow but easily limited process of hydration.

At the end of a very short time the essential oils in the sections thus exposed to the action of the acid appear in the form of small, yellow, transparent globules; if the exposure be prolonged the globules disappear again, having been transformed into diffusible substances; as such a disappearance of the globules does not occur in the case of fatty oils the two classes can be readily distinguished.

From an examination of various flowers at different stages of development the author arrives at the following general conclusions:—

1. The essential oil generally occurs in the epidermic cells of the superior faces of the petals or sepals. It may, however, occur on both faces, especially if the floral parts are completely hidden in the bud; the cells of the inferior faces generally enclose tannin, or pigments derived from it.

2. The essential oil seems in every case to have its origin in the chlorophyll. This transformation is quite comprehensible if it be admitted, as is generally done, that the floral parts are only leaves which have been modified to fulfil new functions; the chlorophyll, thus excluded from its proper *rôle*, is transformed into tannins and essential oils.

The perfume of a flower is not noticeable until the essential oil has sufficiently freed itself from the intermediate products from which it is formed, and its occurrence is in some way inversely proportional to the production of tannin and of pigments in the flower. This would explain why flowers with green petals have no scent, why white or red flowers are most frequently odoriferous, why the *compositæ*, which are rich in tannin, have a disagreeable odour, and why the white artificial lilac and forced roses acquire a finer perfume.—F. S. K.

Action of Sulphuric Acid on Citrene, a Terpene occurring in Lemon Peel. G. Bouchardat and J. Lafont. Comptes rend. **115** (1892), 1083--1085.

The products of the action of sulphuric acid upon citrene are very different from those of the action of that acid upon terebenthene.

When citrene, $C_{10}H_{16}$, boiling at 175°—178° and having a specific rotatory power $[\alpha]_D = +72° \ 40'$, is treated with concentrated sulphuric acid at the ordinary temperature a slight development of heat occurs, a very little sulphur dioxide is evolved, and the whole of the hydrocarbon passes into solution, being converted into various compounds, all of which are optically inactive.

Part of the oily product is volatile with steam, and consists of a mixture of cymene, $C_{10}H_{14}$, a hydrocarbon, C_9H_{12}--probably pseudocumene,--and a saturated hydrocarbon, $C_{10}H_{20}$ or $C_{10}H_{22}$, which is not acted on by concentrated sulphuric acid at the ordinary temperature; the two former probably exist in the original cymene.

The portion of the oily product which is not volatile with steam consists of diterpilene, $C_{20}H_{32}$, or colophene, and a solid polymeride of high molecular weight.—F. S. K.

The Physiological and Therapeutic Effects of Chloralose, a Substance derived from Chloral. Hanriot and C. Richet Comptes rend. **116**, 1893, 63—65.

The authors have obtained excellent results by the use of "chloralose" as a hypnotic agent. Chloralose has already been described by Hefter (Ber. 1889, 1050), but the latter did not, apparently, obtain it in a state of purity. It may be prepared by heating to 100° C. for one hour a mixture of equal parts of anhydrous chloral and dry glucose. The mass is subsequently cooled, moistened with water, and extracted with boiling ether. The soluble portion is distilled 5—6 times with water in order to drive off all free chloral. The residue by fractional crystallisation from water yields two bodies, "chloralose" (yield 3 per cent.) and "parachloralose." Chloralose ($C_8H_{11}Cl_3O_6$) crystallises in fine needles, melting at 184°—186° C., and volatilises without decomposition. It is slightly soluble in cold and fairly soluble in hot water. Potash does not liberate glucose from it, and with sulphuric acid and acetic anhydride it yields di- and tetra-derivatives respectively. Parachloralose forms nacreous plates melting at 229° C., with difficulty soluble, even in hot water.

Physiologically, chloralose possesses two, apparently contradictory, properties. It is hypnotic, and at the same time augments the excitability of the spinal chord. A dose of 2--3 grms. administered internally to a dog (weighing 10 kilos.) caused the animal after 10—15 minutes to stagger about and presently fall into a profound slumber lasting several hours; but differing from the effects produced by chloral, in so far that reflex action was not abolished, but, if anything, exaggerated. A dose of 0·6 grm. per kilo. did not prove fatal, but only produced anæsthesia. The minimum dose required to produce a visible hypnotic effect was 0·02 grm. per kilo.

Landouzy and R. Moutard-Martin have employed chloralose during five months in the treatment of various maladies attended by persistent insomnia, and come to the following conclusions:—

1. Chloralose may be administered without danger in doses not exceeding 0·8 grm., and does not produce any digestive troubles, head-ache, or toxic symptoms.

2. One grm. forms a strong dose; it is better to keep within the limits, 0·2—0·75 grm. A dose of 0·5 grm. provokes a deep, calm sleep, even in those cases where recourse has been had, in vain, to other hypnotic agents.

—H. T. P.

Presence of Ethyl Alcohol in German and Turkish Rose Oils. T. Poleck. Ber. **26**, 1893, 38—39.

Eckart (this Journal, 1892, 265) having found ethyl alcohol in the distillate obtained from oil of roses coming over below 100°, the author considered it desirable to investigate the nature of its origin. The production of oil of roses from German roses was commenced by the firm of Schimmel and Co., of Leipsic, about six years ago. More than 50 hectares of land are now cultivated at Gross-Miltitz, near Leipsic, with a variety of *Rosa centifolia*. Recently the distillation has been conducted on temporary premises erected in the midst of the rose fields, whilst a new factory is being built, which is designed to work up about one million kilos. of roses, all necessary provisions being made to ensure the material being put into process as rapidly as possible. It has been found by experiment that by reducing the distance of the carriage of the fresh flowers as much as possible, a richer oil containing a smaller proportion of the odourless stearoptene is obtained, and the formation of ethyl alcohol, due to the fermentation of the flowers in transit, is prevented.—D. B.

Methyl and Ethyl Alcohols. C. A. Lobry de Brun. Ber. **26**, 1893, 268—274.

This paper contains the results of a series of comparative experiments made upon methyl and ethyl alcohols, with reference to their solvent and other actions upon various bodies. Great differences are shown to exist, in many cases, between their respective actions, which differences are of great importance for experimental laboratory work and would lead in several instances to the use of methyl in preference to that of ethyl alcohol.

Gaseous ammonia is more soluble (to the extent of 9 per cent.) in methyl than in ethyl alcohol, as are potassium iodide and the cyanides of potassium and mercury. The greater solubility of hydrochlorides in methyl alcohol offers a superior substitute for ethyl alcohol in the preparation of a non-aqueous solution of hydroxylamine from the hydrochloride. Sodium, or sodium methylate, is much more soluble in methyl alcohol than is the ethylate in ethyl alcohol, and the methyl alcohol solution has the advantage that it does not darken on exposure to the air. Such a solution could advantageously take the place of metallic sodium in synthetical chemistry and would be of service in precipitations and titrations.

Sodium ethyl-alcoholate is more easily oxidised and has a stronger reducing action than the methyl-alcoholate, as shown by their action on the aromatic nitrogen compounds, *m*-dinitrobenzol, for example, being rapidly reduced by sodium ethyl-alcoholate to dinitro-azoxybenzol, whereas the methyl-alcoholate has a much slower action. Methyl alcoholic potash has not so great a reducing action as the ethyl alcoholic solution, but both alcoholic potash solutions have a greater action than the soda ones, from which it is evident that methyl alcoholic soda is the best to use when substitution is the aim, but ethyl alcoholic potash when reduction is in view.

Ethyl alcohol is more rapidly oxidised both by platinum sponge and oxygen and by potassium permanganate than is methyl alcohol: the action of chlorine on the latter is also much less intense than it is on the former. A saturated solution of chlorine in methyl alcohol, placed in a sealed tube at the ordinary temperature, gradually darkened in colour, however, and yielded methyl chloride and methylic aldehyde, carbonic anhydride, hydrogen chloride, and water. Bromine is almost without action on methyl alcohol at ordinary temperatures, even when present in large quantity. With ethyl alcohol, on the other hand, a great rise in temperature takes place, accompanied by an aldehydic smell. At higher temperatures a slight action takes place, with methyl alcohol, and on heating in a sealed tube to 75° for 12 hours, methylic (formic) aldehyde and carbonic anhydride were formed in small amount. After the lapse of some years, the liquid still contained free bromine and methyl alcohol, in addition to aqueous hydrogen bromide. The first reaction is proved to take place according to the equation—

$$CH_3OH + Br_2 = CH_2O + 2HBr.$$

Iodine dissolves in both alcohols in fairly equal amounts, and acts but slowly on ethyl and not appreciably on methyl alcohol, even after several weeks.

The hygroscopic capacity of methyl alcohol is somewhat greater than that of ethyl alcohol.

As a solvent, methyl alcohol sometimes approaches its lower homologue, water, and sometimes its higher one, ethyl alcohol, but it does not always take a mean position, several organic bodies (also hydrogen chloride, sulphurous anhydride, mercuric chloride, and iodide) which are not at all or only slightly soluble in water, dissolving more readily in methyl than in ethyl alcohol.—J. G. W.

Separation of Salicylic from Benzoic Acid. Miss J. Schaap. Ned. Tydschr. v. Pharm. July 1892

See under XXIII., *page* 382.

A New Reaction for Cocaine. A. Kuborne. Pharm Centralhalle, **33**, 411.

See under XXIII., *page* 380.

Estimation of Quinine in Sulphate of Quinine in presence of other Cinchona Alkaloids. L. Barthe. Comptes rend. **115**, 1892, 1085.

See under XXIII., *page* 380.

Estimation of Impurities in Commercial Methyl Alcohols E. Barillot. Comptes rend. **115**, 1892, 1315.

See under XXIII., *page* 381.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

The Hardening of Gelatino-chloride Films. F. Stolze. Phot. Nachr. 1892, **4**, 396.

Aluminium chloride is by far more suitable for hardening the film on gelatino-chloride plates, than the hitherto employed tanning agents. The salt is best added to the combined fixing bath, for which the following recipe is given:—

Water 1,000 parts, fixing soda 175, sulphocyanide of ammonium 10, lead nitrate 2, aluminium chloride 10, chloride of gold solution (1:100) 50 to 100 parts. The bath becomes turbid, and within 24 hours deposits a slight precipitate, which is filtered off. It gives, without addition of silver, beautiful and uniform tones, is easily preserved, and loses nothing thereby, either in toning or hardening power. The latter is such that the plates when strongly rubbed in this bath between the fingers produce a loud scraping sound, without being in the least injured.—J. C. C.

Solvent for Gelatin. R. E. Liesegang. Phot. Arch. 1892, **33**, 212.

Gelatin is dissolved by lead nitrate solutions at ordinary temperatures. At 25° C. as much as 24 per cent. of gelatin are dissolved by a concentrated lead nitrate solution. A still more powerful solvent than the lead salt, in the fixing bath, is the much-used ammonium sulphocyanide.

It is very easy to prepare a solution of 5 grms. of gelatin in 10 cc. of water containing dissolved 5 grms. of ammonium sulphocyanide.

One hundred parts of water with 1 grm. of ammonium sulphocyanide dissolved at 23° C., 2·5 grms. of gelatin. There ought not to be too much of this salt therefore in fixing baths for gelatino-chloride plates.—J. C. C.

Photographic Development by Electrolysis. The Electrician, 1893, 627.

The reduction of sulphurous acid or an acid sulphite by means of zinc, gives rise, as is well known, to the formation the salts of an acid in a lower state of oxidation than sulphurous acid, and therefore termed hyposulphurous acid. It must not be confused for a moment with the body popularly and commercially known by this name, or rather by the name of its salts, the so-called hyposulphites, familiar to the photographer by the abbreviation "hypo." True hyposulphites ($Na_4S_2O_4$) are much less common, their industrial use being chiefly in the preparation of a form of indigo vat of tolerably recent introduction in which the indigo is reduced to the condition of indigo-white by their operation. The reduction of an acid sulphite can also be effected by electrolysing its solution, hyposulphite appearing at the cathode. Now, like many reducing agents, sodium hyposulphite can act as a developer to a photographic image, a fact that was observed in 1886 by Eder. The negatives thus developed are very soft and full of detail, and are grey in tone, but not so bluish-grey as those developed by ferrous oxalate. On account of the ease with which sodium hyposulphite is oxidised by exposure to the air, no practical use has hitherto been made of this observation, but a simple variation in the procedure by R. E. Liesegang, has recently brought it into a more workable form. This modification consists in electrolysing a nearly saturated solution of acid sodium sulphite in the developing dish, the cathode being a platinum plate dipping direct in the dish, and the anode being contained in a porous cell and thus the oxidised products appearing thereat prevented from mixing with the hyposulphite produced. The current given by half-a-dozen Gassner dry cells suffices for reducing the acid sulphite. On immersing a fully-exposed bromide plate in the bath, an image, brownish-red in tone, is developed in the course of a few minutes, the oxidation of the hyposulphite by the air or by the work of development, being made good by its being immediately reduced again by the action of the current. The image is not very strong, and fades somewhat on fixing, but it retains its characteristic colour.—J. C. C.

PATENTS.

New or Improved Developers for Photographic Pictures. O. Imray, London. From the Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany. Eng. Pat. 1736, January 30, 1891. Second Edition.

The author claims the use of paramidophenol and paramidocresol, their haloid-, oxy-, and amido-derivatives, and their carboxylic and sulphonic acids, for the development of photographic plates. Solutions of the compositions given below are mentioned as suitable for developing purposes.

	Parts.
Paramidophenol hydrochloride	5
Sodium sulphite	50
Potassium carbonate	25
Water	1,000

Paramidophenol hydrochloride	10
Potassium metabisulphite	30
Water	100

Concentrated caustic soda is added to the latter solution until the precipitated amido-compound is just redissolved; for use this solution should be diluted with 5—50 parts of water.—W. J. P.

A Process for Developing Photographic Images. J. Hauff, Feuerbach, near Stuttgart, Germany. Eng. Pat. 4498, March 7, 1892. Second Edition.

The great value of orthoparadiamidophenol as a developer lies in its immunity from atmospheric oxidation, and in the fact that addition of a caustic alkali or a carbonate is unnecessary (see this Journal, 1892, 937; 1893, 289).
—W. J. P.

Improvements in the Manufacture of Pyroxyline Solutions and Compounds for Photographic or other Films or Coatings and for Solid or Massive Articles. J. S. Fairfax, London. From F. Crane, Bloomfield, New Jersey, U.S.A. Eng. Pat. 6543, April 5, 1892.

A solvent for pyroxyline should be non-hygroscopic, in order that it may dry rapidly; such a solvent is found in acetone oil, for the use of which the author accordingly claims protection. The most suitable fraction of acetone oil for dissolving pyroxyline is that boiling below 140°. The oil may be diluted with other liquids, and the following formulæ are given for making pyroxyline solutions for the preparation of photographic or other films:—

50 galls. of volatile ketones or acetone oil.
50 galls. of wood alcohol.
200 lb. of soluble pyroxyline.

or—

20 galls. of petroleum naphtha or benzole.
20—50 galls. of volatile ketones or acetone oil.
30—60 galls. of wood alcohol or acetone.
200 lb. of soluble pyroxyline.

—W. J. P.

XXII.—EXPLOSIVES, MATCHES, Etc.

Estimation of Nitrogen in Nitrocellulose. E. von Keussler. Zeits. Anal. Chem. 1893, **32**, 51.

See under XXIII., *page* 382.

PATENTS.

Improvements in Explosives. C. H. Curtis, London, and G. G. Andre, Sandbank, Argyleshire. Eng. Pat. 7978, April 27, 1892.

The inventors in a previous patent No. 5821, April 4, 1891 (this Journal, 1892, 456), describe an explosive coated with a film of tanno-gelatin. They now propose to use this tanno-gelatin "compounded with nitrocellulose either with or without nitroglycerin by the aid of a suitable solvent, such, for instance, as acetone."—W. M.

Improvements in Explosive Material and in the Manufacture thereof. B. J. B. Mills, London. From C. E. Munroe, Newport, Rhode Island, U.S.A. Eng. Pat. 580, January 11, 1893.

Guncotton which has been freed from the lower nitrocelluloses, by treatment with methyl alcohol, is mixed with a liquid nitro-substitution product, such as nitrobenzene, and incorporated in a mill or between rolls. The methyl alcohol used, must have been first freed by distillation, saponification, or other suitable process, from acetone and such other impurities as have a solvent action on the higher cellulose nitrates. The material, which is now plastic, is cut or moulded into suitable forms. The inventor prefers to use from nine-tenths to one and eight-tenth parts of nitrobenzene to one part of guncotton. This material may be mixed with suitable oxidising salts to perfect combustion. The inventor finds that this plastic material may be indurated and converted into a material having the consistency of bone or ivory, by treatment with hot water or steam. This new explosive he calls "Indurite." —W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Simple Method of Fractional Distillation. A. Tigerstedt. Ber. **26**, 1893, 172.

In subjecting liquids to fractional distillation it is frequently necessary to ascertain the weight of distillate coming over between different temperatures. This is usually effected by collecting and weighing the various fractions in tared flasks. When the separation of the fractions is not desired, but merely the weight is to be determined, the operation may be simplified by distilling the liquid into a small flask placed on a delicate spring balance, such as is frequently used for weighing letters. The pointer indicates the increase of weight of the fractions distilled at any period of the distillation. Sensitive balances for this purpose are made by Desaga, of Heidelberg.—D. B.

An Apparatus for Distillation by Superheated Steam for Laboratory Use. B. Jaffé. Ber. 1893, **26**, 123—125.

The apparatus consists of a tubulated retort joined to a series of receivers. One or two of the anterior receivers are empty, the rest contain a little water, and the last one is connected to a water suction pump. Besides the thermometer, an open copper tube, 3—4 mm. internal diameter, is fitted into the tubulus of the retort by means of a perforated asbestos plug, the joint being well luted with clay. This tube may dip either right into the liquid or, preferably, reach just down to its surface. In the former case a glass tube should be slipped over its end, in order to prevent direct contact with the liquid. A Bunsen burner is placed close to the exterior orifice of the tube, which is trumpet- or funnel-shaped, and through this the flame is drawn in. The second burner serves to heat the liquid to be distilled more quickly to the boiling point. In operation, the burner is lit and the aspirator set to work, with the result that the highly-heated products of combustion of the gas, mixed with air, are drawn through the liquid in the retort, and effect its distillation. The fact that other gases besides steam (CO_2, air, &c.) come into contact with the substance under treatment is in many cases of no importance. The author has obtained excellent results with paraffin, stearic acid, glycerol, and similar substances. In fact, the apparatus is particularly suited to the estimation of glycerol in crude glycerol, duplicate analyses giving results differing not more than 0·1 per cent. The temperature may be regulated by varying the speed of aspiration, size of the flame, &c.—H. T. P.

PATENT.

Improvements in the Detection and Estimation of Combustible Gas or Vapour present in Air, and Apparatus for that Purpose. B. Redwood, London, F. Clowes, Nottingham, and S. Waters, London. Eng. Pat. 187, January 4, 1893.

This invention relates more particularly to the detection of combustible gas in the atmosphere of mines and in petroleum vessels or receptacles, in order to ascertain whether it would be safe to bring a light into, or to work with heated metal, in such an atmosphere.

The principle of the apparatus depends on the fact that when a hydrogen flame burns in air containing a combustible gas or vapour, it presents a bluish-grey cap, the height of which depends on the quantity of combustible gas present and on the size of the hydrogen flame; by regulating the flame to some standard height, the percentage of combustible gas in the air supplied to the flame can be approximately determined.

The hydrogen flame burns in a safety-lamp, provided with a special burner, the hydrogen being conveniently supplied from a reservoir of the compressed gas; the lamp may be either taken into the atmosphere which is to be tested, or, the usual inlet having been closed, it may be connected by means of a pipe with a vessel containing a sample of the atmosphere.—F. S. K.

INORGANIC CHEMISTRY.—QUALITATIVE.

The Purification of Arsenical Zinc for Analysis. H. Lescœur. Compt. rend. **116**, 58.

See under X., *page* 358.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Critical Studies on the Methods for the Estimation of Sulphur existing as Sulphides. L. P. Marchlewski. Zeits. Anal. Chem. 1893, **32**, 1—15.

The author employed a sample of finely-pulverised slaked cement in which the amount of sulphides was determined indirectly by oxidation with aqua regia and directly by iodometric titration. Direct methods are much quicker than indirect, and are to be preferred when the sulphur existing as sulphate is not required to be ascertained.

Indirect Methods.—A portion of the sample is oxidised and the total sulphur precipitated as barium sulphate, whilst another portion is boiled with hydrochloric acid until the sulphuretted hydrogen is expelled, and the sulphates existing as such determined. When the oxidation is conducted with aqua regia exact results are obtained; good results are also obtained with the use of chlorine in acid solution ($KClO_3 + HCl$), as oxidant, the process is, however, slow. Chlorine in alkaline solution, bromine, and hydrogen peroxide do not give reliable results. Potassium permanganate gives good results, but the oxidation is slow. Oxidation in the dry way (Fresenius) must be classed as one of the most exact methods. As the oxidation processes are all somewhat lengthy, the author has attempted to expedite the determination by employing volumetric means for the estimation of the sulphuric acid. For this purpose Andrew's method gives results agreeing with those obtained by gravimetric analysis, and is very expedious; it can be used in the presence of magnesium, calcium, aluminium, zinc, ferric iron, nickel, cobalt, and silver. The sulphate solution is treated with an excess of barium chromate dissolved in hydrochloric acid, neutralised filtered, and potassium iodide and hydrochloric acid added to the filtrate, the liberated iodine being titrated in the known way.

Direct Methods.—The sample is decomposed in a Classen's apparatus and the sulphuretted hydrogen oxidised to sulphuric acid and estimated as such.

Oxidation with hydrogen peroxide, and iodometric titration both give excellent results. Oxidation with aqua regia gives satisfactory results but is tedious, whilst low results were obtained with nitric acid. Good results are obtained by passing the sulphuretted hydrogen into a 2 per cent. solution of silver nitrate, filtering off the silver sulphide, digesting it with bromine water, filtering the silver bromide and determining the sulphuric acid in the filtrate. Instead of a solution of silver nitrate, one of mercuric cyanide and ammonium chloride is preferable (De Koninck) Berg's method also gives good results; it consists in leading the sulphuretted hydrogen into a 5 per cent. solution of zinc sulphate, and treating the zinc sulphide with hydrochloric acid and an excess of iodine when the following reaction occurs:—$ZnS + 2HCl + I_2 = ZnCl_2 + 2HI + S$. The excess of iodine is then titrated in the usual manner.

Colorimetric methods only give satisfactory results when much time is expended in carrying them out.—A. R. L.

A Quick Method for the Complete Precipitation of Arsenic as Pentasulphide: Separation of Arsenic from other Elements. F. Neher. Zeits. Anal. Chem. 1893, **32**, 45—51.

For the precipitation of a solution of arsenic acid as pentasulphide, such a solution should contain at least two-thirds of its volume of concentrated hydrochloric acid, and a brisk current of pure sulphuretted hydrogen should be passed through for 1½ hours. When there is any doubt as to the complete precipitation, the mixture which ought to smell strongly of sulphuretted hydrogen, is allowed to remain for two hours previous to filtration. The solution must be exactly at the temperature of the room before passing in the sulphuretted hydrogen, as the results are lowered when it is of a higher temperature. This may be due to the elimination of a portion of the arsenic as arsenious chloride or sulphide, and in support of this hypothesis the author states that by boiling arsenic oxide with hydrochloric acid arsenious chloride is formed and partially distils over; he also finds that when sulphuretted hydrogen is passed through a boiling solution of arsenic acid, arsenious sulphide is carried over with the steam. A single test occupies about four hours.

Solutions of lead, bismuth, cadmium, and antimony are not precipitated by sulphuretted hydrogen in the presence of a large excess of hydrochloric acid, and experiments show that the above described method serves to separate these metals from arsenic. The process seems to require some modification in order to separate arsenic and stannic oxides. The results which are given show that the method is very accurate.—A. R. L.

Oxidation of Sodium Thiosulphate by Potassium Permanganate. C. Luckow. Zeits. Anal. Chem. 1893, **32**, 53—57.

The author finds that 14 cc. of a solution of potassium permanganate, of such a concentration that 10 cc. of it are equivalent to 5 atoms of oxygen, are required for the oxidation of 0·0496 grm. of sodium thiosulphate, consequently 10 cc. are required for the oxidation of S_2 in this compound. Sodium thiosulphate is, in accordance with this result, oxidised by potassium permanganate to sodium sulphate and sodium dithionate: the same products are obtained when the oxidation is conducted in either acid or alkaline solution. The sodium dithionate was identified in the oxidation product by means of its soluble barium salt.
—A. R. L.

Estimation of Phosphoric Acid by Means of Magnesia Mixture. N. von Lorenz. Zeits. Anal. Chem. **32**, 64—67.

This investigation establishes the fact that for the exact estimation of phosphoric acid by precipitation with magnesia mixture, it is necessary to add to the phosphate solution an amount of ammonium citrate solution (ordinary concentration), corresponding to 2 per cent. or more of citric acid, and then to drop in the magnesia mixture by means of a pipette, slowly, and with stirring. In the absence of citric acid, the precipitate of ammonium magnesium phosphate is invariably contaminated with magnesia, the presence of which cannot be avoided even when the magnesia mixture is slowly dropped in.—A. R. L.

Volumetric Determination of Lead. H. H. Alexander. Eng. and Mining Jour. 1893, 298.

This method is based upon the fact that ammonium molybdate when added to a hot solution of lead acetate will give a precipitate of molybdate of lead which is insoluble in acetic acid. Any excess of ammonium molybdate will give a yellow colour with a freshly prepared solution of tannin; this solution is made by dissolving one part of tannin in 300 parts of water. The standard solution of ammonium molybdate is prepared by taking 9 grms. and dissolving it in one litre of water, adding, if necessary, a few drops of ammonium hydrate to clear the solution. This gives a solution of about 1 per cent. To standardize the solution, 300 m. grms. of pure sulphate of lead are dissolved in hot ammonium acetate, the solution acidified with acetic acid and diluted with water up to 250 cc. This is then heated to boiling, and the molybdate solution run in from a burette until all the lead is precipitated as a white precipitate; this is ascertained by placing drops of the tannin solution upon a porcelain plate, and adding to these drops other drops from the beaker from time to time. As long as the lead is in excess no colouration is produced, but as soon as the molybdate is in excess a yellow colour is produced. To estimate the lead in a substance, ½ to 1 grm. is weighed out and treated with 15 cc. of strong nitric acid and 10 cc. of strong sulphuric acid; heat is applied until all the nitric acid is completely expelled, which is done by evaporating until fumes of sulphuric anhydride appear. It is then allowed to cool and diluted with cold water, stirred, and boiled until all soluble sulphates are dissolved. It is then filtered, leaving as much as possible of the precipitate in the basin, washed twice with hot dilute sulphuric acid and once with cold water. The sulphate of lead in the basin is dissolved with hot ammonium acetate, this hot solution being poured on to the filter and allowed to run into a beaker; this is repeated until all the sulphate of lead is dissolved. The solution is then acidified with acetic acid and made up to 250 cc. with hot water, and titrated as described. By this method a lead determination can easily be made in 30 minutes. Arsenic, antimony, and phosphorus do not interfere with this method, as they readily pass through the filter in solution.—J. C. C.

Method of Estimating Calcium in Thomas-Phosphate. A. F. Holleman. Chem. Zeit. 1892, **16**, 1471—1472.

A solution of this material is made as follows:—10 grm. are boiled with concentrated hydrochloric acid (100 cc.) for half an hour, made up to 500 cc. filtered from silica, only traces of the latter remaining in solution; the estimation of calcium is made by the following combinations of Classen's and Jones's method. Iron and manganese are completely separated. Of the above solution (50 cc.) is concentrated to a small bulk and a solution of neutral potassium oxalate (1 to 3) added, and the mixture digested on the water-bath with frequent stirring until the precipitate appears white and is free from lumps; this generally takes 10 minutes. The precipitated calcium oxalate is now collected and washed with hot water until the filtrate is free from oxalic acid. The filter is then pierced, and the precipitate washed through the filter being finally treated with hot dilute hydrochloric acid. After dissolution 10 cc. of dilute (1 to 5) sulphuric acid and 150 cc. of 96 per cent. alcohol are added. After remaining for three hours the precipitated calcium sulphate is collected, washed with alcohol of 96 per cent. until free from acid, and weighed. The test analyses were satisfactory.—A. R. L.

A Review of the Methods of Estimating Chromium, Copper and Nickel in Steel. A. Ziegler. Ding. polyt. J. 1892, 140—142.

Four methods are given for estimating chromium. In all of them this metal is finally precipitated with ammonia and weighed as sexquioxide. The methods resolve themselves therefore into schemes for effecting the decomposition of the substance under examination, so as to obtain the whole of the chromium in solution.

I. From 1—2 grms. of the steel are dissolved in hydrochloric acid (1:3), oxidised in a porcelain dish with peroxide of hydrogen (or nitric acid), evaporated to dryness and the residue transferred to a silver crucible and fused with 6 grms. of caustic soda, and 3 grms. of sodium nitrate Or, instead of using a silver crucible, a platinum one may be employed, and the residue melted with fusing mixture (120 grms. of sodium carbonate to 80 grms. of potassium nitrate), but this modification is confessedly not so good as the fusion in a silver crucible. The fused mass is extracted with water, the solution saturated with carbonic acid gas, evaporated, to dryness, taken up with water, filtered, washed with water containing sodium carbonate and the residue again fused. If after this, it still contains chromium, it must be once more fused.

II. In this method one grm. of the steel is dissolved in a flask by means of a solution of ammonio-cupric chloride. The solution is affected in an atmosphere of carbonic acid, this gas being led into the flask during the period of solution. The temperature is kept at about 70° C., and 50 cc. of a saturated solution of the salt are used to each grm. of steel. By fitting a cork bored with three holes to the flask through one of which a tube passes leading in the carbonic acid gas, through the second a tube passes to the bottom of the liquid, whilst the third hole is left open to allow of the escape of gas, the liquid may, by temporarily closing the last-mentioned hole, be forced by the gas pressure out of the flask through the tube, passing to the bottom of the liquid, and thus be transferred to a filter, without allowing air to enter the flask. By this means the oxidation of the iron is prevented. No acid should be used to effect the solution of any ferric oxide. After filtration the residue should be fused as in the first method.

III. (*a*.) 1—2 grms. are dissolved in a platinum crucible by nitric acid (1·2 sp. gr.), evaporated to dryness and fused with sodium bisulphate.

(*b*.) Or the turnings may be dissolved in dilute sulphuric acid and evaporated until acid vapours are evolved. Water is added until the ferrous sulphate all dissolves. The residue contains all the silica and a minute quantity of chromium. In exact analyses this must be burnt off, and the residue fused with sodium bisulphate. The filtrate is then oxidised by heating, and adding a solution of 8 grm. of $KMnO_4$ in 1 litre of water, until a red colour is permanent for some minutes. In this way all the chromium sulphate is oxidised to chromic acid. Sodium carbonate (in powder), is now added until the solution is alkaline, the precipitate is allowed to settle, is then filtered, and the chromium precipitated in the filtrate.

IV. The sample is dissolved in hydrochloric acid, evaporated to dryness, heated some hours at 120° C., and extracted with 99 per cent. alcohol, in which chromium chloride is practically insoluble. By this means the greater part of the other metallic chlorides present are separared from the chromic chloride. The residue is filtered and fused with caustic soda and sodium nitrate as in method I. The author recommends the first method as the best.

The Estimation of Copper in Steel.—I. As is well-known, copper can be correctly estimated by precipitation with sulphuretted hydrogen from solutions slightly acidified with hydrochloric acid, even when other metals precipitated in this way are absent. It must be borne in mind, however, that in dissolving in hydrochloric acid sometimes an insoluble residue containing sulphide of copper remains.

II. v. Reis in Stahl u. Eisen, 1889, 720, and 1891, 238, describes a method for precipitating arsenic and copper in iron by ammonium sulpho-carbonate, by which means the disagreeable use of sulphuretted hydrogen is avoided. The ammonium sulpho-carbonate is prepared by shaking a mixture of 100 cc. of carbon bisulphide, 500 cc. of concentrated aqueous ammonia, and 500 cc. of 95 per cent. alcohol, until the CS_2 is dissolved, and then diluting the solution with 4 volumes of water. The solution must be kept from the influence of air and light. 10 grm. of iron, ferro-manganese, or steel are dissolved in dilute hydrochloric acid (1 vol. of concentrated acid to ½ a vol. of water) and evaporated to dryness, the residue re-dissolved and filtered. The siliceous residue, which may contain some copper, is evaporated with hydrofluoric acid to expel silica and the residue fused with sodium bisulphate, the fusion brought into solution and the copper in it precipitated with H_2S; or the solution may be added to the main filtrate. The main filtrate from the siliceous residue is then warmed and the iron reduced by adding 2—5 grm. of solid sodium hypophosphate, and the liquid is boiled. It is then diluted to 200—700 cc. and from 5—10 cc. of the ammonium sulpho-carbonate solution added and stirred for some considerable time, and the quickly subsiding precipitate of copper sulphide filtered off. It is washed 10 times with a mixture of 500 cc. hot water + 5 cc. of the ammonium sulpho-carbonate + 10 cc. of concentrated hydrochloric acid, the precipitate burnt off wet and the copper weighed as CuO.

III. Instead of weighing as CuO, the copper may be estimated colorimetrically by comparison of the blue tint formed by an ammoniacal solution of known copper contents in the well known and customary way.

IV. The author refers to electrolytic methods described by other chemists.—H. S. P.

Estimation of Nickel in Steel and a New Technical Method of Estimation. Dingl. polyt. J. 1892, 143.

After reviewing various known processes for determining nickel, the author describes the following new method which depends upon the fact that an ammoniacal solution of ammonium borate precipitate iron, manganese, and aluminium, from their solutions in hydrochloric or sulphuric acid, whilst nickel, cobalt, and copper, remain in solution. 1 grm. of the metal (containing up to 8 per cent. of nickel) is dissolved in nitro-hydrochloric acid in a covered porcelain dish, evaporated to dryness and the silica rendered insoluble by repeated addition of hydrochloric acid and long continued digestion, and then finally taken up with water acidulated with hydrochloric acid and filtered. A mixture of ammonium borate and as much ammonia as is needed to precipitate all the iron, manganese, &c. is meanwhile brought to the boiling point in a platinum or porcelain dish, and the solution of the metal under examination is poured into it, slowly, whilst constantly stirring. The precipitate settles rapidly and is washed by decantation, once with concentrated ammonia and afterwards with water. The precipitate is then transferred to a filter and washed well. All the nickel is in the filtrate, which must be now evaporated to about 100 cc., filtered if necessary and precipitated in the usual way with pure sodium or potassium hydrate as described in Fresenius' Quantitative analysis. The use of glass rods and glass vessels is to be avoided. The precipitated nickelous hydrate is burnt off at a gentle heat after putting a little ammonium nitrate in the filter. After the paper is carbonised, the oxide is moistened with fuming nitric acid and the paper carefully incinerated, and the oxide finally heated over the blowpipe. The resulting oxide is generally of a dirty greyish green colour and should be tested for impurities, by fusing with sodium bi-sulphate, the solution of the fused mass being treated again as already specified, if much impurity be present. Silica is usually the chief impurity, and is acquired from the sample or from the vessels used. Alkalis also sometimes form an impurity.—H. S. P.

Spica's Method of Estimating Phosphoric Acid. C. Arnold and K. Wedemeyer. Zeits. ang. Chem., 1892, 603—604.

Spica's method (Gaz. Chim. **12**, 117) is a volumetric one, and depends upon the fact that potassium-ferric-sulphate precipitates the whole of the phosphoric acid from neutral solutions as ferric-phosphate. The operation is conducted in the cold, the solutions of phosphoric acid must be free from other acids, and salicylic acid is used as indicator. It gives a violet colour with excess of the precipitant. The authors find the determination of the end-point of precipitation somewhat indefinite. To determine the phosphoric acid in Thomas' slag, Spica evaporates the slag with concentrated sulphuric acid to dryness, and then, in order to obtain a solution free from iron, aluminium and manganese, dissolves out the liberated phosphoric acid with absolute alcohol. The authors find that the method thus gives results that are too low, as the sulphates retain phosphoric acid, which is not removed even by large quantities of alcohol. They conclude by saying that they think the method will not be adopted in laboratories, on account of its costliness, because of the length of time taken up by it, and because of its inaccuracy.—H. S. P.

The Estimation of Manganese in Iron. M. A. von. Reis. Zeits. ang. Chem., 1892, 604—607 and 672—674.

The author describes some modifications of Wolff's method which is a method that has received the recommendation of the committee for introducing uniform methods of analysis. The method as modified is as follows:—1 grm. of the sample (iron, spiegel, or ferromanganese) is weighed out into a porcelain dish and dissolved in 25 cc. of a mixture of nitric acid and sulphuric acid (in the proportions of $2\frac{3}{4}$ vols. of water to $1\frac{1}{4}$ vols. of nitric acid, sp. gr. 1·4, and 1 vol. concentrated sulphuric acid). The mixture is then digested over a naked flame, the dish being covered over, and the boiling prolonged until sulphuric acid vapour begins to come off. The dish is allowed to cool, the cover is rinsed, and water added until the volume is about 100 cc. 10 cc. of the acid mixture are now added to the contents of the dish, and the whole is warmed until complete solution takes place. The liquid is then transferred to an Erlenmeyer flask holding 1 litre, and about 3 grms. of barium peroxide and 5 cc. of concentrated nitric acid are added to completely oxidise the carbonaceous matter. The liquid is now boiled for two or three minutes to effect the decomposition of the barium peroxide, when 300—400 cc. of water at 90° C. are next added, and then enough zinc oxide (suspended in water) so as just to form a slight excess. A too considerable excess, such that a red-brown precipitate is formed, must be avoided. The sample is now ready for titration. In the case of iron, a solution of permanganate is used for titrating, of which 1 cc. = 0·001 grm. of manganese, whilst in the case of spiegel and ferromanganese the strength is such that 1 cc. = 0·005 grm. of manganese.

The method of titrating is as follows:—The permanganate is added until there is an excess of from 0·5 to 1 cc. This excess is then removed by adding a standard solution of neutral manganese sulphate until the intensity of the colour is only such as is due to an excess of 0·1 cc. of permanganate. The manganese sulphate solution is made by dissolving 19·9 grms. of crystallised manganese sulphate in 5 litres of water. Algœ grow readily in such a solution, but this may be prevented by adding 5 grms. of mercuric chloride to it. The permanganate solution is standardised by dissolving 0·5 grm. of chemically-pure permanganate of potash in water, and evaporating to dryness with addition of hydrochloric acid. The manganous chloride is then dissolved in 50 cc. of water and 10 cc. of concentrated nitric acid added. (For standardising the weaker solution the manganous chloride solution is still further diluted to 500 cc., of which 100 cc. are taken and 10 cc. of nitric acid added.) The liquid is diluted with boiling water to from 400 to 500 cc., zinc oxide milk in slight excess added, and then the permanganate solution to be standardised is added. If it is of right strength, 34·8 cc. should be required to produce a colour, this volume being equivalent to 34·8 per cent. of manganese in the pure permanganate taken.

The author has undertaken the investigation of the influence upon the accuracy of the test of (1) Repeated slight additions in excess of permanganate with back-titrating with manganese sulphate; (2) of temperature; (3) of the added zinc oxide; (4) of the nitric acid. In the first case, when the permanganate is added in excess and titrated back more than twice, an addition of 0·1 cc. must be made to the amount of permanganate required by the test, for every fresh addition after the second. These repeated additions in excess and back-titrations are, however, rarely necessary in practice. If the temperature be above 80° when titrating, very slightly low results are obtained. The quantity of zinc oxide affects the rate at which the precipitate settles during titration. For 1 grm. of iron about 20 grms. of zinc oxide are necessary; more than this causes the precipitate to settle more slowly. The accuracy of the test is not affected by the excess of zinc oxide until 8—10 times this amount is added, when slightly higher results than the correct ones are obtained. The addition of the nitric acid within the limits of the quantities specified in the process, does not affect the test, but if very large quantities are added (15—50 cc.) slightly too high results are indicated.

Comparative experiments were also made with this method, and various other modifications of the permanganate volumetric process, and with gravimetric determinations, and the results show a very marked uniformity throughout all the processes.—H. S. P.

On the Determination of Phosphorus in Steel and Iron. A. Carnot. Comptes. rend. **116**, 106—108.

The author proposes to weigh the phosphorus contained in steel and iron as phospho-ammonium molybdate, which has been precipitated in the manner described below. This appears to him a more accurate method than those in vogue, inasmuch as the molybdate contains only 1·628 per cent. of phosphorus, or about 17 times less than the magnesium pyrophosphate (with 27·928 per cent. of phosphorus).

Five grms. of steel or iron (or 0·5 grm. of phosphor-bronze) are dissolved in 40 cc. of nitric acid contained in a porcelain dish which is covered by a glass funnel, until the liquid has ceased to effervesce. By gently heating the substance is dissolved completely, and 10 cc. of concentrated SO_4H_2 are added with constant stirring with a glass rod. A voluminous magma is obtained which dissolves on heating; the mass is carefully evaporated on the sand bath to dryness, and heated for two hours from 120° to 125° C. in an air-bath. 50 cc. of boiling water are then added and the insoluble matter washed on to a filter with the same quantity of water. The filtrate is received in a litre flask.

The silica on the filter generally contains graphite and manganese peroxide. The latter is removed by washing with hot concentrated hydrochloric acid and subsequently with hot water. The graphite is burnt on igniting the precipitate, the weight of the latter multiplied by 0·4667 gives the quantity of silicon.

The hydrocarbons in the filtrate are oxidised by adding 1 grm. of chromic acid and boiling for half an hour, whereby any pyrophosphoric acid which may have been formed during evaporation to dryness, will be transformed into orthophosphoric acid. 60—80 cc. of a 5 per cent. molybdate solution (prepared as usual) are now added, and a temperature of 100° C. maintained for two or three hours in order to ensure complete precipitation. When the precipitate has settled down the cold liquid is decanted through a filter and the precipitate washed with warm water containing 5 per cent. of molybdate solution, until the wash waters contain only faint traces of iron. The precipitate in the flask is dissolved in 30 cc. of ammonia and 30 cc. of hot water, the solution poured through the filter into a flask of 150 cc. capacity and washed with 50 cc. of water. Small quantities of ferric phosphate and ferric hydrate remaining on the filter are dissolved in a few drops of hot dilute nitric acid and added later on, to the acid liquid. The ammoniacal solution is cooled, and, whilst the temperature is not allowed to rise above 40° C., gradually neutralised by nitric acid until the yellow precipitate refuses to redissolve; 3 cc. of nitric acid and the solution of ferric phosphate are now added, and the precipitate allowed to settle down during two hours at a temperature of 40° C. The liquid is decanted through a tared filter, the phospho-ammonium molybdate washed with water containing 1 per cent. of nitric acid, and finally transferred to the filter where it is washed with a little distilled water. The precipitate is dried at 100° C. in an oven and weighed. Multiplied by 0·01628 the weight of the molybdate gives the quantity of phosphorus.

Special experiments by the author have shown that under the conditions stated above a salt of constant composition is obtained possessing the formula—

$$P_2O_5 24MoO_3 3(NH_4)_2O . 3H_2O$$

with 1·628 per cent. of phosphorus.—J. L.

Causes of Discrepancy in Chemical Analysis. C. B. Dudley. Eng. and Mining Jour. 1892, 605.

Two chemists working on the same sample rarely obtain the same figures for the various constituents, especially when, as in the case of carbon, sulphur, &c., in iron and steel, the percentage of each is extremely small. For instance, in a series of 16 determinations of sulphur in a piece of pig iron, with which the author was connected, the figures varied from 0·005 to 0·02 per cent. Similarly, some time ago, some borings from a piece of pig iron were sent to eight different chemists for phosphorus determinations, and the highest figure was just double the lowest. It is, of course, an impossibility to obtain strict accuracy in any chemical analysis, and all that an intelligent and experienced chemist can hope to strive after is to eliminate all known sources of error, as far as is commercially possible, and to approximate as closely as he can to the absolute truth. There are four main causes of error to which may be attributed the discrepancies between the results of different workers. *Firstly*, the sample may not be the same, although supposed to be so; *secondly*, the degree of purity of the chemical reagents always varies; *thirdly*, there is a "personal error" in manipulation, and there are various causes which prevent any particular method from being carried out in the usual way; and, *fourthly*, each individual operator may use a different method from the others, and the results given by each method may be regularly higher or lower than the truth. Each case of variation in these four classes is always extremely puzzling, and it needs a learned and acute chemist to locate the error.

As regards the first cause, the author had not been troubled with many cases.

The second cause of discrepancy, viz. the variation in the purity of the chemicals, is one which every chemist is familiar with. Some time ago the author was mixing up some wash water of ammonium sulphate and free sulphuric acid for washing the yellow precipitate in phosphorus determinations. After washing a few minutes, the filtrate became turbid, and gradually increased in turbidity. It appeared as if the yellow precipitate was not really insoluble in ammonium sulphate and sulphuric acid, but on looking into the matter the author found that the commercial sulphate of ammonia contained a little phosphorus. There are two ways of ascertaining the purity of reagents. The first is to test them for impurities, and the second is to make a dummy analysis with the article to be analysed omitted. The first remedy is always uncertain, as it is impossible to test for every known substance or combination of substances. In the work of the International Standards Committee in carbon determinations, the ammonium chloride was found to give bad results, and it was only accidentally found out that it contained some organic matter. Such a thing would never be analysed for. The dummy analysis is also far from satisfactory, as there is nothing to prove that the reactions between the chemicals and their impurities will be the same in the absence as in the presence of the substance to be tested.

The third cause, that of personal error, introduces discrepancies through differences of manipulation. Many times these errors arise from the indefiniteness of the instructions, such as "add a little of this or that," or "heat to a temperature of from 330° to 310° C." The weighing and measuring of constituents may be done by scales or by guess. Some men spill a little here and there, and so on. Again, some chemists study each step intelligently, while others simply follow the instructions of the book without inquiring into the why and wherefore. The author remembers an interesting case which occurred sometime ago at his laboratory, which illustrates this point well. He analysed a tire and found about 0·11 per cent. of silicon in it. Drown's method was used, dissolving in sulphuric and nitric acid, evaporating until the sulphuric acid fumes, and then diluting with hot water and filtering. The chemist of another railroad happened to see the result, and found it gave just half his figures, viz., 0·28 per cent. Si. On his drawing attention to the discrepancy, the author repeated his analysis, and found that his figures were right and his (the author's) wrong. On investigating the cause of the error, it was found that the test had been interrupted in the middle and had been laid aside for two days, whilst something else more pressing had been attended to. The operator had dissolved the steel and evaporated to fuming point, and then, after diluting, had placed it on one side. This pause in the test had introduced the error, though it was only after some time that this cause was discovered, for such a cause had never been anticipated, nor is it known generally. Apparently the silicon obtained by the sulphuric acid method is not dehydrated completely. If it is allowed to stand 48 hours half is lost, and a six days rest leaves only 0·06 per cent.

The fourth cause, that of method, is the one which may be most easily eliminated in commercial analysis. Different methods and treatments of the same method give different results and introduce discrepancies between the makers and the buyers' results. Hence, the author proposes that in every specification the test shall be included. He is hoping to be able to introduce this innovation in the Pennsylvania Railroad Company's specifications, for, although it is apparently a high-handed proceeding, it will certainly get rid of disputes and simplify matters generally. If steel low in phosphorus be desired, it is to the interest of the user to employ a method that gives high results, whereas the steelwork's chemist prefers, naturally, a method that gives a low result. Now, the only way to prevent a dispute is to specify a certain method of analysis. The desirability of adopting a universal series of tests that shall always be specified, is a point much to be desired, and if some learned society could adopt a standard series of tests to be used in commercial analysis, a great boon would be conferred.

There are multitudes of cases where errors arise through differences in methods that are not to be attributed to this desire to obtain uniformly low or high results. The author calls to mind a case in point. In a determination of tin in bronze, author never weighs up the metastannic acid as he separates it from the bronze by means of nitric acid. He has never yet succeeded in getting all the iron and all the copper away from the oxide of tin by means of nitric acid. Also, if the bronze contain any phosphorus it will go down with the tin. So he dissolves the metastannic acid in sulphide of ammonium, filters, and reprecipitates the tin sulphide. In this way he always gets a little copper out, and sometimes a little iron. He does not, of course, completely separate the whole of the copper from the tin, yet he gets much nearer the truth than before. This difference in method produces different results.—W. S.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Detection of Denatured Spirit in Wine. K. Portele. Zeits. Nahrungsmittel-Unters. u. Hygiene, 1892, **6**, 357.

One hundred cc. of the wine are distilled to 10 cc., when the methyl alcohol passes over completely, together with the greater portion of the pyridine bases; the distillate is treated with dilute sulphuric acid and again distilled, when methyl alcohol alone passes over. The residue is evaporated to a small volume, and, while warm, treated with an excess of caustic soda. The presence of pyridine bases is recognised by a strong characteristic narcotic odour: 0·25 per cent. of added denatured spirit may be detected. It is recommended, however, to make blank experiments with pure wine, and wine to which denatured spirit has been added.—A. R. L.

A New Reaction for Cocaine. A. Kuborne. Pharm. Centralhalle, **33**, 411.

About 1 cc. of nitric acid of sp. gr. 1·4 is added to a little of the alkaloid in a small porcelain dish, and the mixture evaporated to complete dryness on the water-bath. A few drops of alcoholic potash, or preferably a solution of caustic potash in amyl alcohol are added to the residue after it has become cold. Should no colour be produced, atropine is absent. On warming again on the water-bath an intense violet colouration is suddenly developed.—B. B.

Para-Ethoxy Derivatives of Hydracetine and of Antipyrine. Altschul-Pharm. Zeit. 1892, **37**, 448.

See under XX., *page* 371.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Separation and Estimation of Acids in Beer, Wort, Malt, and the like. E. Prior. Bayer. Brauer-Journal, 1892.

The following scheme is proposed for the estimation of the volatile and non-volatile acids, and the acid phosphates in beer, wort, &c.

To estimate the volatile acids, 50 cc. of the beer are distilled under diminished pressure, so that the boiling-point is 45—50° C. The distillation apparatus is connected with a flask containing 175 cc. of water at a temperature of 45—50°C., and when the liquid which is being distilled is reduced to two-thirds its original volume, sufficient of the water is admitted into the distillation flask by opening a pinch-cock, to bring the liquid to its original volume. The subsequent influx of water is now regulated to the rate of the distillation, and when nearly 175 cc. have been introduced the pinch-cock is closed and the distillation continued until the residue measures 16—20 cc. It is possible in this way to completely expel the volatile acids in 3—3½ hours without altering the acidity of the residue. The distillate is titrated with $\frac{N}{10}$ alkali.

Neutral absolute alcohol (75 cc.) is then added by degrees to the residue, and then ether until the mixture measures 500 cc. It is necessary during the addition of the alcohol and ether to maintain a rotatory motion. It is then allowed to remain aside for 20—24 hours, when it is filtered and the precipitate washed 5 or 6 times with (100 cc. in all) of a mixture of alcohol (15 vols.) and ether (85 vols.). The alcohol and ether are then distilled from the filtrate, the residue taken up with a little water, and the non-volatile acids determined in the solution by titration with $\frac{N}{10}$ alkali. The precipitate contains the acid phosphates; it is dissolved in about 20 cc. of water and also titrated. The total acidity of the beer is determined in a separate portion.

Phenolphthaleïn is used as indicator for the volatile and non-volatile acids, but for titrating the acid phosphates an indicator prepared by mixing 6—7 drops of phenophthaleïn solution with 20 cc. of water, and 0·3 cc. of $\frac{N}{10}$ alkali is made use of. A drop of this deep red solution is decolourised on addition of 1—2 drops of a solution containing only traces of monophosphate, whilst the red colour remains as soon as all the monophosphate is converted into diphosphate. The new indicator renders it possible to titrate dark coloured liquids with great precision. A drop of the indicator is brought on to a deep-welled white porcelain plate, and tested with a drop of the beer wort, &c. If decolorisation is not produced with 1 drop, a second is added. If more than this be required one or two drops of $\frac{N}{10}$ alkali are added to the liquid, which is again tested. The titration is finished when 2 drops of the liquid under examination no longer decolorise 1 drop of the red phenolphthaleïn solution.—A. R. L.

Estimation of Quinine in Sulphate of Quinine and in Presence of other Cinchona Alkaloids. L. Barthe. Comptes rend. (1892) **115**, 1085—1088.

On agitating different quantities (1, 2, 3, 4, 5 grms.) of the same sample of commercial quinine sulphate with equal volumes of water at 20°, and then titrating the solutions, after filtering at 17°, with $\frac{n}{10}$ potash, employing phenolphthaleïn as indicator (this Journal, 1893, 294), the author found that the quantity of alkali required (4·6, 5·3, 6, 6·7, 7·4 cc.) increased with the amount of sample taken by a constant quantity, namely 0·7 cc., which, therefore, is a measure of the amount of the sulphates of other alkaloids present in the sample; the percentage of total impurity, expressed as crystalline cinchonine sulphate (equiv. = 397), would consequently amount to 0·7 × 100 × 0·0397 = 2·779 grms. If only two portions, weighing, say, 1 and 5 grms. respectively, had been taken, the percentage of impurity, expressed as crystalline cinchonine sulphate, could be obtained by multiplying the difference between the two quantities of $\frac{n}{10}$ potash required by $\frac{100 \times 0{\cdot}0397}{4}$.

The solubility of pure quinine sulphate in water at a given temperature varies very much, and is dependent on the conditions of the experiment. A saturated aqueous solution at 20° contains 1·774 grms. of the salt per litre, and at 12°, 1·482 grms.; if, however, the solution at 20° be frequently shaken with excess of the salt during the process of cooling to 12°, it retains as much salt in solution at the low as at the higher temperature. When, on the other hand, the solution, saturated at 20°, is left undisturbed for about two hours in contact with excess of the sulphate while it cools to 12° or 15°, the salt retained in solution varies from 1·482 to 1·787 grms., and is not always the same even for the same final temperature; on leaving the mixture for 24 or 48 hours, other conditions remaining the same, solutions are frequently obtained which contain so small a quantity as 1·09 grms. of the sulphate. Such solutions do not take up any more quinine sulphate at the same or at lower temperatures, but they readily dissolve the sulphates of cinchonidine and cinchonine in considerable quantities.

The analysis of a sample of cinchona alkaloids can be carried out as follows:—The chloroform solution of the alkaloids, obtained by any of the usual methods, is treated with a known quantity of $\frac{n}{10}$ sulphuric acid in excess, and, after agitating well, the chloroform is evaporated; the excess of acid is then determined by titration with $\frac{n}{10}$ potash, using litmus as indicator, from which the amount of acid (n cc.) combined with the alkaloids is obtained by difference. After adding sulphuric acid in sufficient quantity to redissolve the alkaloids, the latter are reprecipitated with potash, extracted with chloroform, the extract mixed with n cc. of $\frac{n}{10}$ sulphuric acid, and evaporated to dryness; the residue is digested for two hours at 20° with a saturated solution (200 cc.) of pure quinine sulphate, 100 cc. of which require 4 cc. of $\frac{n}{10}$ potash, and, after filtering, 100 cc. of this solution are titrated with $\frac{n}{10}$ potash, using phenolphthaleïn as indicator; after subtracting the quantity of potash neutralised by the solution of pure quinine sulphate, the number obtained gives the amount of impurity which is expressed as crystalline sulphate of cinchonine (see above).—F. S. K.

Estimation of Fluorine in Ashes of Plants. H. Ost, Ber. **26**, 151—154.

While investigating the injurious effect of smoke on plant life, the need arose of estimating small quantities of fluorine in plant ashes. Estimating as calcium fluoride or silicon fluoride was inadmissible; an etching method was adopted, which, however, would only be successful in the absolute absence of silica. The mode of procedure was as follows:—The dry plant is ignited, and to convert the fluoride into the soluble form, the ash is fused with 1⅓ parts of silica and 5 parts of fusion mixture, first over a Bunsen and then for five minutes over a blow-pipe flame, until tranquil. The mass is extracted with hot water, and the extract warmed with ammonium carbonate, and, after 12 hours, filtered from the alumina, silica, &c., which is washed with water containing ammonium carbonate. The solution, evaporated down and rendered free from ammonia, is nearly neutralised while hot with nitric acid, using phenolphthaleïn as indicator, and evaporated to dryness with a little ammoniacal solution of zinc oxide, as free from acid as possible, then redissolved, filtered, and the last operation repeated once again. The feebly alkaline solution of sodium fluoride may be filtered on a glass funnel without fear. The solution, free from silica and ammonia, is treated at a boiling temperature with nitric acid, and while still alkaline and boiling, is precipitated with calcium chloride. The precipitate, consisting of calcium fluoride, phosphate, &c., is evaporated with acetic acid, treated with water, introduced into a platinum crucible with a little sulphuric acid of 60° B., the crucible is covered with a weighed glass plate, and is heated from 4 to 8 hours at 100°—150°. The temperature is raised at the end to drive off the sulphuric acid. When conducted with proper care, it is found that the loss of weight of the glass is sufficiently proportionate to the amount of fluoride present to be taken as a measure of the latter; 1 mgrm. of fluoride causing 0·8 to 0·9 mgrm. of etching-loss. In this way estimable quantities of fluorine have been detected in healthy birch leaves, may flowers and leaves, and in rose leaves.—D. A. L.

Estimation of the Impurities in Commercial Methyl Alcohols. E. Barillot. Comptes rend. **115**, 1892, 1315—1317.

It is very important to be able to determine the proportion of impurities other than acetone contained in commercial methyl alcohols, used either for denaturing spirit or for methylating aniline.

The following method is intended for the determination of the impurities, other than acetone, existing in commercial methyl alcohols; and is based on the fact that chloroform, when shaken up with a mixture of such spirit and sodium bisulphite, absorbs the impurities (benzenes, methylol, diallyl, &c.) and increases in volume to a corresponding degree. The details are as follows:—10 cc. of the spirit to be examined are well shaken in a stoppered cylinder with 15 cc. of a solution of sodium bisulphite (1·325 sp. gr.), 5 cc. of water are then added, and the shaking repeated. The chloroform extraction is effected in a stoppered bulb-pipette, marked at 20 cc., graduated above this mark in one-tenth cc., and provided with a tap at its lower extremity. The instrument is filled with chloroform to the 20 cc. mark, the spirit and bisulphite mixture added, and the whole thoroughly shaken and allowed to settle. The increase in volume of the chloroform, multiplied by 10, gives the percentage of impurity present. In this manner the author finds that commercial methyl alcohol, employed for the methylation of aniline, contains 1—2 per cent. of impurities, whilst wood-spirit used for denaturing alcohol usually contains 2—5 per cent. Comparatively few samples contain 10—20 per cent., nevertheless only the latter are really effective as denaturing agents.—H. T. P.

Hübl's Iodine Method for Oils. W. Fahrion. Chem. Zeit. 1892, **16**, 1472—1473.

The author recommends that in ascertaining the iodine value a blank experiment shall be made, employing the same quantities of chloroform and Hübl's reagent as in the actual test.

It is pointed out that the iodine value of castor-oil, 84—84·5, given by Hübl and by Dieterich is too high, as Hazura and Grüssner have shown that the oil contains rincinoleïc and rincinisoleïc acids, the triglycerides of which have the theoretical iodine value 81·4. Kraft has also found that castor-oil contains 3—4 per cent. of solid fat (tristearin and trioleïn); and the author finds 2·6 per cent. of solid fat by Allen's method.

The author's experiments to establish the iodine value of castor-oil, in which he obtained most variable results according to the duration of the test, lead him to the view that the use of separate mercuric chloride and iodine solutions is not here to be recommended. Using a Hübl's solution three days after its preparation, and restricting the duration of the test to five minutes, too high (82·4) an iodine value was obtained. Attention is finally drawn to the necessity of ascertaining the precise *rôle* of mercuric chloride in the process.—A. R. L.

Hübl's Iodine Method for Oils. E. Dieterich. Helfenberger Annalen, 1891.

According to Brüche the iodine value, which is obtained by allowing Hübl's solution to remain for 24 hours in contact with an oil, represents the amount of iodine which the latter is capable of combining with. The author points out that when the titre of the solution is taken at the commencement of the experiment a high iodine value is obtained with a test of 24 hours' duration. This value is the greater the higher the temperature, the older the Hübl's solution, the larger the excess of iodine, and the longer the duration of the test. A low iodine value is, however, obtained when the titre of the solution is taken at the end of the experiment. Taking it for granted that the iodine titre of the excess of Hübl's solution, in an oil test, decreases at the same rate as that of Hübl's solution itself kept as nearly as possible under corresponding conditions, the amount of iodine equivalent to this decrease should be deducted from the iodine value; the above-mentioned sources of error are thereby practically eliminated. It is necessary to work under the last-described conditions (for 24 hours or longer) with linseed oil, balsams, and resins, but in the case of olive oil, oleïc acid, tallow, and lard, these conditions may be neglected, and a duration of two hours is sufficient for a test.

Referring to Holde's observations (this Journal, 1891, 954), an excess of Hübl's solution, equivalent to 10—20 cc. of $\frac{N}{10}$ thiosulphate, is sufficient for non-drying oils, and an excess equivalent to 20—30 cc. is sufficient for drying oils. Furthermore, Holde lays too great stress on the age of Hübl's solution; it being simply necessary to employ a larger quantity of the reagent when its iodine titre has gone down.

The author agrees with Fahrion (this Journal, 1892, 183) that the mercuric chloride and iodine solutions are best kept separate, but inasmuch as the iodine titre of Hübl's reagent falls rapidly during the first 24 hours, he allows the mixture of the two solutions to stand for this period before using it. (See also previous abstract).—A. R. L.

Soap Analysis. E. Dieterich. Helfenberger Annalen, 1891.

In the salting-out process a partial dissociation of the alkali salts in soap takes place, and by repeating the operation several times the amount of free fatty acid in the sample is considerably increased. Salting out in hot solution or in dilute solutions leads to the same result. The author has therefore given up the salting-out process for the estimation of total alkali in soap, and has adopted in its place the following modification of Geissler's process:—1 grm. of the sample is dissolved in 30 cc. of 96 per cent. alcohol, and 5 cc. of $\frac{N}{10}$ sulphuric acid added, the mixture being boiled until carbonic anhydride is no longer evolved; the cooled solution is then titrated with $\frac{N}{10}$ alkali and phenolphthaleïn.—A. R. L.

Detection of Rosin in Gum-Dammar. E. Hirschsohn. Pharm. Zeit. Russl. 1892, **31**, 609.

The author shows that the sophistication of gum-dammar with 5—10 per cent. of rosin cannot be detected by ascertaining the acid and saponification values. Rosin may, however, be detected by 10 per cent. solution of ammonia, which dissolves it with the formation of an opalescent solution, from which it is reprecipitated on acidification. Gum-dammar, on the other hand, yields a yellowish or reddish solution when shaken with ammonia, which, on acidification, exhibits at most a slight opalescence.

A sophisticated sample (2 grms.) was powdered and shaken for half an hour with ammonia (20 cc.) and thrown on to a filter. The filtrate on acidification with acetic acid gave a precipitate when 5 or 10 per cent. of rosin was present, but with 20 per cent. of rosin it gave a jelly which could not be filtered.—A. R. L.

Separation of Salicylic from Benzoic Acid. Miss J. Schaap. Ned. Tydschr. v. Pharm. July 1892.

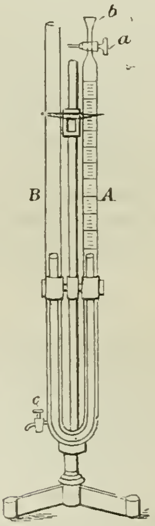
A MIXTURE of salicylic and benzoic acids is dissolved in a little hot water and cooled. An excess of bromine water is then added, and the precipitated *dibromosalicylic acid*, which is quite insoluble in water, collected on a filter, washed, dried in a desiccator, and its weight ascertained. The filtrate is rendered alkaline with sodium carbonate, and evaporated to a small bulk to get rid of the bromine; it is then acidified with hydrochloric acid and the benzoic acid shaken out with chloroform, the chloroform extract being evaporated and the residual benzoic acid weighed.—A. R. L.

Estimation of Theobromine in Cocoa Beans. P. Süss. Zeits. Anal. Chem. 1893, **32**, 57—63.

THE author recommends the following method for the estimation of theobromine in cocoa beans:—3 grms. of the sample are rubbed to a fine powder with an equal weight of purified quartz sand, and the mixture digested with light petroleum (boiling-point 45°—60°) for 10 hours to extract the fat; the residue is boiled for half an hour with 200 cc. of water and 6 grms. of pure lead oxide mixed into a sludge, strained and pressed, the lead oxide being again boiled for a quarter of an hour with 100 cc. of water. The combined aqueous extracts are filtered, evaporated to 10 cc., and shaken with 100 cc. of chloroform for three minutes in a separating funnel. After three hours the chloroform is run off, and the extraction repeated a second time. The greater portion of the chloroform is now distilled from the combined extracts, and the remaining portion evaporated on the water-bath in a tared beaker, the residue being weighed as theobromine; it contains extremely little ash.—A. R. L.

Estimation of Nitrogen in Nitrocellulose. E. von Keussler. Zeits. Anal. Chem. 1893, **32**, 51—53.

THE author has further altered Hess' modification (Zeits. Anal. Chem. **22**, 128) of Lunge's process for the estimation of nitrogen in nitrocellulose. He employs the form of Hofmann's eudiometer depicted below.



The nitrocellulose (0·15—0·16 grm.) is folded in a cartridge of specially-prepared cigarette paper, which evolves no gas on treatment with sulphuric acid in the presence of mercury. The cartridge is admitted into the arm A, the eudiometer filled with mercury, and the tap *a* closed. Some mercury is now drawn off by the tap *c*, in order to suck out the occluded air from the cartridge, which latter lies below the platinum wires fused into the eudiometer, and is surrounded completely by mercury. The arm B is filled with mercury, and the air which has collected in A expelled by the tap *a*; the process is repeated several times to ensure the complete expulsion of the air. Five cc. of sulphuric acid are now introduced into A by the funnel *b*, the same volume of mercury being simultaneously run out at *c*. Immediately the acid is in contact with the nitrocellulose, two small bubbles of air are generally noticed to rise; these are got rid of through *a* by filling up the arm B with mercury. An interval of about 10 minutes is now allowed for the sulphuric acid to dissolve the nitrocellulose. The arm B is then closed with the palm of the right hand, A being held between the second and third fingers, with the thumb pressing on the tap *a*, whilst the portion of the stand immediately under the eudiometer is taken between the third and fourth fingers of the left hand, the thumb pressing on the curved portion of the apparatus. The eudiometer is then shaken in a vertical position with short jerks, after which the necessary quantity of mercury, dependent on the volume of nitric oxide, is discharged by *c*. When the volume of the gas no longer increases by shaking, the operation is complete, and after the apparatus has cooled the levels are adjusted and the reading taken.—A. R. L.

Estimation of Aniline and of Methylaniline. Zeits. Anal. Chem. 1893, **32**, 108.

GIRAUD (this Journal, 1890, 660) has modified Reverdin and de la Harpe's method (*ibid.* 1889, 422) of estimating aniline and methylaniline, thus, instead of employing pure acetic anhydride, a mixture of 1 vol. of the latter with 10 vols. of dimethylaniline is recommended, and it is shown that this mixture may be kept for a long period without undergoing change.

Reverdin and de la Harpe (Bull. Soc. Chim. [3], **7**, 211) state, however, that the mixture slowly interacts at the ordinary temperature, giving rise to tetramethyldiamidodiphenylmethane. It is only after keeping the mixture for six months in a well-closed vessel that sufficient of the base is formed to influence the quantitative determination of aniline and methylaniline—only 4 grms. of the base was produced in two years. On exposing the mixture to the air the conversion of dimethylaniline into tetramethyldiamidodiphenylmethane is somewhat rapid.—A. R. L.

A Method for the Analysis of Cheese. A. Maggiora. Archiv. f. Hygiene, **14**, 216.

THE sample is pounded in a mortar and the dough pressed through a wire sieve, the mesh of which is less than 1 sq. mm. The mass is now kneaded for a long time in a large vessel and placed in a stoppered bottle.

For the Estimation of Moisture.—2—3 grms. are mixed with 23 grms. of prepared quartz sand, and heated at 100° until constant in weight.

The fat is estimated by extracting the dried residue with light petroleum (boiling-point 45°) in a Soxhlet's apparatus.

The total nitrogen is estimated in 1—2 grms. of the samples by Kjeldahl's method.

The proteïds are separated by Stutzer's method (in 2 grms. of the sample), the nitrogen being determined in the copper precipitate by Kjeldahl's method, and converted into proteïds by the factor 6·25.

Nitrogen as Ammonia.—2—3 grms. of the sample are mixed into an emulsion with about 250 cc. of distilled water; 5 grms. of calcined magnesia are added, and the ammonia expelled by heating and collected in the usual way.

The amidic nitrogen is the difference between the total nitrogen and the nitrogen as proteïds.

The ash is estimated by carbonising 5 grms. of the sample, extracting the carbonaceous mass with boiling water, evaporating the extract and igniting the residue. The amount of sodium chloride is determined by dissolving the ash in dilute nitric acid and precipitating the chloride with silver nitrate.—A. R. L.

The Reducing Sugars Present in Beetroot Juice. Claassen. Deutsche Zucker-ind. 1892, 17, 1372.

See under XVI., *page* 366.

The Estimation of the Fermentable Matter in Beer Worts. A. Bau. Chem. Zeit. 1892, 16, 1473 and 1520.

See under XVII., *page* 368.

INORGANIC CHEMISTRY.—QUANTITATIVE.

The Determination of Calcium Carbonate in Slurry. C. Mann. Thonind. Zeit. 1892, 18, 1055.

See under IX., *page* 355.

ANALYTICAL AND SCIENTIFIC NOTES.

The Fusion of Calcium Carbonate. A. Joannis. Comptes rend. 115, 1892, 1296—1298.

The author in replying to Le Chatelier's (Comptes rend. 1892) criticisms on his previous communication (*ibid.* 935), maintains that calcium carbonate cannot be fused by heating to 1020° C. under the ordinary pressure, but that a considerably higher temperature, combined with great pressure, is required. Hall's work is again cited in support of this statement.—H. T. P.

The Fusion of Calcium Carbonate. A. Joannis. Comptes rend. 1892, 115, 934—936.

It is maintained here that in the experiments of Hall and of Le Chatelier (this Journal, 1893, 295) the fusion must be considered to have been practically brought about through the intervention of externally applied pressure. The insufficiency of the pressure attained merely by the dissociation of the carbonate of lime below the melting-point of gold, was demonstrated. The mass was heated and the tension approximated 9 atmospheres. The carbonate of lime was not massed together and showed no sign of fusion having taken place.

On heating at an increased temperature until a pressure of 17 atmospheres was attained, it was ascertained that a very friable form of chalk was produced, and with a pressure of 22 atmospheres the mass obtained presented much the appearance of ordinary chalk.

On further raising the temperature it was found that underneath a thin layer of lime there was formed a very hard crystalline mass, which was capable of being polished.

Experiments with chalk heated at a temperature above the melting point of gold, and such that the gas tension produced was about 15 atmospheres, produced a marble-like mass capable of being polished, but which was more finely grained than marble.—T. L. B.

The Fusion of Calcium Carbonate. H. Le Chatelier. Comptes rend. 1892, 115, 1009—1011.

The previous results of the author (this Journal, 1893, 295) having been attacked by Joannis (see preceding abstract), further experimental evidence is brought forward. Hall's experiment is repeated of heating precipitated carbonate of lime at 1020° in a steel tube internally coated with nickel. In an hour a beautifully crystallised mass was obtained. The apparent disagreement of such a result with that of Joannis is explained thus:—

We know that when a body can exist in several allotropic forms, each of these forms has a different fusing-point. Octahedral sulphur melts at 113° C., whilst prismatic sulphur melts at 117° C. If octahedral sulphur be slowly heated it is transformed at 95° C. into prismatic sulphur and then melts at about 117° C. If, on the contrary, the octahedral sulphur be heated quickly, it melts at 113° C., but could, immediately melted, be transformed into solid prismatic sulphur. If the fusion and solidification follow each other with sufficient rapidity, a condition of pasty fusion is attained in the mass. Analogously with silica, when silica bricks used in steel furnaces are heated too quickly, it is possible to bring about fusion of them, a consequence not to be feared with slow heating. The author has proved that in these bricks the quartz is converted into *tridymite,* a variety of silica less fusible than quartz (this Journal, 1893, 314). In the same way, a mixture of silica and alumina, heated quickly, melts, afterwards solidifying again in consequence of the crystallisation of *silimanite.* It is not impossible that there may be for carbonate of calcium a number of allotropic varieties possessing different fusing-points.—T. L. B.

Behaviour of Metallic Oxides at a High Temperature. H. Moissan. Comptes rend. 115 (1892), 1034—1036.

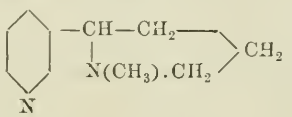
A study of the behaviour of various metallic oxides at temperatures ranging from 2000° to 3000° has led the author to the following conclusions:—The oxides of magnesium, calcium, and strontium first crystallise and then rapidly liquefy; boric acid, titanium protoxide, and alumina are quickly volatilised, whereas the oxides of the metals of the iron group are converted into liquid masses, which are studded with small crystals.

In all the experiments a simple elevation of temperature brought about the crystallisation of the metallic oxide.

—F. S. K.

The Constitution of Nicotine. A. Pinner. Ber. 26, 292—305.

All facts so far experimentally derived on this subject demonstrate that nicotine is a bitertiary base, and consequently possesses the formula—



It is therefore a condensation product of pyridine with methylpyrrolidine. To this conclusion also the author's investigation distinctly points.—W. S.

Relation between the Heats of Formation and the Critical Temperatures of Reaction. M. Prud'homme. Comptes rend. 115, 1892, 1307—1308.

Berthelot has shown at different times that in similar reactions the critical temperatures of reaction (*i.e.*, the lowest temperature at which reaction can take place) vary inversely as the respective amounts of heat liberated. Also, according to Pictet (Comptes rend. 1892, 814), all chemical action ceases at very low temperatures (− 155° to − 125° C.), and only comes into play at more elevated temperatures, varying in different instances. The author finds that for similar compounds the product of the heat of formation (Q) and the critical temperature (absolute) of reaction (T) is sensibly constant. For example—

$$S + O_4 + K_2 = 342.2 \text{ cal.}; \quad S + O_4 + Na_2 = 326.4 \text{ cal.};$$
$$S + O_4 + N_2 + H_8 = 282.2 \text{ cal.}$$

The products Q T are—

$$342.2 \times 183 = 626; \quad 326.4 \times 193 = 629;$$
$$282.2 \times 213 = 601.$$

On the other hand, the molecular heat (M × C) is constant for similarly constituted bodies. One may, therefore, write—

$$Q\,T = K \times M \times C \text{ or } \frac{Q}{M} = K\frac{C}{T};$$

i.e., for a series of similar compounds the heat of formation of the unit of mass is proportional to the specific heat, and inversely proportional to the absolute critical temperature of reaction.—H. T. P.

Note on the Boiling-Point of Nitrous Oxide at Atmospheric Pressure, and on the Melting-Point of Solid Nitrous Oxide. William Ramsay and John Shields. Proc. Chem. Soc. [122], 1893, 76.

The boiling-point of the liquid nitrous oxide was found by means of a constant volume thermometer filled with hydrogen to be − 89·8°, and the melting-point of the solid to be − 102·3°. The method adopted is one in which the errors due to the gas in the stem of the thermometer not being at the same temperature as that in the bulb and to the alteration of the capacity of the bulb by change of temperature are eliminated.

New Books.

Tabellarische Uebersicht über die Künstlichen Organischen Farbstoffe und Ihre Anwendung in Färberei und Zeugdruck. Von Dr. Adolf Lehne. *Erste Lieferung.* Berlin: Verlag von Julius Springer, 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. Six Parts, 6*s.* each.

This beautifully illustrated tabular review of the artificial organic colouring matters is intended as a companion work, when completed (the present issue being Part I. of six parts in all to be issued), to Schultz and Julius's "*Tabellarische Übersicht der Künstlichen organischen Farbstoffe.*" It represents, indeed, the illustrative section of that work, containing in one column of each table the reference numbers corresponding to the colours represented in the work of Schultz and Julius (this Journal, 1891, 662), where the scientific names and formulæ may be found; in the next column the trade names of these colours are found; in the next the details as to use of the colours, means of solution, fastness, reactions on the fibre, &c.; and, finally, a column of about 1½ inches width containing a sample of dyed material corresponding to each colour represented and described.

Part I., which is of quarto size, contains a friendly dedication of the whole work to Dr. Gustav Schultz; Preface; List of Abbreviations of the names of firms represented, which include both British and American; a scheme for testing the colours for fastness on the fibre, another for testing and discriminating the colours themselves on the fibre, and finally one of methods for systematically applying the colours with or without mordants to the fibres:—I. Wool; II. Silk; III. Cotton and Linen; and IV. Jute. An additional scheme is added, of printing recipes on—I. Wool and Silk; II. Cotton (Linen); and III. Jute. Next follow the Tables, commencing with—I. The Nitro-dyestuffs. Next follow II. The Azo- and Hydroxy-colours. III. The Hydrazone Colours. Then the comprehensive group of the Azo-colours is represented, but is not completed in Part I., which thus comprises 16 tables, in which each colour referred to is illustrated, as already stated, by a dyed specimen.

Handwörterbuch der Pharmacie. Praktisches Handbuch für Apotheker, Ärtzte, Medicinalbeamte und Drogisten. Herausgegeben von A. Brestowski. Lieferungen 7 und 8. 1893. M 4.80. 4*s.* 10*d.* Vienna and Leipsic, W. Braumüller, K. U. K. Hof- und Universitäts-Buchhändler. London: H. Grevel and Co., 33, King Street, Covent Garden.

Parts 7 and 8 of this work are now issued, a Dictionary of Pharmacy, in the production of which a staff of some 41 of the first Pharmacists and Chemists of Germany, Austria, and Switzerland is engaged, along with the editor, A. Brestowski. Part 7 commences with "*Comptonia*" and ends with "*Dissociation,*" whilst Part 8, which continues and finishes this subject, ends upon the word "*Fäulniss.*" (See this Journal 1892, 782.)

Traité Pratique D'Analyse Chimique et de Recherches Toxicologiques, &c. Par G. Guérin, Professeur Agrégé à la Faculté de Médecine de Nancy, &c. Paris: Georges Carré, 58, rue Saint-André-des-Arts, 58. 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. Price 12*s.*

This work on Chemical Analysis, pure, as well as applied to Toxicology, fills a large 8vo volume in paper cover, and containing 471 pages of subject matter, followed by an Alphabetical Index. The work opens with a Preface, in which the Author states that the fruits of many years' practical experience are embodied in its pages. The details of qualitative analytical methods are given with much minuteness, and are copiously illustrated both by woodcuts and diagrams, the coloured diagrammatic charts representing the bead tests before the blowpipe, of the various metals, forming a striking feature of that portion of the work devoted to the dry methods. The general method of examination for acids and bases covers 46 pages, when a section is commenced dealing with the distinctive characteristics of the metals and metalloids, which is continued to page 161, when Part IV. is reached, in which the qualitative analysis of gases and gaseous mixtures is dealt with. Part V. treats of spectrum analysis; Part VI., of toxicological analysis, with the reactions of the alkaloids; Part VIII., analysis of potable waters, river waters, and mineral waters, and, as a section of this, there is a very complete treatise on the bacteriological analysis of waters. Next follows a system of analysis of clays, and also of iron and steel. A short Appendix closes the subject matter, and a complete Alphabetical Index, the work. The text is illustrated with 77 woodcuts, and two fine plates representing the solar spectrum and those of the principal metals, with also an additional one of absorption spectra.

Die Wirkungsweise der Rectificir- und Destillir-Apparate mit Hülfe einfacher mathematischer Betrachtungen, dargestellt von E. Hausbrand. Mit 4 Textfiguren und 14 Tafeln nebst 18 Tabellen. Berlin: Verlag von Julius Springer. 1893. London: Aug. Siegle, 30, Lime Street, E.C. Price 5*s.*

This work is a treatise on the manner of working of rectifying and distilling apparatus of the so-called column types, for spirit distilling. In the mathematical treatment of the subject subsequently adopted throughout the work, the following assumptions are made:—

1. Only a mixture of not more than two liquids is considered.

2. The liquids are always taken to be at their boiling-point, unless specially stated otherwise.

3. The latent heat of the vapours arising from a boiling mixture, is equal to the sum of the latent heats of the individual vapours present.

4. The latent heat of all substances changes with the pressure under which their vapours exist. This pressure is different in different parts of the apparatus, and consequently the latent heats vary correspondingly. For the sake of simplicity, however, the same, or an even, latent heat is assumed in every part of the apparatus, in the subsequent calculations and figures.

5. A mixture of vapours is developed from a boiling liquid mixture, the composition of which depends directly on that of the liquid.

Modified by these limitations and conditions, the functions of every part of the rectifying or dephlegmating column are considered and treated of. The mathematical treatment is exemplified in the numerous tables and illustrations.

An Introductory Manual for Sugar Growers. By Francis Watts, F.G.S., F.I.C. London: Longmans, Green, and Co. New York: 15, East 16th Street. 1893. Price 6*s.*

An experience of some years in the West Indies has led the author to see the necessity for some simple handbook for the use of those engaged in the sugar industry—one containing an outline of the principles of agriculture, based on modern scientific discovery, as well as an outline of the principles underlying the manufacture of sugar.

This little work is thus suitable, since it was intended for young overseers about to begin their training in the sugar fields and boiling-houses.

The book is of 8vo. size, with Table of Contents, List of Illustrations, and text covering 140 pages. It concludes with an Alphabetical Index. The text is illustrated with 20 woodcuts. The subject is treated pretty much as indicated below. I. Chemical Elements and Symbols. Cells, Tissues, &c. Structure and Function of Roots, Stems, and Leaves. II. Origin of Soil; Clay, Chalk or Marl, Sand. Analysis of Soils. Nitrification. Retention of Plant Foods by Soils. Drainage. III. Sugar Cane. Planting, Manuring, &c. Cutting Cane, &c. IV. Manures. V. Cane Mills. Three-roller Mill. VI. Cane Juice. Use of Lime. Clarifying. Formation of Scum. VII. Manufacture of Sugar. Inversion. Open-fire Process. Steam Pans. Vacuum Pan. Use of Sulphur. Phosphoric Acid Process. Animal Charcoal. VIII. Hydrometers or Saccharometers. IX. Molasses. Recovery of Sulphur from Molasses. X. Fermentation. Conversion of Cane Sugar into Alcohol. Stills.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

TURKEY.

The Importation of Explosives.

According to the *Bulletin du Museé Commercial* for the 18th March, the prohibition of the importation into Turkey of explosive materials, notably of picric acid, is rigorously maintained. These products are confiscated on entry, and in cases where they are declared in customs under a name which does not indicate their dangerous character, a fine, amounting to double the value of the articles seized, is applied.—*Board of Trade Journal.*

UNITED STATES.

Regulations affecting the Disinfection of Imported Rags.

Under the new Act of the United States Legislature affecting quarantine laws and regulations, approved on the 15th February last, the following regulations with regard to the disinfection of imported rags have been made:—

All rags and all textile fabrics used in the manufacture of paper collected or packed in any foreign port or place, must, prior to shipment to the United States, be subjected to disinfection by one of the following methods:—

First. Boiling in water for not less than 30 minutes, all rags to be unbaled for this purpose.

Second. Exposure to steam for not less than 30 minutes, the steam to be of a temperature not less than 100° C. (212° F.), nor greater than 115° C. (239° F.).

Third. Exposure for not less than six hours to sulphurous acid gas, made by burning not less than 3 lbs. of roll sulphur to each 1,000 cub. ft. of space.

Fourth. Exposure for not less than six hours to an atmosphere containing 3 per cent. of sulphurous acid gas liberated from its liquid state (liquid sulphur dioxide).

In methods No. 2, No. 3, and No. 4, the rags must be well scattered upon racks, or so arranged that they can from time to time be turned in such a manner that all shall be exposed to the steam or gas.

In methods No. 3 and No. 4, the exposure to gas must be conducted in a closed apartment, where the rags do not at any time occupy more than 50 per cent. of the total cubic space, and the exposure to date from the complete combustion of all the sulphur.—*Ibid.*

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Merchandise commercially known as "india-rubber cement," chiefly used in patching shoes and cementing, either in combination or separately, parts of india-rubber and leather, and consisting of crude india-rubber dissolved in benzene, is dutiable at 20 per cent. *ad valorem* under section 4, Act of October 1st, 1890.—*Ibid.*

DECISIONS OF THE BOARD OF GENERAL APPRAISERS.

Bog Iron Ore.

In the case of the Prince Manufacturing Company against the Collector of Customs at Ogdensburg, N.Y., concerning the duties on bog iron ore, it was decided that, as the material in question contained over 53 per cent. of iron, was used for purifying gas and never as a paint or colour, it was iron ore and dutiable at 75 cents a ton.

Cadmium Yellow.

Protest of the Roessler and Hasslacher Chemical Company, of New York, concerning the duties on cadmium yellow. The merchandise was invoiced as cadmium yellow and assessed for duty as a pigment at 25 per cent. It was claimed it was exempt from duty as cadmium. The board found that cadmium yellow was "something more" than metal cadmium, and the protest was overruled.

Magnesium Chloride.

Protest of Eastwood and Co., of Boston, against the Customs Collector of that port concerning the duties on chloride of magnesium. The material was assessed for duty as a chemical salt, and it was claimed that it was exempt from duty "as either magnesium, as muriate of potash, or as kieserite." The Board found that chloride of magnesium differed from all the foregoing, and was a chemical salt. The protest was overruled.

Mineral White.

Protest of John Bromley and Sons against the Collector of Customs of Philadelphia, concerning the duties on mineral white. The material was assessed for duty at 20 per cent., under section 4, new tariff, and it was claimed that it was dutiable at 1 dol. per ton as plaster of Paris, under Paragraph 97. According to analysis the article is composed of corn starch 7·10 per cent., and dehydrated calcium sulphate 92·90 per cent. The matter, consequently, is not plaster of Paris, and the protest is overruled.

Duties on Ground Asphalt.

Protest of the Roessler and Hasslacher Chemical Company against the decision of the Collector of Customs of New York, as to the rate of duties on ground asphalt. The asphalt was assessed for duty at 20 per cent. *ad valorem* under section 4, new tariff, and the importers claimed free entry as crude asphalt under paragraph 496, new tariff. The Board found that said merchandise is bituminous limestone advanced in condition by grinding, and containing in its natural state about 8 per cent. of bitumen; also, that said limestone is naturally impregnated with bitumen, and is quarried in Italy. It is a non-metallic substance, and is not crude asphalt. The Board therefore sustains the collector.

Chrome Ore.

Protest of the Baltimore Chrome Works, of Baltimore, Md., against the decision of the Collector of that port as to the duties to be paid on chrome ore. The appeal was sustained. At the time of making the entry the appellants added to the *per se* value of the ore, the cost of transporting the same from the mines of Syria to the shipping port, and also added a sum equal to the tax imposed by Turkey on ore mined in and exported from that country. No question was raised as to the action of the Collector in assessing duty on the amount of tax so added. The question at issue was whether duty should be assessed on these transportation charges, or whether the company should pay duty on the goods, based on their value at the mines. The Board held that the entries of the ore were made under duress and that said entries are not binding upon the appellants.

The protests lodged against the assessment of duty on transportation charges from the mines to the exporting vessel are, so the appraisers say, well founded, and the same are sustained. The Collector's decision is reversed and he is authorised to reliquidate the entries in accordance with this decision.—*Eng. and Mining Journal.*

Mexico.

Tariff Changes.

Mr. Lionel Carden, Her Majesty's Consul at Mexico, in a report to the Foreign Office, dated the 14th March, encloses copy and translation of an amended decree modifying the existing Customs tariff of Mexico. The following changes in the rates of duty now levied came into force on April 15th:—

Note.—By "net" weight must be understood the actual weight of the merchandise; by "legal" weight, that which includes besides the "net" weight, that of the interior bottles, boxes, winders, wrappers, &c., in which the articles are imported, and by "gross" weight, the total weight of the packages.

No.	Description.	Duty.	
51	Albumen made from eggs or blood........	Legal	0·05
53	Glue..................................	Gross	0·05
59	Gelatine..............................	Legal	0·10
61	Fish glue.............................	"	0·10
64	Cod-liver oil.........................	"	0·10
122	Stearine candles......................	Gross	0·18
123	Tallow candles........................	"	0·18
179	Camphor...............................	Legal	0·25
260	Crucibles of platinum.................	Gross	0·01
295	Zinc..................................	"	0·01
355	Asbestos..............................	"	0·01
361	Carbonate of lime or Spanish white......	Per 100 kilos.	0·50
386	Vaseline..............................	Gross	0·10
652	Acetates of aluminium, ammonia, lime, copper, chrome, iron, lead, or soda.	Legal	0·05
653	Arsenical acid........................	"	0·02
654	Hydrochloric, sulphuric, and sulphurous acids.	Gross	00·1½
655	Acetic, nitric, oxalic, and pyroligneous acids	Legal	0·03
656	Carbolic acid.........................	"	0·02
658	Acids in crystals or in powder, not elsewhere specified.	"	0·40
668	Sugar of milk.........................	"	0·25
677	Alkaline cyanides.....................	"	0·02
683	Chloride of lime, soda, and potash.........	Gross	0·01
697	Hyposulphate of soda..................	"	0·01
699	Concentrated lyes.....................	"	0·01
702	Nitrate of silver.....................	Legal	2·00
704	Patent pharmaceutical products..........	"	1·00
707	Permanganate of potash................	Gross	0·02
710	Putty (binoxide of tin)................	"	0·03
712	Common or table salt..................	"	0·02
716	Saltpetre or nitrate of potash and soda.....	"	0·01
718	Soda and caustic potash...............	"	0·01
719	Sulphate of copper, iron, and ammonia....	"	0·01
720	Sulphate of soda and magnesia and borate of soda.	Gross	0·04
721	Sulphite, bisulphite, and trisulphite of lime and soda.	"	0·01
722	Sulpholine............................	"	0·05
727	Poison for preparing skins..	Legal	0·02
728	Medicinal wines, even though they be patented.	Net	0·40
729	Iodine................................	Legal	0·50
731	Spirits in earthenware or glass bottles.....	Litre	0·55
732	Spirits in barrels....................	"	0·40
736	Bitters...............................	Net	0·35
737	Liqueurs..............................	"	0·35
741*a*	Sparkling wines.......................	"	0·50
899	Unscented soap........................	Gross	0·20

—*Board of Trade Journal.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Glove Leather Industry in Austria.

The following particulars respecting the glove leather manufacture in Austria are extracted from the last report of the United States Consul at Prague:—

The material used in the manufacture of gloves is almost exclusively lambskin, the skins coming in three different different sizes only—first, second, and third grades. The skin of the young lamb slaughtered when but a few months old is called first grade; the skin of the more mature lamb, which, however, is not full grown, is called second grade; and the skin of the full grown lamb is called third grade. The second-grade skin is best adapted to the manufacture of gloves, and is mostly used. The supply of skins comes from the Orient and the Danube provinces; Bulgaria, Servia, Albania, Greece, Turkey, and Russia sending large quantities of skins. Vienna is the market for the skins, and Oriental capitalists control the import principally. The skins are brought into the market mostly in a dry state, but a small proportion come in a salted condition. The dry or salted skin is treated in the following manner in order to prepare it for use as glove leather.

The skins are placed in a cemented pit, soft river water being poured upon them, and they are allowed to stand from 12 to 18 hours. At the end of this period they are taken out and then once more placed in the pit and subjected to this same softening process for a similar length of time. This softening process sometimes is of longer duration, as in the winter time or when the skin is not in a normally dry condition. After the skin is sufficiently softened, the fleshy side is smeared with white lime, and it is placed in the pit and covered with water, being ready for depilation after 10 or 14 days. A mixture of sulphide of sodium with the white lime shortens this time and tends to improve the quality of the leather. As soon as the skins are ready for the process of depilation, they are washed in running water to remove the lime and then placed upon a stand and depilated with a dull instrument. The hard portions are cut off with a sharp knife, and the fleshy side of the skin is loosened. After this is done, the skins are placed in a solution of animal excrement, or, according to the old method, in a bran-dye bath. This process has a decomposing effect upon the impurities contained in the pores and fibres of the skin. After the skins have remained in this ooze from 2 to 12 hours they are taken out and both sides are carefully gone over to open the pores and to remove the dirt. Thereupon the skins are again allowed to stand from 2 to 12 hours in a bran-dye bath, when they are ready for treatment with tannin. The tannin used is a mixture made of the following substances:—Alum, 60 parts; salt, 20 parts; egg-yolk, 50 parts; flour, 100 parts. The skins are fulled for two hours in this mixture and then taken out and dried. After drying, they are again moistened and dressed, the whole process of tanning taking about three weeks' time. Before dyeing, the superfluous tannin is removed by fulling the skins in soft water, and they are also fulled again with egg-yolk. The skins are dyed with a decoction made from dyewoods, such as fustet, Cuba yellow-wood, redwood, and logwood. After being dyed, the skins are again dressed. The brilliancy of the colours depends principally on the thoroughness of the tanning, but is also increased by a skilful mixture of the dyes.

The prices of the skins vary, according to size and quality, from 90 to 160 florins per 100 skins, and the cost of tanning adds from 14 to 20 fl. to this amount.

The hours of labour in tanneries are 10 per day, and the wages range from 9 to 12 fl. per week for workmen, 20 kreutzers an hour being paid for overtime. Appentices are paid 5 fl. per week. The wages for dyers are about the same.—*Ibid.*

GENERAL TRADE NOTES.

The World's Petroleum Supply.

Petroleum is produced in various countries, either in its raw state springing from natural sources—as for example, in the United States, Russia, Canada, Dutch East Indies, Austria, Roumania, Peru, and the Argentine Republic, or produced by the distillation of bituminous schist, as in Italy and France. Up to the present the United States has been the most important centre of the petroleum production. The *Moniteur des Intêrets Materiels* says that statistics establishing the yield during the last months of 1892 seem to indicate a gradual exhaustion of the sources, as the average monthly supply in 1892 was only 87,711 gallons, compared with 94,980 gallons in 1891. On the other hand, the production of raw petroleum in 1891 and 1890 was respectively 34 and 45 million barrels, or a falling off of 11 million barrels in 1891. In spite of this the exports of petroleum, raw and refined, have followed, thanks to the employment of tank-steamers, an ascending scale and amounted to 740,905,237 gallons in 1892, as compared with 667 millions in 1891.

In spite of the diminished production the prices instead of rising have experienced a fall owing to the keen competition of Russian with American petroleum.

At Baku, in Russia, the production is very great, and even exceeds the demand. No greater proof of this fact can be evidenced than the low prices lately quoted, viz., ½ copeck per poud (36 lb. avoirdupois) for raw petroleum, and 7 copecks free on railway trucks for refined petroleum. During the first nine months of 1892 the production of raw petroleum in the Apsheron Peninsula amounted to 213,560,157 pouds, as compared with 213,056,000 pouds for the corresponding period of 1891.

The present depressed condition of the petroleum market in Russia will be improved, it is expected, by the formation of the syndicate that has been constituted by the seven principal producers of petroleum at Baku under the presidency of MM. Nobel frères.

With respect to petroleum production at Baku, Mr. P. Stevens, Her Majesty's Consul at Batoum, in a report to the Foreign Office, dated the 1st March, states that an oil well has recently commenced to flow at Baku, which at its present rate of production, considerably exceeds the daily output of all the largest wells that have hitherto been in activity in the Apsheron Peninsula.

It is estimated that the well in question is delivering as near as possible 1,000,000 pouds, or 17,742 tons, of crude oil a day, but owing to the almost insurmountable difficulties experienced in getting a flow of this magnitude under control, most of the oil is running to waste into an adjoining lake known by the name of Romani.

The well is situated from a quarter to half a mile further eastward on the Peninsula than any of the other wells, and, it would appear, opens up a fresh territory, comprising several hundred acres of land from which no oil has as yet been extracted.

From the point of view of the importance of the production, the petroleum supplies of Canada take the third place. From the 1st January to the 30th November 1891, 192,700 barrels of raw petroleum, and 248,025 barrels of refined were exported; during the same period of 1892 these shipments amounted to 182,371 and 279,823 barrels respectively, a total production in the first 11 months of 1891 equivalent to 805,687 barrels of raw petroleum, and in 1892 to 917,561 barrels. As was stated in the *Board of Trade Journal* for January last, petroleum has been found in Quebec, Nova Scotia, and New Brunswick, and particularly in the North-West Territories, where it seems certain that there is an immense unexplored oil region. It is, however, in the county of Lambton, Ontario, whence most of the oil has been, and still is, obtained; the township of Enniskillen is one of the largest oil-producing districts, and the oil is obtained there at a depth of from 370 to 500 feet. The first flowing well was struck in February 1862, and before October of the same year there were no less than 35 wells. As there was no accommodation for the storage of this enormous flow, there was a frightful amount of waste, and it is calculated by one authority that between the dates mentioned no less than 5,000,000 barrels of oil floated off upon the water of a neighbouring creek.

The petroleum supplies of the island of Sumatra have only recently been exploited. The product of one district amounted to 20,000 ten-gallon boxes in a year. According to the most recent analyses* the Langkat petroleums are of excellent quality, and moreover they are derived from lands the extent of which is 40 times greater than those in Russia.

According to official statistics, published by the Austrian Minister of Agriculture, there were in Galicia in the year 1891, 199 establishments engaged in the production of petroleum, and 79 ozokerite mines, supplying together a total quantity of 93,875 tons of an estimated value of 491,000*l.*

In Italy and France petroleum is obtained by the distillation of bituminous schist. In 1891 the Italian production was 1,155 tons of petroleum, while in France the amount of the product for 1889 was 194,000, as compared with 174,000 in 1888.

The yield in Roumania barely attains a value of 2,400*l.*, although this amount might easily be increased, seeing that there are vast numbers of beds from which it can be obtained, and that the oil itself is of excellent quality. The explanation of the small supply lies in the fact that the government insists, in the case of crown lands, upon the payment of a royalty immediately upon the signing of the contract, and even before any petroleum has been found.

The petroleum beds in Peru are of vast extent and are beginning to attain considerable importance. The London and Pacific Petroleum Company have works extending over a distance of two miles along the coast, and own 26 wells which are in working, having a depth of from 70 to 500 feet, and producing 900 barrels a day.

In the Argentine Republic, 12 pits have been sunk in the department of Lujan, province of Mendoza, of which three have yielded excellent results. The company working these mines since 1890 have produced about 1,500 tons of petroleum.

In the republic of Ecuador numerous petroleum beds are known to exist, and these are of considerable extent. In certain places the oil springs from the ground and forms pools and streams which eventually find their way into the sea. A syndicate has recently been formed, with the object of obtaining the concession of these sources of petroleum.

In British Burma it appears from a report by Dr. Fritz Noetling, Geological Survey of India, a résumé of which was published in the *Board of Trade Journal* (this Journal, Nov. 1892) p. 950, that there are now 602 petroleum wells, an increase of 92 since 1888, but there are distinct signs of exhaustion. The fact that the aggregate production of the richer wells has fallen off, while that of the poorer ones has increased, although many new wells have been opened, is regarded as the surest indication of the approaching decline in the industry. The drilled wells worked by the Burma Oil Company and the Burma Oil Syndicate have given very satisfactory results. In 1890 the total out-turn amounted to over 3,670,000 *viss.*; but the rate of progress during 1888, 1889, and 1890, has not been maintained during the past two years. The history of the industry shows that the production of the oil field steadily increased from the beginning of the century until about 1873, when it began to decline, rising again in 1885 and coming practically to a standstill in 1891.—*Ibid.*

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* *See* Report on the Comparative Tests of American, Russian and Sumatra Oils, this *Journal*, March 1893, p. 255

Some Misconceptions Concerning Asbestos.

During the past decade the uses of asbestos have become widely extended, and consequently brought to the knowledge of the great majority of those who live within range of our industrial centres. As a result of the wide applications of this substance and of the interest excited in the minds of many by a "stone" which may be teased out into a fluffy mass resembling silk or cotton, there has arisen a somewhat extensive literature of asbestos. This is scattered through geological, chemical, technical, and even religious publications, while there have appeared one or two not unpretentious volumes devoted entirely to this mineral. In these there are frequent statements which clearly indicate that the writers entertained serious misconceptions, and to call attention to some of these is the object of this paper.

1. There is a misconception as to the mineralogical character of asbestos, and this has arisen from the use of the name in a somewhat generic sense. Dana in his "Mineralogy" says that asbestos is a finely fibrous form of hornblende, but much that is so-called is fibrous serpentine. This statement seems to divide many of our writers into two camps, the one calling the mineral a variety of hornblende, the other proclaiming its serpentinous character.

The Canadian province of Quebec produces, it is estimated, about 85 per cent. of the world's supply, the balance coming principally from Italy. The products of these two countries are known the world over as asbestos, and it is not unreasonable, therefore, to ask that they be allowed to appropriate the name, even though they be of other composition than the mineral to which mineralogists originally applied the term, and that other minerals, if such there be, used for similar purposes be otherwise designated.

The asbestos of commerce is a hydrated magnesian silicate of the same composition as ordinary serpentine rock; in other words, it is fibrous serpentine. It is curious to note, however, that the Canadian miners working continually among serpentine and nothing else have fallen upon the word hornblende, and apply it to very coarsely fibrous and polished serpentine, such as is often met with along lines of faulting.

2. The second misconception is in reality but a special case of the first; it is to the effect that Canadian and Italian asbestos are different minerals. In the early days of the asbestos industry, Italy was the only source of supply, and immediately prior to the discovery of the Canadian deposits a powerful company had been formed, and had succeeded in bringing under one control the numerous small mines of the Italian district. Under the circumstances it is not to be wondered at that the Canadian fibre found no favour in the eyes of the owners of the Italian mines. The Canadian mineral was declared to be far inferior to the Italian; the latter, it was maintained, is true asbestos, while the former is only fibrous serpentine. As a matter of fact the two minerals are practically of the same composition, as is shown by the following results of analysis of fair samples recently made by myself:—Italian: Silica, 40·30; magnesia, 43·37; ferrous oxide, 0·87; alumina, 2·27; water, 12·72; total, 100·53. Canadian: Silica, 40·57; magnesia, 41·50; ferrous oxide, 2·81; alumina, 0·90; water, 13·55; total, 99·33.

Canadian asbestos has largely displaced the Italian, not because of difference in composition, but by reason of the greater ease with which the former can be wrought into the various forms required in the arts.

3. The third misconception is that asbestos is in nowise affected by heat. This is set forth in such statements as "temperatures of 2000° to 3000° are easily withstood," and "a mineral which has been successfully exposed to a heat of 4500° and 5000° F." Now what are the facts of the case? It is true that asbestos is infusible except at very high temperatures, but it is equally true that only a very moderate degree of heat, heating to low redness in a platinum crucible, for instance, is required to entirely destroy the flexibility of the fibre and render it so brittle that it may be crumbled between thumb and finger as readily as a piece of biscuit. In this connection one is reminded that the ancients are said to have possessed asbestos napkins which they cleansed by means of fire, and that Charlemagne in like manner cleansed his tablecloth to the delight of his warrior guests. It is not improbable that these statements are to a large extent mythical; certainly, if true, the articles in question were not made of asbestos, the hydrated magnesian silicate.

4. The fourth misconception is that asbestos is possessed of high non-conducting qualities. This is perhaps the gravest and most widely spread of the several misconceptions, and is held by many who should know better. As an example of the manner in which this last misconception is set forth, I may cite the following from an address of a well-known geologist: "Among the most important properties of asbestos is that of non-conductivity or its power of resisting the action of heat." Here we have the misconception clearly stated; it is that because asbestos is infusible it must of necessity be a good non-conductor. The truth is that asbestos itself is a very poor non-conductor, as any one may prove by placing a vessel of water on a sheet of asbestos cardboard, and applying heat from below, or more simply still by placing a piece of wood on a sheet of asbestos millboard on a hot stove. If, however, asbestos is teased out and worked into a fluffy mass we then obtain a non-conducting material, but it is the air inclosed by the fibres that is the real non-conductor; the asbestos serving simply to entangle the air. The use of asbestos in the manufacture of non-conducting coverings for boilers, &c., is due to its fibrous texture and its infusibility. The latter property gives it a decided advantage over hair and other fibrous materials which char under continued exposure to heat, while the exceeding flexibility of its fibres gives it a like decided advantage over mineral wool and other fibrous but brittle mineral substances.

The removal of the misconceptions to which attention has been called will in no respect tend to decrease the uses of asbestos, for the mineral has a sufficiency of good quality of its own to maintain and increase the demand; while, on the other hand, a true conception of its nature and properties will prevent its use under conditions where only disappointment can follow; a circumstance which in the end would tend to bring discredit upon a most valuable mineral.—*Eng. and Mining Journal.*

Quicksilver Mining in California.

Quicksilver mining in California, which began with the discovery of the New Almaden and adjoining mines, and which was stimulated by the discoveries of great bodies of argentiferous ore in Nevada and elsewhere, the reduction of which necessitated the consumption of large quantities of the mobile metal, has been on the decline for many years. The great bonanzas of the New Almaden and the New Idria have been exhausted, and no new mines which can equal their former production have been discovered. In addition, the quantity consumed by the reduction of silver ores has decreased, lead smelting, hyposulphite lixiviation, and other processes which require no mercury having entered the field and supplanted to a great extent the amalgamation plants, which were the only custom works in early days. Still, the industry is not dead by any means, and strong attention is being paid in California to the working of its minor deposits, which a few years ago were considered of too low grade or too small to be profitable.

The largest annual production of quicksilver in California was 79,396 flasks in 1877, and the highest price, 1·55 dols. per pound, was reached in 1874–75. The price in 1879 declined to 33 cents, the lowest ever reached; it averaged 58·1 cents in 1892.

Exportations to Great Britain, Chili, Peru, Australia, and New Zealand, which countries formerly bought large quantities of the quicksilver, have practically ceased, while those to China diminished from 36,958 flasks in 1879 to none during the past year.

Notwithstanding this decreased demand, the production during 1892 was greater than in either 1890 or 1891. It reached 27,993 flasks, as against some 22,300 flasks in each of the two previous years. Of this the greater portion came from four mines—the New Almaden, producing 5,563 flasks; the Napa Consolidated, 5,680 flasks; the Great Western, 5,867 flasks; and the Morabel, formerly the Bradford, 3,208 flasks.

This last-named mine is considered a promising one. It was purchased by the late Thomas Bell, J. B. Randol, and others in the early part of 1892, and while it has not as yet produced startlingly large quantities, it is believed that it will soon be the greatest California producer. New developments are said to have been made in the Guadalupe district, Santa Clara County, in 1892, but these have not been confirmed. The outlook for this industry does not seem to be poor. Of late the market price has been fairly steady, and the demand, while limited, is sufficient.

New furnaces, with labour-saving devices, and those for almost perfect fume condensation, have allowed the working of extremely low-grade ore, and as a consequence many of those mines which formerly proved unprofitable are now attracting attention. There is yet a considerable area of the Coast Range, to which these deposits seem to be confined, in which other bodies may be discovered.—*Ibid.*

THE TYNE CHEMICAL TRADE.

The following list has been specially abstracted from the yearly analysis made by the Tyne Improvement Commissioners of the goods imported and exported from the Tyne. As the figures include coastwise shipments, the coastwise total is given as well as the total for the year, the difference being the amount of the foreign imports or exports respectively. The annual total for the previous year is also given for the purposes of comparison.

Imports.

Description of Goods.	Coastwise.	Total. 1892.	Total. 1891.
	Tons.	Tons.	Tons.
Candles	1,036	1,050	1,357
Barytes	1,823	2,849	2,426
Copperas	123	123	1
Nitre cake and salt cake	..	..	6,178
Soap	2,545	2,546	2,342
Arsenic	301	391	2,543
Unenumerated chemicals	659	1,309	
Glucose	130	578	777
Drysalters' stores	4,369	5,006	5,379
Litharge and colours	653	988	979
Ochre	206	280	431
Nitrate of soda	43	6,150	6,346
Phosphates	253	17,916	12,884
Burnt sulphur ore	67,715	69,593	73,618
Sulphur ore	..	73,174	75,686
Salt	65,065	75,155	88,456
Oils (mineral)	6,145	18,137	23,989
Oils (other sorts)	3,398	4,115	4,850
Mineral tar and pitch	922	1,006	1,397
Margarine	..	1,560	1,755
Cutch	5	5	5
Esparto grass	..	11,546	9.929
Resin	27	3,623	3,139
Sumac	218	273	289
	Barrels.	Barrels.	Barrels.
Tar and pitch	487	6,436	7,435
	Tons.	Tons.	Tons.
Valonia	49	69	92

Exports.

	Tons.	Tons.	Tons.
Alkali and soda ash	1,270	10,588	14,219
Alum and alum cake	2,913	3,529	3,464
Ammonia and salammoniac.	25	2,232	2,220
Arsenic	21	322	132
Barytes (carbonate and sulphate).	1,276	6,007	5,212
Sodium bicarbonate	9	26	52
Bleaching powder	9,301	28,725	27,569
Caustic soda	8,824	20,329	20,753
Copperas	122	311	564
Epsom salts	76	83	286
Sodium hyposulphite	455	916	566
Magnesia	111	316	262
Manganate of soda	108	103	948
Manure	7,472	22,05	19,868
Sodium nitrate	118	286	691
Potash	27	38	
Pearl hardening and gypsum	542	1,353	2,522
Soap	264	273	78
Soda crystals	50,742	54,584	64,658
Sodium sulphate	115	4,563	3,015
Sulphur	1,012	10,208	9,324
Silicate of soda	91	505	1,705
Unenumerated chemicals	207	725	
Glue	21	22	20
Litharge	396	909	841
Red and white lead and paint	14,078	19,998	19,424
Oil, varnish, and turpentine.	6,562	6,900	4,302
Paper	5,073	5,548	6,844
Salt	175	201	162
Slag and mill cinders	476	977	..
Ochres	6	65	100
Tar, pitch, and resin	219	645	1,946
Venetian-red	34	72	168
Vinegar and acids	..	75	76

It is interesting to know to what countries the larger shipments of the more important items go or come, and we have therefore appended the following special analysis:—

Imports.—The chief source of barytes was Belgium and Holland, from which 1,016 tons were shipped. Of the glucose imported, 439 tons were from U.S.A. Of phosphates 12,348 tons were from African ports, 4,078 from Holland and Belgium, 1,237 from France. Of sulphur ore 42,772 tons came from Spain, and 30,402 from Portugal. Of salt 10,007 tons were imported from Germany. Of mineral oils 9,411 tons came from U.S.A., and 2,139 from Russia. Of margarine 1,549 tons came from Holland and Belgium.

Exports.—The largest shipments of alkali were to Sweden, to which country 2,065 tons were sent, followed by 1,652 to U.S.A., 1,101 to Germany, 1,009 to Holland and Belgium. Of bleaching powder 6,415 tons were sent to Russia, 3,770 to Belgium and Holland, and 3,248 to Germany. Of caustic soda 2,831 tons went to the U.S.A., 2,419 to Russia, and 1,996 to Italy and Malta. Of soda crystals the largest shipments went to U.S.A., amounting to 1,565 tons. Of sulphur Sweden took 2,615 tons, Norway 2,212, and Holland and Belgium 2,146; none was sent to U.S.A.—*Chemical Trade Journal.*

Cost of Treating London Sewage.

At a recent meeting of the London County Council the annual financial statement was presented, including the estimated amount required during the coming municipal year for chemicals. The following is the list:—Barking Outfall.—Lime: Four grains per gallon on 130,000,000 gallons (including storm-water)—12,000 tons, at 16*s.* per ton, 9,600*l.* Iron: One grain per gallon on above quantity—3,000 tons, at 30*s.* per ton, 4,500*l.* Manganate of soda: One grain per gallon on above quantity during 90 days—375 tons, at 16*l.* per ton, 6,000*l.* Sulphuric acid: One grain per gallon on above quantity during 90 days—375 tons, at 1*l.* 14*s.* per ton, 637*l.*—20,737*l.*; less manganate of soda in stock—121 tons, at 16*l.* per ton, 1,936*l.*—18,801*l.*, say 18,800*l.* Crossness Outfall.—Lime: Four grains per gallon on 100,000,000 gallons (including storm-water)—9,311 tons, at 16*s.* per ton, 7,449*l.* Iron: One grain per gallon on above quantity—2,328 tons, at 30*s.* per ton, 3,492*l.* Manganate of soda: One grain per gallon on above quantity during 90 days—287 tons, at 16*l.* per ton, 4,592*l.* Sulphuric acid: One grain per gallon on above quantity during 90 days—287 tons, at 34*s.* per ton, 488*l.*—16,021*l.*; less manganate of soda in stock—7 tons, at 16*l.* per ton, 112*l.*—15,909*l.*, say 15,910*l.* Sewerage and drainage (storm overflows).—Manganate of soda: 170 tons, at 16*l.* per ton, 2,720*l.* Sulphuric acid: 170 tons, at 34*s.* per ton, 289*l.*—3,009*l.*; less manganate of soda in stock—65 tons, at 16*l.* per ton, 1,040*l.*—1,969*l.*, say 1,970*l.* Total for chemicals, 36,680*l.* The use of manganate of soda at the outfalls is contingent upon the condition of the river.—*Chemist and Druggist.*

An Alleged New Metal.

Professor Joplin, the assayer to the Federal Government, who is attached to the Missouri Mineralogical School, has analysed the aerolite from the direction of the constellation Perseus, which recently struck the John Brown statue Electric fusion disclosed that 25 per cent. consisted of an unknown metal with lines in the spectrum which are assigned to the hypothetical element peculiar to the sun, to which the name of helium has been given.—*Standard.*

Articles of Interest to Technologists.

The following, in the *Board of Trade Journal* for April, will repay perusal:—

"Russian Sugar Production"	p. 398
"French Coal Production"	p. 406
"Mexican Silver Lead Mines"	p. 413
"Australian Coal Production"	p. 415
"Tariffs of the Portuguese Colonies"	p. 439
"Tin-Plate Industry in the United States"	p. 472

The Portland Cement Industry in Europe.

The first known cement factory in England was at Northfleet, on the Thames; another was built about 1825. For many years the manufacture of Portland cement made no advance. Owing to the crude process used then, this new product was looked upon with great suspicion. In 1850 four factories only were engaged in the manufacture of Portland cement; but from 1860 this industry increased until the quantity manufactured in England exceeds 8,300,000 bbls. a year. The annual production of the most important English cement works is about as follows: White Brothers, 550,000 bbls.; Knight, Bevan, and Sturge, 450,000; Lee, Son, & Smith, 450,000; Burham, 450,000; Robins, 450,000; Johnson, 330,000.

The process of manufacture used in England is very much the same as it was 20 years ago. Few improvements have been realized. The raw materials used in England are chalk and clay, both very pure and readily miscible in water. The quality of the raw materials is considered perfect, and this explains how with inferior methods of manufacture English manufacturers succeed in producing a satisfactory cement.

Only one quality of cement is made in English factories and this includes the whole output of a kiln, less the underburnt clinkers picked by hand with more or less care. But there are different commercial qualities of cement according to the fineness of grinding. Until a few years ago the English cement was put on the market just as it comes from the mills. The sifting operation did not exist, and the result was that the cement usually left a residue of 15 and 20 per cent. on the No. 50 sieve, and 25 to 30 per cent. on the No. 80 sieve. The progress in grinding made in other European factories has led English manufacturers to improve their own grinding facilities, but still the English cement, as a rule, is far from being as finely ground as the German and French Portland.

The manufacture of Portland cement was introduced in Germany by Mr. H. Bleibtreu, who, in 1852, established at Stettin the Zulchow works, which made from 25,000 to 30,000 bbls. a year until 1856. He built at about the same time another cement mill at Obercassel, near Bonn on the Rhine. These two establishments still exist and produce yearly from 160,000 to 200,000 bbls.

New works were built soon after, and there are now no less than 60 large Portland cement works; the annual production in Germany is about the same as in England, 8,500,000 bbls. The production of the most important German cement works is about as follows:—Alsen & Son, Hamburg, 550,000 bbls.; Dyckerhoff & Son, Amoneburg, 500,000; Germania Cement Fabrik, Manske & Co, 450,000; Schifferdecker, at Heidelberg, 450,000; Mannheimer, at Mannheim, 450,000; Pommerscher, Guistorp, at Stettin, 400,000.

The development in Germany of the cement industry is not due, as in England, to the favourable quality of the raw materials; on the contrary, in many of the German works the materials used are difficult to handle, but German manufacturers have made great efforts to produce an article of reliable quality, and to develop in their works the most progressive methods of manufacture. They have organised themselves into a public association; they admit foreign manufacturers among them, and in their meetings they discuss questions relating to the manufacture and quality of cement. Thus the researches and studies made in one establishment serve all others. This association of manufacturers is one cause of the development of the cement industry in Germany during these last few years.

The works of Messrs. Dyckerhoff & Son, at Amoneburg, near Biebrich-on-the-Rhine, were built in 1863; within a few years the annual production attained 100,000 bbls.; in 1883 the output was 400,000 bbls., and now the yearly production is 500,000 bbls. The raw materials used here are nearly pure but very hard carbonate of lime which is found in the vicinity of the works, and a certain marl very rich in clay, which comes from Florsheim to the works by boat. These materials are often analysed and the proportions of their admixture carefully determined. The laboratory of this establishment deserves special mention. Its installation is perfect, and the experiments which are made under the supervision of Mr. R. Dyckerhoff and Dr. Schuman have contributed a great deal in Germany to enlighten manufacturers and users on the properties of Portland cement.

In France the Portland cement industry did not grow as rapidly as in England or Germany. In 1880 the whole production hardly exceeded 750,000 bbls. a year; it is now, however, 1,800,000 bbls. It was only in about 1850 that Portland cement commenced to be used in France, when Messrs. Dupont and Demarle started the manufacture at Boulogne-sur-Mer in the North. They had previously spent several years in experiments to find out the best way to use the chalk marl, in that vicinity, which is still the raw material they use. In a comparatively short time Mr. Demarle succeeded in finding a process so perfect that it is still followed and the composition of the cement has not been changed.

The reputation of the cement manufactured at Boulogne is inferior to none in Europe. The works of the Company of French cements alone manufacture about 800,000 bbls. a year, being the largest of the kind in the world.

In Russia the first cement works were built at Polen in 1857. There are now 12 of importance; 8 of them make Portland cement, the others only natural cement. The total production of Portland cement in Russia is about 900,000 bbls. a year. The three largest works are: Schmidt, at Riga, 140,000 bbls.; Port-Kunda, Eshstand, 140,000; Grodziec, Polen, 140,000.

In Belgium there are four Portland cement works, making altogether about 800,000 bbls. a year, the largest being those of the Societe Anonyme de Niel, Ruppel, making 400,000 bbls. yearly.

In Italy the manufacture of Portland cement does not properly exist. Several works make a kind of natural Portland cement by burning cement rock to a little higher point than common cement. The two largest factories are located at Cazale and Bergamo. In Switzerland there are several Portland cement works, but a so-called natural Portland cement is mostly what they manufacture. In Austria there are only a few establishments producing Portland cement, and their product has acquired little reputation. There are five Portland cement works in Denmark, and their output reaches 300,000 bbls. a year. In Sweden four factories produce annually 425,000 bbls. One establishment in Norway makes 80,000 bbls.

The total annual production of Portland cement in Europe is estimated at 20,000,000 bbls.—*Eng. and Mining Journal.*

A Chemical Factory in the Transvaal.

The Johannesburg *Star* gives particulars of a new factory for sulphuric acid manufacture, known as the "Transvaal Chemical Works," which has just been erected at Knight's Dam, in the Transvaal Republic, close to the Hungarian Ore Reduction Company's factory. The factory is under the management of a Mr. Bagshawe, who has had experience of similar work in Scotland and elsewhere. The works will be of great advantage, it is thought, to the gold-fields; they will use the pyrites obtained in treating the ore, and supply the gold companies with the sulphuric acid, of which they require large quantities. There are four lead chambers, measuring 130 ft. by 90 ft., and from 12 ft. to 14 ft. high, erected by English workmen.—*Chemist and Druggist.*

Glycerine as an Aliment.

Last February the Paris Prefect of Police consulted the Council of Hygiene with a view of learning if it is feasible to allow preparations containing from 20 per cent. to 40 per cent. of glycerine to be sold. M. Riche was delegated to study the subject, and he has just issued an interesting report of his researches. After reviewing the results of experiments of authorities such as MM. Dujardin-Beaumetz, Catillon, &c., M. Riche comes to the conclusion that it is impossible to say what effect would be produced on a man taking a preparation containing glycerine, even in small doses, continuously. He forms the decided opinion that such things ought not to be introduced for human consumption. He considers that ordinary commercial glycerine is dangerous, and can only be rendered pure by lengthy and expensive processes. M. Riche's report has been adopted by the Council of Hygiene. *Ibid.*

The French Resin and Turpentine Industry.

In 1892 the production of resin and turpentine in France showed an increase of 15 or 20 per cent. over the yield of 1891, thanks especially to the favourable weather. By reason of this augmented production of resin, prices of turpentine fell considerably, and a fair export trade took place. For resin the demand was good and prices were satisfactory for producers. The use of this article is extending, and many new industries are now employing it, both in France itself, and also in neighbouring countries. It is estimated that in 1892 6,000 tons of turpentine and 30,000 tons of resin were exported, and that 12,000 tons of turpentine and 50,000 tons of resin were consumed in France. *Ibid.*

BOARD OF TRADE RETURNS.

Summary of Imports.

—	Month ending 31st March	
	1892.	1893.
	£	£
Metals	1,850,188	1,897,333
Chemicals and dyestuffs	664,548	694,670
Oils	537,820	696,935
Raw materials for non-textile industries.	2,692,545	2,450,455
Total value of all imports	36,793,194	34,089,413

Summary of Exports.

—	Month ending 31st March	
	1892.	1893.
	£	£
Metals (other than machinery)	2,842,986	2,810,024
Chemicals and medicines	839,111	917,165
Miscellaneous articles	2,711,285	2,899,766
Total value of all exports	19,665,382	19,432,904

Exports of Miscellaneous Articles for Month ending 31st March.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Gunpowder	Lb.	713,800	676,000	18,881	15,267
Military stores	Value £	..	..	93,361	57,141
Candles	Lb.	1,871,500	2,050,300	36,249	37,235
Caoutchouc	Value £	..	..	103,855	111,644
Cement	Tons	41,194	39,277	79,275	67,830
Products of coal	Value £	..	..	143,612	143,601
Earthenware	"	..	..	164,942	192,535
Stoneware	"	..	..	15,828	15,892
Glass:— Plate	Sq. Ft.	147,629	97,024	8,776	5,285
Flint	Cwt.	9,556	7,940	21,006	19,577
Bottles	"	71,714	50,029	33,909	23,897
Other kinds	"	17,041	17,832	14,654	15,101
Leather:— Unwrought	"	11,308	14,449	107,454	137,483
Wrought	Value £	..	..	27,270	27,161
Seed oil	Tons	7,703	6,684	152,243	152,912
Floorcloth	Sq. Yds.	1,525,200	1,877,000	65,712	71,965
Painters' materials	Val. £	..	..	137,769	141,821
Paper	Cwt.	85,817	75,644	145,183	126,892
Rags	Tons	5,351	6,704	36,558	50,697
Soap	Cwt.	49,160	50,871	55,338	57,001
Total value		..	..	2,711,285	2,899,766

Imports of Oils for Month ending 31st March.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut........ Cwt.	4,470	31,968	4,992	41,545
Olive .... Tuns	1,831	2,973	71,026	109,112
Palm .... Cwt.	96,823	90,325	113,824	134,908
Petroleum .... Gall.	9,659,528	11.159,708	192,126	196,916
Seed .... Tons	1,838	3,713	49,863	91,248
Train, &c.......... Tuns	1,532	1,397	29,551	31,958
Turpentine .... Cwt.	5,204	9,931	5,748	11,366
Other articles .. Value £	..	..	70,690	79,882
Total value of oils ...	..	..	537,820	696,935

Imports of Raw Material for Non-Textile Industries for Month ending 31st March.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	9,850	8,124	20,328	16,354
Bristles.......... Lb.	220,395	183,422	31,189	29,832
Caoutchouc...... Cwt.	27,184	22,111	296,900	268,877
Gum :—				
Arabic......... „	3,863	4,162	12,906	12,017
Lac, &c......... „	11,739	7,242	45,988	33,079
Gutta-percha .... „	2,828	4,470	33,788	24,801
Hides, raw :—				
Dry............ „	48,805	30,030	113,487	71,746
Wet .... „	30,990	43,472	67,990	92,531
Ivory .... „	1,164	840	56,951	39,546
Manure :—				
Guano .... Tons	3,926	1,860	34,294	7,385
Bones.......... „	8,226	6,221	37,495	27,171
Nitrate of soda. „	10,994	19,601	99,504	192,825
Phosphate of lime „	28,457	29,754	71,096	57,415
Paraffin.......... Cwt.	58,387	58,344	86,568	69,357
Linen rags....... Tons	2,864	6,840	28,658	67,443
Esparto.......... „	22,096	15,188	104,531	72,699
Pulp of wood .... „	13,690	15,800	64,808	89,633
Rosin............ Cwt.	92,985	89,752	19,512	22,923
Tallow and stearin „	94,548	53,703	122.028	81,654
Tar ....Barrels	2,118	2,231	1,208	1,023
Wood :—				
Hewn .... Loads	138,627	90,187	254,489	131,705
Sawn .... „	107,916	50,589	254,508	123,034
Staves .... „	7,387	3,536	47,073	15,969
Mahogany ..... Tons	4,965	4,551	42,934	38,671
Other articles....Value £	..	..	744,312	862,765
Total value	..	..	2,692,545	2,450,455

Besides the above, drugs to the value of 82,744*l*. were imported, as against 78,618*l*. in March 1892.

Exports of Drugs and Chemicals for Month ending 31st March.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	527,859	688,709	195,629	218,310
Bleaching materials „	114,505	146,511	46,291	60,775
Chemical manures. Tons	35,517	39,523	249,970	268,521
Medicines....... Value £	..	..	100,448	86,040
Other articles ... „	..	..	246,773	283,519
Total value	..	..	839,111	917,165

Imports of Chemicals and Dyestuffs for Month ending 31st March.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............. Cwt.	3,663	5,182	2,193	4,904
Bark (tanners', &c.) „	29,728	17,426	11,801	5,604
Brimstone .... „	27,751	39,327	8,059	9,384
Chemicals...... Value £	..	..	118,317	119,249
Cochineal .... Cwt.	211	283	1,275	1,607
Cutch and gambier Tons	2,375	3,509	56,594	78,500
Dyes :—				
Aniline .... Value £	..	..	16,485	11,120
Alizarine ..... „	..	..	30,661	22,072
Other .... „	..	..	1,088	1,821
Indigo .... Cwt.	9,016	9,812	173,344	209,330
Nitrate of potash . „	25,666	15,578	22,374	14,107
Valonia .... Tons	4,756	4,295	62,121	55,011
Other articles... Value £	..	..	160,236	161,961
Total value of chemicals	..	..	664,548	694,670

Imports of Metals for Month ending 31st March.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
Copper :—			£	£
Ore .... Tons	6,516	8,841	48,937	87,399
Regulus .... „	10,664	9,263	276,959	224,952
Unwrought .... „	2,378	1,644	114,014	75,263
Iron :—				
Ore............. „	407,920	382,089	297,733	252,928
Bolt, bar, &c.... „	3,625	3,707	29,977	32,206
Steel, unwrought.. „	481	686	5,010	7,804
Lead, pig and sheet „	15,722	16,446	172,754	164,359
Pyrites .... „	46,948	60,125	82,534	106,368
Quicksilver .... Lb.	815,315	1,470,243	77,374	122,224
Silver ore....... Value £	..	..	287,311	262,891
Tin .... Cwt.	57,299	68,790	255,127	317,885
Zinc .... Tons	3,365	5,388	73,557	96,662
Other articles ...Value £	..	..	128,901	146,392
Total value of metals	..	..	1,850,188	1,897,333

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST MARCH.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	9,623	10,574	42,695	42,472
Copper:—				
Unwrought..... „	80,877	68,036	193,190	169,423
Wrought........ „	34,337	35,564	101,329	102,104
Mixed metal.... „	25,413	30,960	64,935	74,586
Hardware..... Value £	..	..	197,178	199,037
Implements....... „	..	..	115,287	112,440
Iron and steel..... Tons	218,980	220,837	1,860,382	1,873,592
Lead............ „	5,680	3,288	72,960	41,160
Plated wares... Value £	..	..	26,308	26,457
Telegraph wires „	..	..	18,827	22,961
Tin............... Cwt.	10,317	8,929	47,820	43,053
Zinc.............. „	17,676	25,571	16,489	21,332
Other articles .. Value £	..	..	82,586	81,407
Total value.........	..	..	2,842,986	2,810,024

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

5358. D. Clerk.—From J. Scheuerecker, United States. An apparatus for manufacturing ice and for refrigerating purposes. March 13.

5375. J. Wetter.—From M. Weinrich, United States. Improvements in the manufacture or restoration of filtering media. March 13.

5434. R. Haddan.—From E. Passburg, Germany. Improvements in or relating to evaporating apparatus. Complete Specification. March 13.

5516. A. Robinson. An aërating apparatus for treating or cooling milk or other liquids. March 14.

5631. F. Dannert. A new or improved process for preventing the deposit of incrustations on the walls of steam boilers. March 15.

5651. C. Bateson and C. Bateson. Improvements in furnaces for melting glass, puddling iron, or like operations. March 16.

5847. C. Sachs. Improvements in and relating to freezing or refrigerating apparatus. March 18.

6243. C. K. Mills.—From A. Costadau, France. An improved joint for steam, water, gas, and other liquids or fluids. March 23.

6316. H. J. Worssam. Improvements in refrigerators for cooling and evaporating liquids, such as are used in breweries and distilleries, and for such like purposes. March 24.

6408. J. F. Jones. Improvements in apparatus for cooling or heating air or other gases. March 25.

6441. G. Sinclair. Improvements in boilers for boiling or chemically treating fibrous materials. Complete Specification. March 27.

6446. J. Swift. An apparatus for showing the phenomena of the expansion of crystals and other substances by heat produced by electric force. March 27.

6919. C. A. Allison.—From The Merz Universal Extractor and Construction Co., United States. Improved extracting apparatus. April 4.

6932. W. N. Cook. Non-conducting composition for covering boilers, steam pipes, hot air and other flues. April 4.

6959. M. Prentice. Improvements in means or apparatus for distilling or obtaining volatile constituents or products. April 4.

7525. J. Drummond. Improvements in apparatus for filtering liquids or for separating liquids from or drying crystallised or other granular matters. April 13.

COMPLETE SPECIFICATIONS ACCEPTED.*

1892.

1858. W. L. Wise.—From C. d'Abbadie de Barrau. *See* Class XVI.

5238. J. A. Yeadon and W. Adgie. *See* Class III.

5281. C. Fery. *See* Class XXIII.

8773. G. F. Redfern.—From W. P. Abell. *See* Class XVI.

9234. J. A. Mays. Process of and apparatus for effecting the concentration and separation of solids. April 5.

10,298. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Evaporating apparatus. April 19.

18,941. W. A. Swain. *See* Class XVII.

1893.

1467. E. Herz. Method of and apparatus for heating or evaporating liquids. March 22.

3862. A. Stein. Improvements in kilns and furnaces, and in steam boilers used in connection therewith. April 12.

4218. J. A. Henderson. Improved compositions for preventing the radiation or transmission of heat. April 5.

II.—FUEL, GAS, AND LIGHT.

APPLICATIONS.

5384. J. Moeller. An improvement in the manufacture of oil-gas. March 13.

5468. J. W. Spencer. Improvements in gas producers. March 14.

5546. P. Dvorkovitz. Improvements in the manufacture of coke, coal-gas, and the obtainment of bye-products, and in apparatus employed therein. March 14.

5647. J. H. R. Dinsmore. Improvements in or connected with the manufacture of gas. March 16.

5710. R. F. Strong and A. Gordon. Improvements in and relating to the manufacture of artificial fuel for use in ore-smelting furnaces. March 16.

5806. J. West. Improvements in machinery or apparatus for charging and drawing gas retorts Complete Specification. March 17.

5841. R. Fallnicht. An improved fire-lighter. March 18.

5920. F. Beale and T. F. Ennis. Improvements in apparatus for charging gas retorts. March 20.

5951. J. H. Fitzgerald. Improvement in gas washers and scrubbers. March 20.

6051. Gaston de Velna. Improvements in the manufacture of illuminating gas, artificial fuel blocks, and coke for metallurgical purposes. March 21.

6142. W. F. Richie.—From J. B. Archer, United States. Process of manufacturing gas. Complete Specification. March 22.

6259. G. S. Ellis and A. M. Dolton. Improvements in the manufacture of coal briquettes. March 23.

6324. A. G. Glasgow. Improvements relating to apparatus for the manufacture of water-gas. Complete Specification. March 24.

6375. J. B. Terrace. Improvements in charging and drawing gas retorts, &c. March 25.

6408. J. F. Jones. Improvements in apparatus for cooling or heating air or other gases. March 25.

6451. G. W. Foreman. An improved fire-lighter. March 27.

6494. G. McHenry. Improved fire-lighter. March 28.

6505. W. Piskorski. The "P. and P." liquid fire-lighter. March 28.

6506. W. Cross. Improvements in anti-dip valves, employed in the manufacture of gas. March 28.

6515. E. Smith. Improvements for the consumption of smoke and waste gases in furnaces. March 28.

6551. T. G. Hall. A pyro-electric generator, an apparatus whereof such generator is an element, a process carried out by the aid of such apparatus, and a new compound gas made by such process. Complete Specification. March 28.

6688. B. D. Healey. An improved system of utilising the heated gases from refuse-destructor furnaces. March 30.

6697. W. Donaldson. Improvements in the heating of gases by electricity. March 30.

6739. R. Campion. Improvements in the treatment of hydro-carbon oil or spirit for various useful purposes. March 30.

6843. J. Addie, J. Cuninghame, and W. Macfarlane. Improvements in the production of ammonia and cyanogen, and compounds of ammonia and cyanogen. April 1.

7467. E. J. Duff. Improvements in gas producers. April 12.

7605. J. Smith. A retort and apparatus connected therewith for the purpose of converting coal-tar into gas for illumination and other purposes. April 14.

7625. D. Westlake. Improvements in machinery or apparatus for moulding artificial fuel or other materials. Complete Specification. April 14.

Complete Specifications Accepted.

1892.

3092. R. L. Barr, J. Macfarlane, E. J. Mills, and S. Young. Improvements in obtaining cyanides. March 22.

6733. D. Rylands. An improved means of utilising gas for warming or heating purposes. March 29.

7983. P. Dvorkovitz. Apparatus for the manufacture of gas for illuminating and heating purposes, applicable also for the distillation of liquid hydrocarbons. March 22.

8892. H. J. Rogers. An improved apparatus for the manufacture of gas for lighting and heating and for use in gas engines. April 12.

9474. W. Foulis. Means for obtaining cyanides from illuminating and heating gas. April 12.

9619. J. Bowing. Manufacture of briquettes and similar artificial fuels, and in the recovery of tar products. April 12.

16,258. V. B. Lewes. Manufacture or production of illuminating gas from liquid hydrocarbons and apparatus therefor. April 19.

20,769. T. Bauer. Coke furnaces. April 12.

1893.

2716. J. Askins. Manufacture of gas and apparatus therefor. March 22.

4225. W. G. Bedford. Generation of gas from water, steam, and the like, and apparatus therefor. March 29.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

5856. C. D. Abel.—From F. von Heyden, Germany. Manufacture of acid esters of creosote, guaiacol, and creosol. March 18.

Complete Specifications Accepted.

1892.

5238. J. A. Yeadon and W. Adgie. Apparatus for distilling mineral or other tars, hydrocarbons, or other analogous liquids. March 22.

9619. J. Bowing. *See* Class II.

IV.—COLOURING MATTERS and DYES.

Applications.

5407. S. Pitt.—From L. Cassella and Co., Germany The production of new disazo colouring matters. March 13

5690. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Production of colouring matters. March 16.

5691. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of acid colouring matters, being the sulphonic acids of alkyl derivatives of the diamidodiphenyl-metatolyl-carbinol. March 16.

5692. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of thionine colouring matters dyeing on mordants. March 16.

5693. J. H. Ziegler. Manufacture of new colouring matters by the action of diazo compounds on the hydrazone derivatives of oxalyloacetic ether. March 16.

6035. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The production or manufacture of colouring matters. March 21.

6046. A. Blanchon and A. Allegret. Improvements relating to the production of black and other dark colours. March 21.

6249. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of colouring matters of the auramine class. March 23.

7014. H. Kysow. A liquid blue for laundry purposes. April 5.

7181. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of a new blue colouring matter. April 7.

7182. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co, Germany. The manufacture or production of new alizarin dyestuffs. April 7.

7185. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of colouring matters. April 7.

7186. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of colouring matters. April 7.

7187. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of a novel diamido base, and of colouring matters from the same. April 7.

7260. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of sulpho acids of hydroxylated compounds. April 8.

7263. C. Blancan. A liquid metallic composition for use as a writing or printing ink or as a colour for decorating surfaces. Filed April 8. Date applied for, November 8, 1892, being date of application in France.

7330. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs. April 10.

7580. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters. April 13.

Complete Specifications Accepted.

1892.

7120. W. Marckwald and J. F. Holtz. Manufacture or production of aromatic disulphoethylenediamides, aromatic disulphopiperazides, and piperazine. April 19.

8270. O. Imray.—From The Farbwerke vormals Meister, Lucius, und Brüning. Manufacture of azo colouring matters derived from paraphenylenediamine. March 29.

9633. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new basic dyestuffs. April 5.

10,465. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture of new basic colouring matters of the auramine class, and of new materials for use therein. April 5.

10,667. C. D. Abel.—From The Farbwerke vormals Meister, Lucius, und Brüning. Manufacture of novel azo colouring matters dyeing directly on cotton. April 12.

10,668. C. D. Abel.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of alumina salts of the naphthol sulphonic acids, called aluminols. April 12.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

6007. A. E. Newman, R. E. Newman, and J. Newman. Improvements in the treatment of fibrous materials and in the means or apparatus employed therein. March 21.

6830. J. T. Pearson. Improvements in and relating to machinery and apparatus for conditioning yarn and other fibrous substances. April 1.

7101. A. E. Newman, R. E. Newman, and J. Newman. Improvements in the treatment of flax and like fibrous material, and in the means or apparatus employed therein. April 6.

7441. T. Buzzi and R. Menochio. Improvements in the separation of wool from vegetable fibres. April 11.

Complete Specification Accepted.

1893.

3506. A. Gruschwitz. An improved process for retting, cleansing, and deoxidising textile fibres. March 22.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

6600. A. McMeekin. Improvements in the method of and means employed for bleaching, dyeing, and otherwise treating flax, hemp, and other fibres. March 29.

6709. T. Lye and W. T. Lye. Improvements in the bleaching or dyeing of "chip," "straw," and "chip plait," and "straw plait." March 30.

7053. A. L. Gwatkin. Improvements relating to the production of designs on paper, which improvements are chiefly applicable to the manufacture of wall paper. April 5.

7350. W. T. Whitehead. Improvements in resists or discharges for use in printing or dyeing cotton, wool, and other fabrics with aniline black. April 11.

7351. W. T. Whitehead. Improvements in resists or discharges for use in printing or dyeing cotton, wool, and other fabrics. April 11.

7487. Read, Holliday and Sons, Limited, and H. Bindschadler. Improvements in the production of an indigo vat or bath employed in the dyeing with indigo. April 12.

7550. A. Ashworth. Improvement in the process relating to dyeing and printing textile fibres and fabrics April 13.

Complete Specifications Accepted.

1892.

5408. G. Jagenburg. Process for dyeing loose cotton, cotton thread, and woven fabrics. March 22.

1893.

3186. A. G. Brookes.—From the Arnold Printworks. Process of producing and fixing coloured figures in cotton material, in conjunction with grounds of contrasting colour. March 29.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

5365. F. J. R. Carulla. Improvements in the process for the manufacture of sulphuric acid. March 13.

5620. C. Wehmer. A method for producing artificial citric acid. March 15.

5849. H. Cosnett, B. C. Bennison, S. Hayes, and P. Smallwood. A new or improved process for obtaining chlorine from the spent liquors of soda ash, from brine, and from other similar substances, and means and apparatus for producing chloride of lime therefrom. March 18.

6044. L. O. Helmers. Improvements in decomposing the neutralised reaction mixture obtained by the action of sulphuric acid on mineral or similar oils, particularly on hydrocarbons artificially or naturally sulphuretted into sulphonic acid compounds and sulphone-like compounds under simultaneous separation of the inorganic salts. March 21.

6738. T. H. Cobley and D. Jones. Improvements in the manufacture of acetic acid and acetates from pyroligneous acid and pyrolignates with formation of sulphides, sulphur, and other products. March 30.

6815. P. Hart. Improvements in and connected with the manufacture of iron salts. April 1.

6843. J. Addie, J. Cuninghame, and W. Macfarlane. Improvements in the production of ammonia and cyanogen, and compounds of ammonia and cyanogen. April 1.

6960. M. Prentice. Improvements in the manufacture of nitric acid. April 4.

7036 W. C. Sellar. Improvements in the production of cyanides and ferro-cyanides of the alkali metals. April 5.

7107. F. Hurter. — From J. Omholt, Norway. Improvements in the manufacture of soda and mono calcic phosphate. April 6.

7108. F. Hurter. — From J. Omholt, Norway. Improvements in the manufacture or production of mono calcic phosphate and ammonia. April 6.

7264. F. M. Lyte. Improvements in the production of chlorine and refined lead, and in the recovery of the silver the lead contains. April 8.

7485. F. M. Spence, D. D. Spence, and J. Gilchrist. Improvements in certain apparatus for the distillation of ammoniacal liquor. April 12.

7512. J. Brock and F. Hurter. Improvements in the manufacture of permanganates of soda or potash from manganates of soda or potash. April 12.

Complete Specification Accepted.

1892.

10,281. E. Hermite and A. Dubosc. Process and apparatus for the manufacture of persalts of iron. March 22.

VIII.—GLASS, POTTERY, and EARTHENWARE.

Applications.

5505. H. Watkin. Improvements in apparatus for moulding the bodies of electric switches, bell pushes, ceiling roses, and other like articles, in china and earthenware. March 14.

5509. F. Schmalz. Improvements in and relating to the art of producing transferable and vitrifiable designs for purposes of ornamentation. Complete Specification. March 14.

5510. F. Schmalz. Improvements in and relating to the art of producing transferable designs for the purpose of ornamentation. Complete Specification. March 14.

5645. J. Lunt and G. Kinson. Improvements in enamelling, hardening-on, and majolica kilns. March 16.

5800. E. Honey. Improvements in or connected with the obtaining of stained glass by means of printing by block or roller thereon. March 17.

6133. W. Wood and J. Clark. A new or improved potters' lathe or apparatus for use in the production of various articles of pottery. March 22.

6612. T. W. Twyford. Improvements in the glazing and enamelling of heavy earthenware and other goods, and in apparatus to be employed therefor. March 29.

6661. Craven, Dunnill, and Co., Lim., and F. R. Smith. Improvements in apparatus for the manufacture of tiles. March 29.

6970. R. Haddan.—From S. Evans, C. L. Rawson, and C. T. Brown. Improvements in preparations for and ornamentation of clear glass. Complete Specification. April 4.

6971. R. Haddan.—From S. Evans, C. L. Rawson, and C. T. Brown, United States. Improvements relating to processes of chipping glass. Complete Specification. April 4.

Complete Specifications Accepted.

1893.

823. J. Davies. Manufacture of ceramic or pottery ware crucibles, cisterns, sinks, flags, and cements; also applicable for paving footpaths, roads, and as a filtering medium. April 19.

1289. P. Sievert. Method of manufacturing glass bars, rods, or sticks. March 22.

1774. C. D. Abel.—From Hector de Grousilliers. Improvements in transferring designs on to ceramic and other objects, and in the materials employed for that purpose. March 22.

5509. F. Schmalz. Improvements in and relating to the art of producing transferable and vitrifiable designs for purposes of ornamentation. April 19.

5510. F. Schmalz. Improvements in and relating to the art of producing transferable designs for the purpose of ornamentation. April 19.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

Applications.

10,010*a* of 1892. J. Hoyle. Improvements in apparatus for purifying and grinding the residue of Portland cement. Filed March 22. Date applied for, May 26, 1892.

5535. R. Astley. An improvement in the construction of fireproof floors. March 14.

5560. M. Underwood. Underwood's building and constructional blocks. March 15.

5711. R. F. Strong and A. Gordon. Improvements in and relating to the manufacture of artificial stone. March 16.

5851. G. M. Mecenero and G. Sentieri. Improvements in artificial marbles. March 18.

5938. R. J. Doyle. Improvements in non-inflammable cement. Complete Specification. March 20.

6314. C. Brand, C. J. Dobbs, and E. W. Jones. Improvements in scoria or slag blocks for paving, masonry, and other purposes. March 24.

6328. H. B. Allaeys. An improved process for making mosaics. March 24.

6486. J. P. Robertson. A method of utilising waste slate. March 27.

7211. G. Gin. Improvements in the manufacture of cement. April 7.

7425. F. H. Willis. Improvements in the construction of fireproof floors. April 11.

7499. W. Sykes. Improvements in the manufacture o compositions suitable for paving, building, pipe-jointing, and other like purposes. April 12.

7504. R. Astley. An improved form and method o construction of fireproof floors. April 12.

Complete Specifications Accepted.

1892.

7490. G. Martenstein. Manufacture of materials for street and other pavements. March 22.

9542. T. Castle. Mills for grinding cement and other matters. March 29.

14,336. J. E. Keseling and C. Fuchs, jun. An artificial stone composition. April 12.

16,354. J. E. Keseling and C. Fuchs, jun. An artificial stone composition. April 12.

1893.

823. J. Davies. *See* Class VIII.

2335. J. F. Kleine. Construction of floors and ceilings. April 5.

3338. C. George. Manufacture of artificial stone and apparatus in connection therewith.

3429. P. J. Jackson. Improvements in or relating to pavements for streets, floors, and the like. April 12.

X.—METALLURGY, MINING, Etc.

Applications.

5353. R. Howarth. Improvements in the manufacture of metallic alloys or compounds. March 13.

5430. G. Perrenoud. An improved composition to be used for hardening steel. March 13.

5568. T. Twynam. Improvements in the manufacture of steel and ingot iron. March 15.

5574. W. B. Hatfield and W. J. Cooper. Improvements in armour plates. March 15.

5632. W. Gilchrist and W. Cryer. A new or improved process for the manufacture of metal partaking of the nature of steel. March 15.

5996. C. M. Pielsticker. Improvements in the recovery of gold and silver from cyanide solutions. March 21.

6137. A. J. Smith. Improvements relating to the pickling of metals and alloys to remove oxide and other impurities from the surface thereof. March 22.

6219. H. Wild. Improvements in or relating to the "Thomas" metallurgical process. March 23.

6302. E. de Pass.—From L. C. Daumas, France. An improved process and apparatus for the extraction of gold. Complete Specification. March 24.

6828. C. W. Thompson. Improvements in the treatment of slag. April 1.

6840. T. Dobbie, jun. Improvements in the means or method of extracting gold and other metals from ores or other mixtures containing same. April 1.

7252. W. Hayward. A new or improved process for recovering zinc or spelter from waste galvanised iron and steel, and furnaces and appliances for the said process. April 8.

7264. F. M. Lyte. *See* Class VII.

7453. W. Wilkinson. Improvements in ingot moulds, and in the process of casting hollow metal ingots. April 12.

7730. A. Longsdon.—From L. Grambow, Germany. A new or improved process for treating steel armour plates. April 15.

Complete Specifications Accepted.

1892.

6399. J. C. Bull. Improvements in the treatment or refining of copper. April 5.

7067. A. E. Butler, B. F. Butler, and H. M. Butler. Furnaces for heating and melting metals. March 22.

7302. A. Turner and M. B. Baird. Manufacture of iron and steel. March 29.

7758. H. Hofer. Refining iron. April 5.

7832. H. A. Penrose. Improvements in or relating to the treatment of silver ores containing zinc and gold ores containing zinc. April 19.

8393. W. Holland. Apparatus or means for hardening and tempering metals. April 19.

8551. A. J. Boult.—From C. Sauer. Improvements in or relating to aluminium solder. April 12.

8932. W. H. Luther. Improvements in and relating to baths for coating metallic plates. April 19.

12,733. C. D. Abel.—From Wirth and Co. Process for the production of metallic antimony. April 19.

24,061. G. Wegner and P. Guhrs. A new or improved method of plating or coating aluminium or aluminium alloys. March 22.

1893.

498. W. P. Thompson.—From J. L. Thompson. Improvements in or relating to obtaining and separating sulphide of nickel in the treatment of mattes containing copper, nickel, iron, and other metals. April 5.

499. W. P. Thompson.—From R. M. Thompson. Improvements in or relating to obtaining and separating sulphide of nickel for use in metallurgical operations in the treatment of mattes of copper, nickel, iron, and other metals. March 29.

563. J. M. White. Manufacture of iron and steel, and in apparatus for the purpose. March 22.

3171. H. D. Hibbard. Apparatus for casting pig iron. April 5.

3586. F. G. Bates. Improvements in compounds for converting iron or low-grade steel into high-grade steel by the cementation process. April 19.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

5495. W. P. Thompson.—From F. L. Pope, United States. Improvements in or relating to the electro deposition of metals. March 14.

5525. T. J. Holland. Improvements in electrolytic apparatus for decomposing chloride of sodium or potassium in solution, and for leading away the products of decomposition. March 11.

5694. J. C. Richardson. Improvements in apparatus for the electrolytic decomposition of solutions of chloride of sodium and potassium. March 16.

5701. S. O. Cowper-Coles. Improvements relating to the coating of articles with metallic alloys by electro deposition. March 16.

5778. A. J. Boult.—From O. Knoefler and F. Gebauer, Germany. An improved process for manufacturing bleaching solutions by electrolysis. Complete Specification. March 17.

5844. W. P. Thompson.—From M. Hartung, Germany. Improvements in storage batteries. March 18.

6000. B. H. Thwaite. Improved methods for effecting the electro fusion of steel and its alloys. March 21.

6163. H. Traun. Improvements in tanks or cells for electrolytical and other chemical purposes. March 22.

6565. Siemens Bros. and Co., Lim., and E. F. A. Obach. An improvement in dry voltaic cells and in conducting connections for the carbons of these and other electric cells. Complete Specification. March 28.

6605. E. T. Parker. Improvements in diaphragms for use in electrolytic processes. March 29.

6671. S. O. Cowper-Coles. Improvements relating to the electrometallurgy of zinc. March 29.

6751. E. Placet and J. Bonnet. Improvements in the extraction of chromium by electrolysis. March 30.

6780. V. C. Doubleday.—From M. Sussmann, Germany. Improvements in secondary batteries. March 30.

6814. C. R. G. Smythe and J. Gordon. Improvements in the deposition of copper and other metal on ordinary insulated conductors. April 1.

7297. W. J. S. Barber-Starkey. Improvements in and connected with secondary batteries applicable also to primary electric batteries. April 10.

7387. W. P. Thompson.—From C. L. Coffin, United States. Improvements in or relating to machines for electrically welding metals. April 11.

7389. W. P. Thompson.—From C. L. Coffin, United States. Improvements in apparatus for electrically welding or working metals. April 11.

7488. J. A. Archer. Improvements in electric battery apparatus. April 12.

7594. F. M. Lyte. Improvements in the electrolytical decomposition of chlorides and mixtures thereof and in apparatus for the purpose. April 13.

7711. P. Schoop. Improvements in electrical accumulators or secondary batteries. April 15.

Complete Specifications Accepted.

1892.

7226. C. H. A. Hoho and E. A. C. Lagrange. Improvements in or relating to the electric treatment of metal or other bodies. April 19.

9192. A. J. Boult.—From F. C. Bromley. Electrolysis of chloride and other solutions. March 29.

10,388. E. Fruend and L. Bristol. Secondary batteries. April 19.

11,087. W. L. Wise.—From T. Rosati, E. Righetti, and G. O'Connell. Galvanic batteries. April 19.

21,794. E. Andreoli. Manufacture of electrodes for ozonisers. March 22.

1893.

2361. F. Szymanski. An improved depolarising material for galvanic elements. March 29.

3477. H. Nehmer. Improvements in constructing and connecting galvanic elements. March 29.

4869. W. T. Gibbs and S. P. Franchot. Process of obtaining chlorates of the alkalis or of the alkaline earth metals by electrolysis. April 12.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

5385. A. C. Irwin and S. Wohle. A new or improved manufacture of detergent. March 13.

5621. J. Peacock and W. L. Colls. Improved manufacture or production of soap. March 15.

6123. W. Brothers. Improved detergent compound or preparation for the washing or scouring of textile fabrics or other articles. March 22.

6564. O. Imray.—From J. F. Newell, United States. Improvements in compositions for self-lubricating bearings. Complete Specification. March 28.

6743. R. Campion. Improvements in the manufacture of a certain kind of soap. March 30.

6993. R. Hutchison. Improvements in treating wool greases and separating their constituents. April 5.

7141. E. Barker and E. Bannister. Improvements in the manufacture of soap. April 7.

7200. M. E. Bernard. Improvements in and relating to the purification of vegetable oils. April 7.

7562. J. Soler. An improved process for the extraction of oleine from tallow. Complete Specification. April 13.

Complete Specifications Accepted.

1892.

10,784. C. D. Abel.—From N. Osuchowski and A. S. Zivierzchowski. Manufacture of hard soap. April 12.

15,482. W. Shepperson. Treatment of animal fats. March 22.

1893.

4935. R. Haddan. — From E. Schaal. Process and apparatus for thickening linseed oil. April 12.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

5349. M. N. d'Andria. Improvements in the manufacture of red oxide paints. March 13.

5675. T. H. Cobley. Improvements in the method of production of white lead. March 16.

5803. P. C. Beiersdorf. A method of producing uniform qualities of gutta-percha and balata. March 17.

5939. R. J. Doyle. Improvements in non-inflammable paint. Complete Specification. March 20.

6906. L. M. Williams. Williams' enameline. April 4.

7117. A. C. J. Charlier. Improvements in apparatus for the manufacture of metallic pigments or compounds, and in the production of lead pigments or compounds by means of such apparatus. April 6.

7118. A. C. J. Charlier. Process for the manufacture of zinc oxide, carbonate of zinc, and compounds of these with lead pigment. April 6.

7119. A. C. J. Charlier. Improvements in apparatus for the manufacture of metallic pigments or compounds, and in the production of lead and zinc pigments or compounds, and combinations of these by means of such apparatus. April 6.

7277. L. Paget. Improvements in pyroxyline solvents and compounds. Complete Specification. April 8.

7500. J. W. F. Alber. An improved enamel. April 12.

7515. P. T. Austen. An improved process for producing a solid colouring matter from fustic. April 12.

7571. C. D. Abel. — From Westfalisch-Anhaltischen Sprengstoff Actien Gesellschaft, Germany. Hygroscopic paint or coating material for keeping packing-cases dry. April 13.

7721. C. H. Hollis and A. W. Byron. A varnish or polish for leather. Complete Specification. April 15.

Complete Specifications Accepted.

1892.

11,029. D. Marcus.—From Japan Curio Co. Preparation or material for lacquering or covering surfaces April 19.

1893.

3398. A. Gentzsch, G. Goldschmidt, and E. Ritter von Scanavi. An improved insulating material for electrical purposes, and method of preparing same. April 5.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Applications.

5700. G. Popp and J. H. Becker. Improvements in the process and in means and apparatus for ungreasing hides, skins, leather, and other materials. March 16.

6061. H. H. Lake.—From A. M. Goodale and M. W. A. Spring, United States. Improvements in the treatment of hydrated phosphates of alumina and iron for obtaining an improved fertilizer. Complete Specification. March 21.

7283. F. Hess. A composition for glueing purposes. April 10. Complete Specification.

7324. J. Ripley and P. Sherrard. Improvements in the method of and apparatus for preserving skins for transportation and other purposes. April 10.

7732. J. S. Fairfax.—From J. D. Gallagher, United States. Improvements in or relating to the process of tanning in the manufacture of leather. Complete Specification. April 15.

Complete Specifications Accepted.

1893.

560. H. J. Sedway. An improved composition for use as size or an adhesive cement. April 5.

2172. E. Drew. An improved substitute for leather. April 5.

XV.—MANURES.

Application.

7637. W. Brothers. Improved manure or fertilizer. April 14.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

5617. H. H. Lake. From W. Angele, Germany. Improvements relating to the manufacture of soluble starch. March 15.

5740. J. Drummond. Improvements in apparatus for separating impurities from sugar. March 17.

7695. L. E. A. Prangey. Improvements in the continuous refining or bleaching of sugar, and in machines employed for this purpose. April 15.

Complete Specifications Accepted.

1892.

1858. W. L. Wise.—From C. d'Abbadie de Barrau. Apparatus suitable for cooling cane-juice and other substances. April 5.

8274. A. Walker. Treatment and saccharification of grain and other materials containing starch, dextrin, and similar substances. March 29.

8773. G. F. Redfern.—From W. P. Abell. Improvements relating to filtering apprratus for saccharine and other liquors. April 12.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

5409. H. Hill. Improvements in and connected with the ageing and maturing or improving of spirits, dilute or otherwise, and liqueurs and essential oils, and in apparatus therefor. March 13.

5870. H. H. Lake.—From K. Müller, Germany. Improvements relating to the clarification of beer. March 18.

6168. G. de Geyter. Improvements relating to the saccharification of wort or the like, and to the extraction and subsequent treatment thereof in brewing, distilling, and in the manufacture of maltose, syrups, and other extracts, and apparatus therefor. March 22.

6248. P. W. May. Improvements in the treatment of beer or other beverages or like liquids for sterilising them or preventing fermentation or acidification thereof. March 23.

6860. A. P. Wright.—From F. Gourdou, France. A new or improved liqueur. April 1.

6963. C. A. Day.—From A. Walther, United States. Improvements in or connected with brewing. Complete Specification. April 4.

7538. B. Barnett. Improvements in vessels or appliances for sampling wort. April 13.

Complete Specifications Accepted.

1892.

18,941. W. A. Swain. Improvements in strainers for the purification of malt liquor or other liquids. April 5.

1893.

2484. J. Gregor. Malt kilns. April 5.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

5425. G. Popp and J. H. Becker. An improved process of and apparatus for sterilising liquids. March 13.

5522. A. G. Bloxam. Improvements in preservatives for articles of food. March 14.

5596. F. W. Golby.—From G. Oppemann, Germany. Process of purifying water for household use and consumption. Complete Specification. March 15.

5957. G. Popp and J. H. Becker. An improved process of sterilising liquids and apparatus to be used therefor. March 20.

6596. E. Sonstadt. Improvements in the preparation of extracts of tea and coffee, and in utilising a bye-product of the process. March 29.

6662. J. Miles. Improvements in the manufacture from vegetable substances of products suitable for use as cattle food, for making boiler compositions or fluids, and for other purposes. March 29.

6838. G. H. Neuhauss, J. F. H. Gronwald, and E. H. C. Oehlmann. Improved process for destroying infectious germs in milk and apparatus therefor. Complete Specification. April 1.

7586. J. Wetter.—From O. Becker, Germany. Improvements in the manufacture or preparation of malt bread and biscuits. April 13.

B.—Sanitary Chemistry.

6423. J. J. Meldrum and T. F. Meldrum. Improvements in or connected with the purification of sewage and analogous foul or impure liquids. March 27.

6746. F. Fanta. Improved apparatus for purifying sewage effluents by means of oxygen, and of automatically regulating the flow of gas required. March 30.

6940. M. C. Meaby. Improvements in apparatus for the treatment of town refuse. April 4.

C.—Disinfectants.

5566. A. Blackie. Improvements in preparing and packing materials for forming solutions containing arsenic, and applicable for dipping animals, preserving skins, for destroying germs, parasites, and weeds, and for other uses. March 15.

6953. P. Molyneux and G. R. Potts. Improvements in or connected with disinfectants. April 4.

7038. S. Pitt.—From the Chemische Fabrik auf Actien vormals E. Schering, Germany. A new antiseptic material to be called "Formalin." April 5.

7065. J. Craven. A new liquid insecticide or insectine for destroying insects on plants. April 6.

Complete Specification Accepted.

C.—Disinfectants.

1892.

11,275. J. M. Raymond. An improved antiseptic, disinfecting, and deodorising compound. April 5.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

6382. H. Colley. Improvements in apparatus for the manufacture of paper. March 25.

6802. W. P. Thompson.—From the Goppinger Papierfabrik, G. Krum, Germany. Improved manufacture of paper or cardboard resembling leather. Complete Specification. April 1.

6925. J. Holden. Improvements in or relating to the manufacture of paper and apparatus for effecting the same. April 4.

7221. G. C. Marks. From R. B. McEwan, J. L. McEwan, and R. W. McEwan, United States. Paper board. Complete Specification. April 8.

7450. W. Knowles and J. Mather. Improvements in finishing paper on paper-making machines. April 12.

7464. J. Mather and W. Knowles. Improvements in mixing pulp for paper-making. April 12.

Complete Specification Accepted.

1892.

8700. C. F. Cross, E. J. Bevan, and C. Beadle. Improvements in dissolving cellulose and allied compounds. April 12.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

6567. C. D. Abel.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. Manufacture of isomeric and homologue pyrazolones from pyraxoles and pyrazolines by means of the acetylised derivatives of phenylhydrazine. March 28.

6596. E. Sonstadt. *See* Class XVIII. (A).

6749. C. Kolbe. Manufacture or production of salols. March 30.

6778. E. Prince and The Tasmanian Eucalyptus Oil Co. Improved means to facilitate the evaporation of eucalyptus and other volatile oils. March 30.

6959. M. Prentice. *See* Class I.

Complete Specifications Accepted.

1892.

5745. J. Pfleger and W. Krauth. An improved process for the production of oxygenated pyrazol derivatives. March 22.

19,329. L. F. Riedel. A new compound or derivative of para-tolyldimethyl pyrazalon, and process for obtaining the same. April 19.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

5504. A. J. Boult.—From T. H. Blair, France. Improvements in or relating to the manufacture of films for photographic purposes. March 14.

5517. W. H. Prestwich. Improved silver haloid emulsions for photographic purposes. March 14.

5932. O. Magerstedt. An improvement in the manufacture of photographic plates. March 20.

6491. E. Norden. An improved method of photographic printing in bromide of silver. March 28.

6501. C. A. Allison.—From F. B. Forster and G. G. Rockwood, United States. Improvements in processes of making transparent photographs on glass. March 28.

Complete Specification Accepted.

1892.

7567. T. Christy. Manufacture of transparent materials and the application of the same to photographic and other purposes. April 12.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

5485. H. C. Hawkes. An improvement in wax matches. March 14.

6775. I. M. Meissner. An improved igniting composition for matches. March 30.

7420. J. E. Bloméu. Improvements relating to blasting compounds. April 11.

7573. C. D. Abel.—From The Westfalisch-Anhaltischen Sprengstoff Actien Gesellschaft, Germany. Method and apparatus for charging cartridges with explosives. April 13.

Complete Specifications Accepted.

1892.

7238. J. K. von Falkenstein and A. M. Bohm. New or improved manufacture of smokeless powder and high explosives. April 19.

9284. C. F. Cross, E. J. Bevan, and C. Beadle. Improvements in nitrating cellulose and other vegetable fibrous substances. April 5.

9359. J. G. Lorrain.—From G. Schnebelin. A new or improved manufacture of gunpowder. March 29.

1893.

2704. C. M. Bowman. Improvements relating to matches and manufacture thereof. March 29.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

7547. C. R. C. Tichborne and C. J. Thompson. Improved apparatus for the determination of butter fat in milk. April 13.

Complete Specifications Accepted.

1892.

5281. C. Fery. A new instrument for the measurement of the refractive index of light in liquids. March 22.

1893.

3388. F. Soxhlet. An improved method and means for retaining disk stoppers upon the mouths of bottles and other vessels. March 22.

4409. P. V. P. Berg. Apparatus for determining the relative percentages of the fluid components of a compound fluid. April 19.

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NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. E. C. C. Stanford has been nominated to the office of President; and Sir John Evans, K.C.B., F.R.S., has been nominated Vice-President under Rule 11.

Sir Frederick Abel, K.C.B., F.R.S., Mr. H. Brunner, Mr. Horace Brown, F.R.S., and Sir John Evans, K.C.B., F.R.S., have been nominated Vice-Presidents under Rule 8; and Prof. G. G. Henderson, D.Sc., has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. E. C. C. Stanford, nominated President.

Mr. E. K. Muspratt has been nominated a Vice-President under Rule 24, and the Treasurer and Foreign Secretary have been nominated for re-election.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

Extract from Rule 18 :—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

Annual General Meeting.

The Annual General Meeting will be held in Liverpool on the 12th, 13th, and 14th July next. A detailed programme appears in this issue, and Members are requested to make early application to the Hon. Local Secretary for such tickets as they require. Tickets of Membership will be issued with the Ballot List in the June number.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application, accompanied by remittance at the rates quoted on the first page, to the General Secretary only, to whom also changes of address should be communicated.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The World's Fair, Chicago.

Prof. H. Carrington Bolton requests us to state that the New York Section of the American Chemical Society will be happy to contribute, by all possible means, to the comfort and enjoyment of the foreign chemists who may visit New York on their way to or from Chicago during the World's Fair. Visitors are requested to leave their names and addresses with the Secretary of the Reception Committee, who will also be glad to furnish all information at his command, in reply to letters of inquiry.—Morris Loeb, Secretary, University of the City of New York, Washington Square East, Room 16.

Australian Association for the Advancement of Science.

A meeting of the Australasian Association for the Advancement of Science will be held in Adelaide, South Australia, under the Presidency of Ralph Tate, F.L.S., F.G.S., Professor of Natural Science at the University of Adelaide, commencing on September 25th, 1893. Section B, Chemistry, will be presided over by Mr. C. Napier Hake, Chief Inspector of Explosives, Victoria; and the hon. general secretaries are Prof. A. Liversidge, M.A., F.R.S., Prof. E. H. Rennie, M.A., D.Sc., and Prof. W. H. Bragg, M.A. The Association now numbers about 900 members.

Smithsonian Institution.

The Hodgkins Fund Prizes.

The Smithsonian Institution announces the following prizes to be awarded on or after July 1st, 1894:—

1. A prize of $10,000 for a treatise embodying some new and important discovery in regard to nature or properties of atmospheric air.

2. A prize of $2,000 for the most satisfactory essay upon—

(*a*.) The known properties of air in relation to research in every department of natural science.

(*b*.) The proper direction of future research in connection with the imperfections of our knowledge of air.

3. A prize of $1,000 for the best popular treatise on air.

4. A medal will be awarded annually or biennially for important contributions to our knowledge of the nature and properties of air or for practical applications thereof to the welfare of mankind.

The treatises should be sent in to the Secretary of the Smithsonian Institution, Washington, before July 1st, 1894, except that for the first prize, the sending of which may be delayed until December 31st, 1894.

LIST OF MEMBERS ELECTED, 23rd MAY 1893.

Chaplin, Edw. M., 60, Westgate, Wakefield, analytical chemist.

Clarke, Arthur, St. Ann's Hill Factory, Nottingham.

Colefax, Dr. Arthur, M.A., 14, Chester Terrace, Chester Square, London, S.W., Fellow of Christ Church, Oxford.

Coyle, Benj. C., Derrymore, Dalkey, co. Dublin, Ireland, analyst.

Dickerson, E. N., 15, Wall Street, New York, U.S.A., lawyer.

Dittrich, Julius C., Ozone Manufacturing Co., 47, Liberty Street, New York, U.S.A., chemist.

Finlay, John, 20, Carment Drive, Shawlands, Glasgow, chemist.

Fletcher, E. Morley, 12, Upper Bedford Place, London, W.C., Assistant to Chief Inspector under Alkali Acts.

Hilton, Edgar G., Russian Steam Oil Mill, 37, Kourlandsky Street, St. Petersburg, Russia, varnish, colour, and paint manufacturer.

Hunter, Oliver, 10, Douglas Street East, Wigan, pharmaceutical chemist.

Ivatts, Harold E., 94, Tritonville Road, Sandymount, Dublin, analytical chemist.

Jackson, the Rt. Hon. W. L., M.P., F.R.S., 7, Cadogan Square, London, S.W., leather manufacturer.

Mandall, Jno. B., 112—48, St. John Street, Launceston, Tasmania, pharmaceutical chemist.

Marchlewski, Dr. L., 15, Peru Street, Higher Broughton, Manchester.

Mayer, Wm. Turner, c/o Albany Chemical Co., 65—67, Green Street, Albany, N.Y., U.S.A., manufacturing chemist.

Riley, Wm., Castleton, Manchester, chemical manufacturer.

Robinson, Wm. S., Omaha, Nebraska, U.S.A. (1112, Dodge Street), chemist and assayer.

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CHANGES OF ADDRESS.

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Ferrie, A., l/o Harpurhey; Roslin House, Ellesmere Park, Eccles, Manchester.

Forrester, Jas., l/o Cannon Street; Layton Villa, Church End, Finchley, N.

Gair, Wm., jr., l/o Chili; 20, Cardigan Terrace, Heaton, Newcastle-on-Tyne.

Gallsworthy, F., l/o Headingley; 5—7, Meadow Lane, Leeds.

Gibbs, W. P., Journals to 57, Clive Road, Canton, Cardiff.

Hamaguchi, K., Journals to Choshi, Shimoosa, Chibaken, Japan.

Hunter, T. G., l/o 540; 625, Dreael Building, Philadelphia, Pa., U.S.A.

Irwin, Wilfred, l/o Higher Crumpsall; 3, Wilton Polygon, Cheetham Hill, Manchester.

Knight, J. J., l/o Widnes; Gorton Brook Chemical Works, West Gorton, Manchester.
Langdon, Dr. M. J., l/o Victoria Park; 3, Cooper Street, Manchester.
Leather, Dr. J. Walter, l/o Calcutta; Dehra Dun, N.W.P., India.
Lombard, E., l/o Rue Grignan; 10, Rue Breteuil, Marseilles, France.
Lord, F. J., l/o Rochdale; Brooklands, Millbrook, Stalybridge.
Lowe, H. A., Journals to Halliwell Bleachworks, Smithills, near Bolton.
Lye, W. T., l/o The Firs; Braehead, Cromwell Road, Luton, Beds.
McFarlane, W., l/o Thornliebank; Holmeview, Mansefield, Pollokshaws, Glasgow.
Marshall, Dr. T. R., l/o Cardiff; 4, East Castle Road, Merchiston, Edinburgh.
Mumford, A., l/o Westwell Street; 19, St. James' Place, Plymouth.
Myers, W. S., l/o Newark; 98, Easton Avenue, New Brunswick, N.J., U.S.A.
Pomeroy, Dr. C. T., l/o Halsey Street; (Office) cor. Passaic and Reynolds Avenue; and (Journals) 18, Pennington Street, Newark, N.J., U.S.A.
Preston, E. S., l/o Tenbury; 10, Holyrood Terrace, The Hoe, Plymouth.
Rawson, C., l/o Technical School; 2, Melbourne Place, Bradford.
Rayner, J. A. E., l/o Wavertree; High Wray Bank, Ambleside.
Richardson, C. T., l/o Portman Mansions; 9, Rosetti Mansions, Cheyne Walk, Chelsea, S.W.
Roberts, J. H. M., l/o Brixton; Laboratory, 6, Trinity Square, Tower Hill, E.C.
Saint, W. J., Journals to Kurfuerstenstrasse 5, Bonn-Poppelsdorf, Germany.
Schweich, E., l/o Jamaica; 20, Avenue Road, Regent's Park, N.W.
Smiles, Jas., l/o Queen Street; Blandfield Chemical Works, Canonmills, Edinburgh.
Smith, A. J., l/o Pitsmoor; Houghton Villas, 2, Andover Street, Sheffield.
Stuart, Jas., Journals to 22, High Street, Hull.
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Wates, E. A., l/o India; 56, Breakspeares Road, St. John's, S.E.
Webb, S. G., l/o Port Royal; 2314, East Grace Street, Richmond, Va., U.S.A.
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Fletcher, R. J., l/o The Hawthornes, Bromley, Kent.
Peploe, D. H. T., l/o 39, Sloane Gardens, S.W.
Serre, C. A., l/o Mitre Chemical Works, Cordova Road, Bow, E.

Deaths.

Bevan, Isaiah, Llanelly Chemical Works, South Wales.
Cowper, E. A., 6, Great George Street, Westminster, S.W.
Foster, Prof. Wm., Middlesex Hospital, W.C. May 23rd.
Norton, Prof. Lewis M., Mass. Inst. of Technology, Boston, Mass., U.S.A. April 23rd.
Ogden, J. M., 49, West Sunniside, Sunderland.

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THE CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE, W.

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74, North Side, Clapham Common, S.W.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Committee:* E. J. Bevan, W. G. Blagden, T. A. Lawson, R. Messel, and C. R. Alder Wright.

SESSION 1892-93.

Monday, June 5th:—
Mr. H. G. Watel. "The Movement of Air as Applied to Chemical Industries."
Messrs. Cross and Bevan. "New Cellulose Derivatives and their Industrial Application."

Meeting held Monday, May 1st, 1893.

MR. WM. THORP IN THE CHAIR.

THE GASIFICATION OF COAL AND LIQUID HYDROCARBONS.

BY DR. P. DVORKOVITCH.

The artificial production of burning gases may be said to have commenced in the year 1669 by Becher, and in the last century the obtaining of burning gas from coal was evidently known to many. The practical application of this knowledge, however, appears to have taken place only in the beginning of the present century, when large gasworks were established in London by Mr. Winsor, to whose great energy we owe the establishment of coal-gas production.

There is little doubt that the inventors of coal-gas, Mr. Winsor and Mr. Murdoch, possessed but a small knowledge of the chemistry of the gas they were producing. This is quite evident from the pamphlet published by Mr. Winsor in 1807 under the heading of "Plain Questions and Answers about Coal-Gas." There, in one of his replies, he asserted that there was not the slightest danger in taking a burning candle into a room filled with gas, as the gas could not ignite owing to its being mixed with air.

TABLE I.
Illuminant Gas.

A.	B.	C.
Lighting Gas.	Gas Carriers or Dilutants.	Foul Gas.
Benzene C_6H_6	Methane CH_4	Carbonic acid CO_2
Naphthalene $C_{10}H_8$	Hydrogen H_2	Ammonia NH_3
Ethylene C_2H_4	Carbonic oxide CO	Carbon bisulphide CS_2
Propylene C_3H_6	Nitrogen N	Sulphuretted hydrogen H_2S
Butylene C_4H_8		
Acetylene C_2H_2		
Allylene C_3H_4		

Even up to the present day chemists have given little attention to the gasification of coal and liquid hydrocarbons, and it has been left to the engineer to devise improvements and to arrive at more economic working, but without changing the original method.

Chemists have devoted themselves to the study of certain by-products of gas-making, but not to the chemistry of the material the engineer himself is treating, and the object of my lecture is to, if possible, indicate what a wide field for research exists in this direction. The immense knowledge we possess of the hydrocarbons contained in the by-products of coal gasification affords us a magnificent vantage ground from which to approach the study of the treatment of the original material from which these by-products come.

I propose first to take the gasification of coal and see what are the results obtained by the present method, both as regards the gas produced and the composition of the by-products. I then propose to show what I have proved to be possible, both as regards the gas produced and the quantity and nature of the by-products, and compare the two.

I will also deal with the gasification of liquid hydrocarbons as at present conducted, and show by what method it may be improved; and also what liquid hydrocarbons I think best suitable for gas production.

I will divide the gas produced from coal under three heads (see previous page).

According to the analysis of English coal-gas manufactured in London, made by Professor Foster in the year 1891, we see that the first-mentioned elements, A, are found in very small quantities compared with the bulk of the gas.

The analysis of seven different samples is as follows:—

Table II.

Analyses of English Coal-Gas made during 1891 *by Professor W. Foster.*

Reference No. of Sample.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Carbonic acid gas	..	0·47	0·32	0·53	..	..	..
Carbonic oxide	7·00	6·58	7·58	7·40	6·01	6·51	5·60
Heavy hydrocarbons (CnHm)	4·35	5·84	4·62	5·93	5·69	6·33	7·88
Marsh gas	35·12	35·93	36·33	33·32	37·80	37·66	37·74
Hydrogen	50·18	41·11	43·65	38·38	40·66	49·10	46·55
Oxygen	0·61	0·36	0·40	0·57	0·44	..	..
Nitrogen	2·52	9·71	7·10	13·89	10·50	0·40	4·00
Totals	99·78	100·00	100·00	100·02	100·50	100·00	101·77

The first-mentioned series, viz., the illuminants or unsaturated hydrocarbons A, are represented by 4·35 to 7·88 per cent., while the second series (B), the gas carriers, range from 89 to 92 per cent., the balance being foul gases, say 4 to 14 per cent.

Now, as regards the by-products obtained, they represent in quantity about 10 gallons per ton of coal gasified, and an analysis of these 10 gallons shows the contents to be as per Table IV.

Table IV.

The Production of Gas and By-Products from 1 *Ton.*

Coal.		Petroleum Distillate "C."	
*Gas.—*10,000 *c.f. of* 16 *c.p.*		*Gas.—*16,836 *c.f. of* 60·3 *c.p.*	
Coke and breeze	10 cwt.	None.	
Ammonia	0·22 per cent.	None.	
Tar 10 *Gallons per Ton.*		*Tar* 92 *Gallons per Ton.*	
Benzene	0·1 galls.	Benzols	30 galls.
Naphtha	0·1 "	Light gas-oil	38 "
Phenol	0·1 "	None.	
Creosote	3·3 "	None.	
Anthracene	1 lb.	Anthracene	1·5 lb.
Pitch	58 "	Pitch	100 "
		Lubricating oil	10 galls.

Such are the results of the present gasification of coal.

It is known that nearly all kinds of coal contain from 50 to 70 per cent. of fixed carbon, and from 30 to 50 per cent. of volatile matter, and it is the latter which defines the goodness of coal for the purpose of gasification. How comes it, then, that by the analysis of Professor Foster referred to, the percentage of these hydrocarbons in coal-gas is so small, namely, 6 per cent., or for the ton of coal, 600 cubic feet by volume, and 42·2 lb. by weight?

If we refer to Table III. it will be seen that the analysis by volume and weight of coal-gas when 10,000 cubic feet per ton be produced, is as follows:—

Table III.

Analyses of Gas by Volume and Weight, taking the Production of 10,000 *Cubic Feet per Ton of Coal.*

Name.	Per Centage by Volume.	Cubic Feet per Ton.	Weight in Lbs. per Ton.
Heavy hydrocarbons	6·00	600	42·2
Marsh gas	36·5	3,650	147·8
Hydrogen	48·3	4,830	24·5
Carbonic oxide	6·3	630	44·6
Totals	97·1	9,710	259·1

The average quantity of volatile matters per ton of coal must be equal to 784 lb., but obtained in gas only 259·1 lb.

That is, the average quantity in weight of volatile matter obtainable from a ton of coal (supposing we take 35 per cent. instead of 45 per cent., so as to allow of 10 per cent. for by-products and liquors) being 784 lb.; the quantity actually obtained by the present method of gasification is only 302·2 lb. as gas, or a little over one-third, the rest being lost in the course of gasification.

The correctness of the above calculation may be proved by taking the specific gravity of coal-gas, namely 0·4, which makes the weight of gas obtained per ton of coal equal to 292·8 lb.

Both calculations give approximately the same result, and clearly show, as I have said, that only a little over one-third of the volatile matter contained in coal is gasified, the rest being lost or converted into solid substance.

What is still more important, however, is that of this one-third only 42·2 lb. or about 5 *per cent.* of the *whole* consists of unsaturated hydrocarbons or illuminants.

Now, the question arises, how are the two-thirds of the volatile matter in coal lost in the process ot gasification?

By numerous investigations it has been shown that illuminating gas is formed by the separation of hydrogen from saturated hydrocarbons. It has also been shown that the less the temperature at which coal is gasified, the greater is the quantity of unsaturated hydrocarbons in the gas obtained; that is, the gas obtained is less in quantity, but better in illuminating power.

It is a known fact that gas taken for analysis from the retort at different times differs in its composition according to the time at which it is taken off. At the beginning it is considerably richer in illuminating power than at a later period. It is also noticed that as the process continues the quantity of unsaturated hydrocarbons decreases and the quantity of hydrogen increases. It is evident that this results entirely from the increased temperature under which the gas is produced. It is the same with petroleum. The composition of petroleum gas varies according to the temperature at which petroleum is decomposed. The gas obtained at a lower temperature contains considerably more carbon than hydrogen, while in raising the temperature the proportion of carbon diminishes and the hydrogen increases, and at a very high temperature pure hydrogen is obtained. This fact shows conclusively that the quantity of light-giving gases depends directly upon two factors.

1st. The quantity of the compounds which under a certain temperature will break up and give light-yielding elements; and

2nd. The temperature to which these compounds are subjected.

If we consider attentively the present method of gasification of coal in retorts, we see at once that there exist all the conditions for destroying the gas formed. The gasification is carried on at a high temperature, and the formed hydrocarbons, passing through the highly-heated mass, throw off the hydrogen in such large quantities that this gas forms nearly 50 per cent. of the whole of the gas produced. In addition to this a quantity of hydrogen produced from the broken up hydrocarbons is consumed by the oxygen in the coal, and a further quantity goes with the nitrogen to form ammonia.

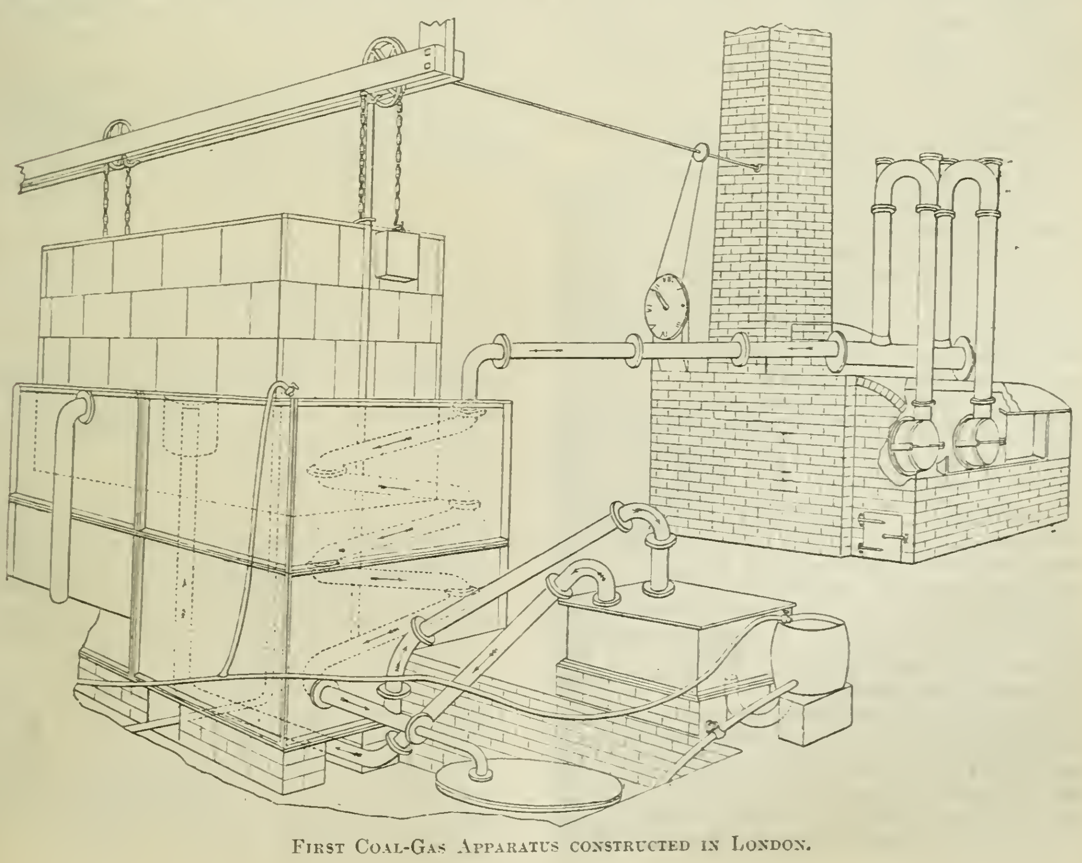
That such is the case can be seen from even a superficial survey of the elements of the gas made. We see hydrogen combined with carbons in the unsaturated form amounts to only 6 lb., and in the form of marsh gases 36·9 lb., while in the *pure* form it amounts to 22·5 lb.; and when it is borne in mind that there exists no free hydrogen in coal, it will be seen to what a great length the breaking up of the hydrocarbons has gone. In other words, the temperature of the retort has been raised to such a point as to destroy nearly the whole of the unsaturated hydrocarbons.

It will be seen from the foregoing that the gasification of coal must be carried on at a lower temperature, the result of which will be the unsaturated hydrocarbons will be preserved, a maximum candle power obtained, and at the same time a large quantity of the hydrocarbons of the benzene series obtained.

Before explaining what I have, by experiment, proved to be possible, and I believe practicable, I may say that, in the treatment of coal for gasification, I have assumed that coal is a substance which may be roughly described for my purpose as fixed carbon saturated with hydrocarbons, and that these hydrocarbons for the most part belong to the paraffin series.

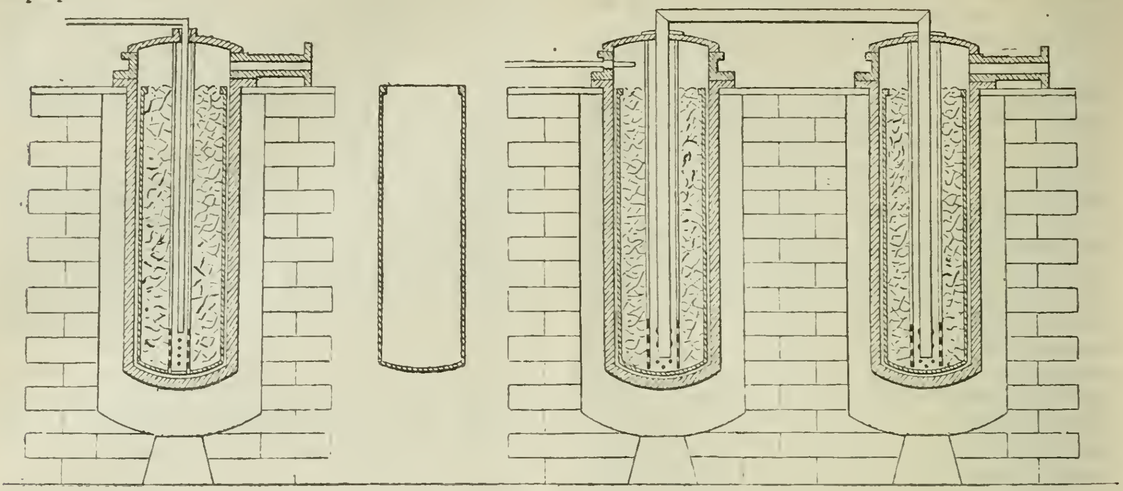
Instead of passing direct to the discussion of what I suggest as the proper method of coal gasification, I will first make a few remarks upon the gasification of liquid hydrocarbons, seeing that it is from this starting-point I have approached the subject of the gasification of coal.

In the year 1824 Mr. P. Taylor patented an apparatus for gasifying liquid hydrocarbons. His invention is



First Coal-Gas Apparatus constructed in London.

described as "a combination of a retort and apparatus for the purpose of more effectually than heretofore decomposing by the application of heat for converting fluids into gas suitable for illumination."



First Oil-Gas Plant, by Philip Taylor.

This is the first apparatus for oil-gas making that I have been able to find. From the drawing it will be seen that his apparatus consists of one or two retorts, in the centre of each of which is placed a pipe reaching to the bottom. The retort is filled with coke or other incandescent material. The fluid enters the pipe and descends to the bottom of the retort, afterwards passing in a gasified form through the incandescent material in the retort and escaping at the top. Shale oil was used for the purpose.

The main principle of passing gas through an intensely heated surface has been adopted by all the patentees of oil-gas apparatus from P. Taylor in 1824 up to the present day. The second idea of all these oil-gas manufacturers was to try to gasify the *whole* of the oil treated, without leaving any residues ; the consequence has been they have all more or less failed.

Little attention has been paid to the few, but still serious, attempts that have been made in the scientific world to obtain valuable bye-products in the gasification of oil.

In 1877, Lietny, Professor of the Technological Institute of St. Petersburg, patented and published in the Transactions of the Berlin Chemical Society a process for obtaining aromatic hydrocarbons from Russian petroleum oils, and to him certainly belongs the first rational gasification of oils.

His method has been improved upon by Dr. Smith at Mr. Ragosine's works near Nijni Novgorod, and, thanks to the enterprise of Mr. Ragosine, we have been able to utilise naphtha for the production of gas of high illuminating power, and at the same time a large quantity of very useful and valuable by-products.

The main attention at these works has been directed to the utilisation of those mineral oil products obtained by the distillation of Russian crude oil which could not be used in oil-lamps on account of their heavy specific gravity, and which at the same time were too light to be used as lubricants. These products of Baku crude oil comprise nearly 20 per cent. of the oil. It was therefore very important for Mr. Ragosine, having his works in the centre of Russia, far away from the sources of naphtha, to have no useless waste; and the attention of all chemists and scientific men engaged by him (and among them I may mention the names of Professor Schutzenberger, of Paris, and Professors Markovnikoff and Ogloblin, of Moscow) has been directed to discovering the best methods for the utilisation of the whole of the Russian oils.

Now, although the gasification of oil as conducted at the Ragosine factory is carried on mainly with the view to obtaining the bye-products which are so valuable, and which amount to 40 per cent. of the oil treated, yet even under such conditions they obtain about the same quantity and quality of gas per gallon of oil used as, according to the latest published information, has been obtained in England, where, or indeed anywhere else except Russia, no valuable by-products whatever are obtained.

Of course this may partly be attributed to the fact that in Western Europe, as well as in America, where the gas industry is so widely developed, the attention of the investigators and inventors has been directed to naphtha products and other oils only from the point of view of how to obtain the largest quantity of gas possible ; while in Russia, where the gas industry is in its infancy, the chemists have spent their energies on by-products, regarding the gas question as a secondary one. Therefore both the Russian chemists and foreign gas engineers have been equally wasteful, the first wasting the gas, and the latter wasting the by-products.

For my experiments upon liquid hydrocarbons I have taken three different distillates, namely, (*a*) solar distillates of the specific gravity of 0·8625 ; (*b*) solar distillates of the specific gravity of 0·8853 ; (*c*) a *specially prepared* distillate of the specific gravity of 0·899. As shown by Table V., by distillation of sample (*a*) at temperatures

Table V.

A. "Solar Oil," Sp. Gr. 0·8625 ; *Flash-point* 53° *C.*

Distillation.

	Per Cent.	
0° to 200° C.	10	Specific gravity of distillate obtained from 0° to 350° C. = 0·8442. Specific gravity of residuals 0·8927.
200° to 250° C.	20	
250° to 300° C.	30	
300° to 350° C.	7	
	67	

B. "Special Solar," Sp. Gr. 0·8852 ; *Flash-point* 120° *C.*

By Distillation no Fraction between 0° *to* 350° *C.*

C. "Special Distillate," Sp. Gr. 0·8991 ; *Flash-point* 115° *C.*

Distillation.

	Per Cent.	
0° to 200° C.	2	Specific gravity of distillate obtained from 0° to 350° C. = 0·8607. Specific gravity of residuals 0·9097.
200° to 250° C.	7	
250° to 300° C.	10	
300° to 350° C.	9	

ranging from 0° to 350° Celsius, I obtained 67 per cent. of a product of the specific gravity of 0·8442. By distillation of sample (*b*) at the same temperatures I obtained none at all. By distillation of sample (*c*) I obtained at the same temperatures 28 per cent. of a distillate of the specific gravity of 0·8607. I subjected these three different kinds of distillates to the process of gasification. The apparatus used for that purpose consisted of two iron pipes laid horizontally one above the other, and connected together at one end. The other end of the upper pipe is carried up vertically about 8 in.; into the top is inserted a glass funnel with a stopcock. The other end of the lower horizontal pipe is connected with a condenser for collecting the bye-products, which in its turn is connected with a gasholder for receiving the gas obtained.

The difference between the results obtained by gasifying at a high temperature and at a low temperature can be clearly seen by Table VI., Example A.

Table VI.

Gasification of Oil A, B, C.

——	Temperature of Breaking up.	Cubic Feet Gas per Ton.	Candle Power.	Candles per Gallon of Oil.	Per Cent. of Residuals.	Specific Gravity of Residuals.
A. "Solar oil"	1600° F.	126·5	22·8	576	32·0	0·9834
A. "Solar oil"	1300° F.	71·4	46·6	665	37·5	0·9266
B. "Special solar"	1300° F.	69·8	53·7	749	37·5	0·9464
C. "Special distillate"	1300° F.	69·0	60·3	832	38·0	0·9670

Distillation of Oil-Gas Tar.

	A.		B.		C.	
	Sp. Gr. 0·9266, 150 Cc.		Sp. Gr. 0·9464, 331 Cc.		Sp. Gr. 0·9670, 292 Cc.	
	Cc.	Per Cent.	Cc.	Per Cent.	Cc.	Per Cent.
60° to 79°	10·5	7·0	19·5	5·9	6·0	2·05
83°	2·5	1·66	4·0	1·2	3·0	1·02
109°	15·0	10·0	29·0	7·0	48·0	16·44
113°	4·0	2·66	8·5	2·56	5·5	1·88
135°	16·5	11·0	30·0	9·06	27·5	9·41
143°	3·5	2·33	10·5	3·17	6·5	2·23
215°	32·5	21·66	49·5	14·95	40·0	13·69
225°	4·0	2·66	10·5	3·17	13·0	4·45
360°						26·0
Over 360°	for A. B. C.	..	..	..	..	11·0
Pitch obtained ...						15·2

You will observe that the illuminating power of the gas produced at a temperature of 1600° F. is much less than that of the gas produced at a temperature of 1300° F. If a still higher temperature be used, the gas produced is again of a lower illuminating power. The next thing we observe is, that in gasifying the three samples of oil described in Table V., *a*, *b*, and *c*, at the same temperature, we obtain very different results, and the best result is obtained from sample *c*, both as regards quantity and quality of gas, and of by-products. The lightest sample certainly produced a foot or two more of gas per gallon, but the candles are only 665, as compared with 823 in the case of sample *c*. Then, again, the percentage of by-products in the case of sample *a* is 37·5 of a gravity of 0·9266, while in the case of sample *c* it is 38 per cent. of the gravity of 0·967. The difference so far as quantity is concerned is very slight, but in the value of the by-product it is very great. The analysis of the by-product in the case of sample *a* clearly shows that it contains a large quantity of light spirit, mixed with the benzol, which mixture it has proved impossible to separate by fractional distillation, owing to the boiling-points of the two being so nearly approximate. The presence of these spirits in benzol is only ascertained by gravity and not by the boiling-point, benzol mixed with spirit having a much lower gravity than pure benzol. On the other hand, the analysis of the by-product obtained from sample *c*, as seen in Table VI., shows that it mainly consists of pure benzol with very little light spirit.

As I have explained before, the most important part in the process of the gasification of the volatile matter in coal is to break up the saturated hydrocarbons into unsaturated hydrocarbons, which are the illuminating elements. It seems to me that, beginning with the first invention of coal gasification up to the present time, the method used, which results in obtaining only 42·2 lb. of unsaturated hydrocarbons out of 784 lb. of volatile matter, cannot stand scientific or practical criticism.

Guided by the results of experiments in oil gasification, and having come to the conclusion that liquid hydrocarbons exist in coal, I thought of gasifying coal on the same principles as oil, in order to avoid the destruction of the volatile matters which, as has been shown, is brought about by the present methods; but I have been prevented at the outset by the absence of any means of carrying out this purpose, and therefore I decided to adopt a combination process of distillation and gasification in the presence of an inert gas, for the purpose of mechanically taking off, or rather squeezing out, those hydrocarbons, which, as stated before, I had concluded existed in coal in liquid form. The inert gas found by me the most suitable for this purpose appeared to be pure hydrogen or a mixture of hydrogen and carbonic oxide. I have also used pure nitrogen, but I found that the breaking up of the oils went further in this case. The inert gas itself prevented the hydrocarbons from touching the surface of the apparatus and so being subjected to great heat, while the presence of hydrogen prevented the hydrocarbons splitting up. On referring to Table VII. you will see the result of this method of gasification is that I have obtained 16 per cent. of coal-oils, not tar.

Table VII.

Analyses of Coal from Yorkshire, Durham, and Lea Co.

——	A.	B.	C.	D.	Durham.	Lea Co.
Specific gravity	1·268	1·257	1·261	1·275	1·265	..
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Moisture	6·64	5·25	1·79	4·37	2·24	9·18
Ash	1·15	0·93	1·76	1·79	1·04	0·90
Coke (by existing methods)	57·60	60·02	63·97	61·81	66·31	57·07
Sulphur	0·69	..	..	..	1·45	..
Coke (by my method)	61·15	67·10	..	66·80	74·00	64·7
Tar	16·0	12·3	..	10·3	9·72	13·1
Sulphate of ammonia	0·7748	0·4257	..	0·7097	..	..
Gas per ton of coal	5120 c.f.	4978 c.f.	..	4045 c.f.	..	..
Candle power	17·3	20·7	..	22·0	..	..

The gas obtained in the first operation by my process is equal to about 5,000 feet per ton of coal, the illuminating power ranging from 17 to 22 candles, or say an average of 20 equal to, say, 20,000 candles per ton of coal gasified.

As I have stated, in the first process of gasification of the coal I obtain 16 per cent. of coal oil. On subjecting this coal oil to distillation, as seen from Table VIII., I obtain at temperatures ranging from 0 to 360 Celsius 38 per cent., or about 13½ gallons of rich *gas* oil. In addition to this I obtain 23·9 per cent. of soft paraffin, and only about 27 per cent. of pitch. Now, taking the 38 per cent. of the light products or gas oil obtained in the course of the distillation of the original by-product and subjecting it to the process of gasification, I obtain a quantity of illuminating gas equal to 11,000 candles per ton of coal, so that you will see the actual total of candles per ton of coal eventually obtainable by my method is 31,000; in addition to which the residue resulting from the gasification of this 38 per cent. of gas oil possesses the same value as the by-products obtained from the gasification of petroleum oil as per Table VI. Therefore, summing the matter up, by my method of gasification, we obtain in the first instance 31,000 candles per ton of coal treated, about 8 gallons of paraffin, about 100 lb. of pitch, and 4 gallons of bye-products of great value resulting from the gasification of the gas oil. As I have just stated, to completely carry out this method of coal gasification it is essential to divide this process into two distinct operations, but as I have told you I have not found the means of doing this. There should first be a process of coal distillation, for the purpose of extracting in an intact form the whole of the hydrocarbons which the coal contains, and having obtained these hydrocarbons they should be subjected to the process of gasification in the same way as any other liquid hydrocarbons. It is evident that it is more economical to divide the processes of distillation and gasification, seeing that the conditions under which the various series of hydrocarbons are formed is so complex, and that it is impossible to apply the necessary conditions in one operation. If you attempt to do so, in securing some hydrocarbons, you naturally destroy others.

Table VIII.

Analyses of Coal-Oil from Coal of Lea and Co.
13·1 *per cent.* 122·4 *cc.* *Sp. gr.* 1·050.

Distillation.

°	Cc.	Per Cent.
0 to 150	1·5	1·2
200	10·1	8·2
225	11·4	9·3
300	20·8	17·0
360	8·7	7·1
Over 360	34·5	28·2
Residuals	29·5	24·1
	5·9	4·8
	122·4	99·9

Distillation of Coal-Oil A.

°	Cc.	Per Cent.
100	1·5	1·5
120	..	..
150	2·3	2·4
200	4·3	4·4
225	7·9	8·1
360	21·3	21·85
Over 360	23·4 gr.	23·9
Residuals	31·18 „	32·4
Loss	5·5 „	5·6
	97·38 gr.	100·15

I prefaced my remarks on coal gasification by the statement that in this question I have acted on the assumption that coal was a substance comprising fixed carbons saturated with hydrocarbons, and I think I am justified in saying that the obtaining of paraffin in such quantities as I have done is ample proof that my assumption was well founded. It is an interesting fact also that the existence of paraffin in coal is not limited to that class of coal called gas coal, as on subjecting a sample of ordinary house coal to the same process of gasification, I obtained almost a similar quantity of coal oils, and about the same quantity of paraffin. It may also be a further interesting fact to you that the gasification of castor oil and other vegetable oils, as well as cod-liver oil, produces similar results, as will be seen from Table IX.

You can understand, although I have been working upon this subject for some time, that it is one so complex and

Table IX.

Gasification of Castor Oil. Sp. gr. 0·9299 (*impure*).

—	Cubic Feet per Gall.	Candle Power.	Candles per Gall.	Absorbed by Bromine.	Per Cent. of Tar.
				Per Cent.	Per Cent.
Exp. I.	81·8	54	882	40·8	20·7
„ II. By higher temp. as in I.	96·2	45	866	34·3	19·0
„ III.	94·6	55	1,040	39·4	17·5

Gasification of Cod Liver Oil. Sp. gr. 0·939.

Experiment I.	77·0	45	693	38·4	23·5
„ II.....	78·5	60	942	43·8	22·0
„ III....	79·5	60	954	43·0	21·0

Tar from Castor Oil. Sp. gr. 0·9521—110 *cc.*

°	Cc.	Per Cent.
50 to 100	27·0	24·5
125	4·0	3·6
150	12·5	11·4
200	20·0	..
225	6·0	..
360	18·5	..
Over 360	2·5	..
Residuals	12·4	..
	102·9	39·5

Tar from Cod Liver Oil. Sp. gr. 0·9753—163 *cc.*

°	Cc.	Per Cent.
55 to 100	30·0	18·4
125	18·0	11·0
150	18·75	11·5
200	26·5	..
225	8·75	..
360	27·0	..
Over 360	8·0	..
Residuals	23·4	..
	160·4	40·9

vast that I may be said to have arrived only at a preliminary stage: in fact the ground to be covered is so enormous that the labours of one individual can hardly ever cover it; but the fact that all coal contains paraffin in so large a quantity appeared to me of sufficient importance to the industry of gas making, that I thought it would interest you to know the progress I have made up to the present. I am continuing my investigations, and I hope in the near future to give you more detailed information on the chemical nature of the products which I have obtained. In addition to the advantages which I have already pointed out, there are others of perhaps less importance, but still sufficiently important to be worth mentioning, such as the obtaining of a far larger quantity of superior coke, absolutely free from sulphur, and of an increased quantity of ammonia. Of course the lines I have sketched out would necessitate such a radical revolution in the method of gas manufacture that I can hardly anticipate that a change of such enormous importance can be carried out rapidly, but I trust that having pointed out the possibilities that exist for the improvement of this industry, the attention of gas engineers and gas chemists may be directed to it, and all working together to the same end, the present wasteful method may, at any rate, be somewhat ameliorated.

Discussion.

Prof. V. B. Lewes said in the first place he thought the great question which had been raised was, the question of residuals versus no residuals, and in the author's very able defence of the residuals side of the question in calculating the prices of the products of goods he had taken benzol at 1*s*. 10*d*. per gallon. Now the present price was about 1*s*. 5*d*., and if the gas companies were to turn to petroleum, either obtained by distillation from coal or, what would be a more probable source, Russian petroleum, and distil that by a method which gave 30 galls. of benzol for every ton of coal carbonised, even the price of 1*s*. 5*d*. would rapidly become less. His own impression was that in the 100 years during which gas engineers had been working their eyes had not been altogether closed as Dr. Dvorkovitch imagined, and that even at the present moment with the extra knowledge of chemistry which they had at their disposal they still would prefer processes by which they got practically nothing but gas with very little residuals than to have their accounts and working hampered by a large quantity of uncertain items which would vary in price from month to month and from day to day. The contention that coal might be looked upon as carbon saturated with various paraffins was an admirable way of putting it no doubt for the purpose of showing that it was from the oil that the gas was afterwards to be obtained; but if it were taken as paraffin then Dr. Dvorkovitch said that by heating those paraffins they split up into olefines and hydrogen. His own impression was based on a great many experiments, including those made by Young, Thorpe, and many other observers, that when you split up paraffins by heat, they generally split themselves up into, not olefines and hydrogen, but into mixtures of very nearly equal proportions of the unsaturated and saturated hydrocarbons. There then at once commenced an enormous number of changes, those changes being entirely dependent upon the amount of heated surface to which the gases after production were exposed, and where the shutting off of the hydrogen from the paraffins did take place he was not at all certain that it was by any means a loss. Take for instance ethane, if that were passed through a red hot tube, the ethane broke up into olefiant gas and hydrogen, and when broken up in that way you had a very much larger volume of gas, having precisely the same illuminating power as the ethane with which you started, only you had double the volume. Dr. Dvorkovitch had pointed out very fully that the methods by which these oils were broken up had an enormous effect on the products obtained. Those products undoubtedly were to a great extent produced at the expense of the gas. When you decomposed an oil you got off a large number of gaseous constituents, and if you could hurry those out of the zone of heating you would get far higher illuminating power from them than by passing them through any long continuous superheating process. It was always a mystery to him why oil gas makers insisted on torturing their gas after they had made it. An idea sprang up in the early days of oil gas making that in order to make a fixed gas you had to take that gas mixed with the vapours which were distilled out of the retort, and to heat them altogether until you reached a temperature which would make them all into permanent gas. That was the first fatal mistake in the oil gas theories. What you wanted to do was to decompose the oil, and then differentiate as quickly as possible from the portion which would afterwards condense, not to try to convert the whole into permanent gas. If you did the infallible result was that you degraded and broke down the already formed unsaturated hydrocarbons, and by doing so, reduced the illuminating power to an enormous extent. Dr. Dvorkovitch said that you could not go further in obtaining illuminating value by additional decomposition, that the total illuminating value to be obtained from such oils as he had been working with was something like about 900 candles per gallon but he should hardly think that was exactly what he meant, for he did not think he would say that the total illuminating value you could get from a Russian oil was 900 candles per gallon. He remembered Mr. Glasgow when he introduced the Lowe plant into England saying he could get 1346 candles per gallon from this same Russian distillate oil. He should be very glad if the author in his reply would give some figures with regard to the Lowe plant. Mr. Golden and Mr. Patten afterwards modified this to a considerable extent, and brought the illuminating power to something like 900 candles, which seemed to be about what Dr. Dvorkovitch had given that night in the case of oils. But if he understood him right he decomposed the oils by passing them through a very large amount of heated tube surface and he imagined this to be his meaning, because on glancing through his very able patent he saw that an essential part of his method of gasifying oil was making the oil during its gasification travel through a considerable length of heated tube, and it was in that way that he got this large amount of benzol formed. But he would venture to say that that benzol was formed at the expense of what ought to be illuminating power in the gas; the ethylene in the oil gas got decomposed by the heated surface into various products, chiefly acetylene and methane if the temperature were high, and this acetylene immediately polymerised into benzines and from that source you got in this method this enormously higher quality of benzol than you would by the other processes. He contended that was a wrong method. It could be thoroughly proved in his opinion that it was quite possible to get out of a gallon of oil over 1,500 candles, or very nearly double the amount given as the result of these experiments, and he knew of several processes, two at any rate, by which these results had been obtained. In the future he thought they would be able to get a very much higher illuminating power out of the gas without exposing it to a large heated surface. In doing this no residues were formed, the only residue being the coke. He ventured to think a gas manager would rather get the total illuminating power and no benzol than half the illuminating power and a varying quantity of benzol which in turn would be of varying value.

Mr. Watson Smith said that he did not agree that British gas manufacturers were going very far wrong in the methods they adopted in the gasification of coal. In order to make his point clear he would like to say that not only did oils obtained from tar differ from those obtained from coal, but coals themselves differed immensely one from the other. Supposing a chemist with good scientific attainments, but rather new to the work, were introduced into a gasworks he might probably bring forward some such theory as that they had heard that evening about the adoption of too high a temperature or too low a temperature; but suppose, as in a case which had come under his notice in South Lancashire, the class of coal to be carbonised were cannel, such as Wigan cannel, which gave extremely rich illuminating gas whether the temperature were a low or high gas making temperature, the anthracene was almost valueless. If the temperature were low the anthracene obtained from the tar eventually was rich in paraffin, and that ruined it as regards its ultimate conversion into artificial alizarin. If the temperature had been an extremely high one no doubt the amount of paraffin wax would be considerably diminished, but not sufficiently so to enable the colour-makers to use the anthracene profitably. What did the gas manufacturers do? They found it best to mix the cannel coal with a certain proportion of less bituminous coals, and such a method was a scientific one, because it was based upon the experience of the tar distiller, which was based again on the experience of the colour-manufacturer. The very fact that this mixture of coals produced its effect showed how very different the coals forming the mixture were from one another. In some cases he knew a mixture of as many as three different coals to be employed for the purpose named. It seemed to him that Dr. Dvorkovitch appeared to argue straight from the Baku oils and residuals to coal oils, coals, American oils and residuals, and it appeared to him that such an argument was not tenable, as all these substances were so different in chemical constitution. To take a common example, you might take a piece of sugar, a lump of naphthalene, one of pure anthracene, and one of paraffin wax in the pure state; they all looked very similar, but if you heated them in precisely the same manner under the same conditions in a closed vessel at a high temperature the results would be extremely different, and it would be the same thing if you attempted to treat in the same manner Baku oils and residuals, or even American petroleum and residuals, coal and coal oils, &c., indiscriminately by one and the same method.

Mr. H. D. Lacy said there was one point which seemed to him to need a little clearing up. As he understood it, the author recommended the production of gas from coal by two processes, first, one by which he obtained 20,000 candles to the ton and a residual shown in Table VIII., on the re-distilling of which he got another 11,000 candles, the total result being 31,000 candles in the two operations, but looking at his own Table IV. it appeared that he got 32,000 candles simply by distilling the coal in the ordinary way. It seemed to him if that was the new method he recommended it was not one which would strike engineers as being worthy of attention. Dr. Dvorkovitch had devoted a deal of time and no doubt a deal of ability to investigating this portion of the subject, but he must say he did not think he had added anything to the information which gas engineers already possessed. He could not agree with Table IV. as to the cost of making coal gas, and thought the figures could not have been obtained from a very reliable source. He noticed a very curious coincidence, that the cost of distilling a ton of coal was 15*s.* and that of distilling a ton of oil was precisely the same.

Professor W. Foster thought the remarks of the last speaker showed that gas engineers were often not very willing to take suggestions made by chemists as to any improvements which occurred to them as the result of their investigations; but, at any rate, if this paper were not of great value to the gas engineer, the author at least deserved the thanks of the Society. There were some matters connected with the paper which might be criticised. He noticed some reference to his own work of a year and a half ago. He was sorry the author had not given a second table, which he considered far more important than that before the meeting. The table referred to set forth the connection between the lighting value of the gas and the total carbon vapour present. This was done in a number of cases, including one where the gas contained the large quantity of 13 to 14 per cent. by volume of nitrogen. This was before Mr. Davis, of Manchester, and other members of the Society brought forward similar results obtained by other methods of analysis. The point he wished to enforce was that there was always a very simple connection apparently between the illuminating power and the total amount of carbon vapour, irrespective of its various conditions, in gas made by the ordinary process of destructive distillation. If you took 100 volumes of, say, London gas, made by Mr. Lacy's company (the Gas Light and Coke Co.), it would always, as far as he knew, be found to contain from 5 to 8 per cent. of carbonic oxide, and would also be remarkably free from nitrogen. He had never found more than 1½ per cent. of the latter. One hundred volumes of such so-called 16-candle gas would give on complete combustion about 57 volumes of carbonic acid. When a gas giving on combustion, say, 63 volumes of carbon dioxide per 100 volumes, the lighting value would be correspondingly higher. This method of attacking a difficult problem was different from that adopted by Dr. Edward Frankland, who had spent a great deal of time in tracing the connection between the lighting value and the quantity and quality of the so called heavy hydrocarbons. He felt extremely obliged to Dr. Dvorkovitch for his boldness in bringing before the Society an account of his experiments, for his own experience was that one was apt to make experiments, look at the results, turn them over, and eventually put them aside, often disgusted as they became so voluminous, and apparently so contradictory. He should like to ask how he accounted for their being only 5,000 cub. ft. of gas per ton of coal; surely there must be a mistake there, for he thought every gas engineer took 9,000 to 10,000 ft. as the average yield.

Mr. Boverton Redwood said, as regarded that portion of the paper which was devoted to the subject of the conversion of mineral oils into gas, it appeared to him that one of the most interesting features had been overlooked by those who had already spoken. He referred to the suggestion that the most satisfactory results, from the gas-makers' point of view, were to be obtained by the employment of the heaviest of the oils with which the author operated. He thought he had correctly understood him to say that he practically preferred to use for the purpose of manufacturing gas of high illuminating power and residuals, an oil of higher specific gravity than most who had worked at the subject of the gasification of oil had found it advantageous to employ. Possibly the necessity which he appeared to have found for the employment of what Professor Lewes had pointed out as a rather large amount of heated surface to effect the conversion of these liquid hydrocarbons into permanent gas, might have some connection with the employment of an oil of that description. His own experience, which was not very recent or very extended, had led him to believe that the best results were to be obtained, not by the employment of a comparatively heavy oil, but rather by the adoption, if it were necessary to make use of an oil of that kind, of some intermediate process for the conversion of such oil into liquid hydrocarbons of less density, which, according to his experience, were more amenable to treatment in the final process of gasification. He knew that the author had devoted a great deal of attention to this subject, and, of course, he would not put forward a statement of that kind without thinking he had sufficient grounds. Obviously the fact that a paper of this kind was possible lent great support to the contention that the greater part of the work which had been done until recent years in connection with the manufacture of oil-gas had been done unscientifically, and he certainly concurred with those who thought that their thanks were due to a gentleman who came forward in an unassuming manner to lay before them the results he had obtained in an investigation of this kind, which he hoped might form a useful contribution to their knowledge of the subject.

Mr. Bertram Blount asked if the specific gravity, as given in one of the tables, for castor oil, 0·9299, was quite correct.

Dr. Dvorkovitch said it was a sample obtained in a chemist's shop; he did not give any guarantee for its purity.

Mr. Mackinnon said, last December he presented to the Institution of Civil Engineers a very long and exhaustive paper on the use of coal and oil gases and carburetters, having given a great deal of attention to the carburetting of gas. Forty years ago he was the engineer of an oil gas works where they employed Mare's oil, and a very fine gas it was—almost pure olefiant gas. In the paper, which would appear very shortly, he urged gas engineers to endeavour to improve the quality of coal gas by the addition of gas made from oil. There were many oils which could be employed, and they were very abundant just now, and he did not see why they could not be adopted on a large scale. The author had criticised the existing process for making gas from coal, but he thought there was no remedy,—that high heats must be continued. It was evident from the large make of coke, 61 per cent., that the author was employing a low heat. With a low heat you got a large yield of coke of very superior quality, and the gas also was of superior quality, but that process would not pay, and, therefore, the only way, it seemed to him, to get over that difficulty was to make up for the deficiency of the illuminating power of the gas by mixing, as he said in his paper, one-third of the gas made from oils. The high heats which were given by the coal carbonizing, had the effect of splitting up the ethylene. Now, in gas made from oil, if you employed a high heat, you also split up the most valuable illuminating gas, which was ethylene, and, therefore, you must use a low heat in making gas from oil.

Mr. Sutherland said they were indebted to the author for bringing forward this paper in a society where it could be discussed in the presence of men who knew something of the subject. In connection with the gasification of coal he should like to ask one question on a point he had had before him once or twice recently, and that was, had the author experimented with lignites at all in the manufacture of gas. He had a lignite coal which gave a very good yield of gas when he tested it at one gas works not long ago, and there was a large amount of oil obtained from that at a comparatively low temperature, as near as he remembered 30 to 40 galls. per ton. With reference to the conversion of oil into gas, the question had been raised whether a yield of over 900 candles per gall. was the proper figure. He was not at liberty to refer to one process which was at present being worked, but in connection with the conversion of Russian oil into gas he had had to do with some other experiments not long ago in which a yield was obtained of fully 1,200 candles per gallon. One point touched upon that night, and to which none of the previous speakers had referred, was a new one; he alluded to the question of elimination of sulphur. He understood the author to say that he had obtained coke containing only a trace of sulphur, and if that were so, all those acquainted with the high importance of coke free from sulphur in metallurgical work would see the value of it. He should like to know if Dr. Dvorkovitch had any hope of producing coke suitable for metallurgical purposes free from sulphur.

Dr. Dvorkovitch in reply said that the commercial success of using Russian oil in England for enriching or for making gas depended upon getting valuable by-products. What he had tried to do was to show how it could be used advantageously by its yield of valuable by-products. At the same time he had not referred to prices in his paper. From a scientific point of view it was an error to convert such a hydrocarbon as benzol into gas. He had with him a few samples of tar from the Lowe process from Beckton and Kensal Green, and the quantity of naphthalene there was enormous. The benzol had been broken up further and transformed into naphthalene, but they could not call that a scientific method. They could not convert saturated hydrocarbons into unsaturated hydrocarbons without obtaining some quantity of aromatic hydrocarbons; and it was much more practical to remove the aromatic hydrocarbons as they formed, and use them for enriching purposes. When one calculated the candle power which could be obtained from the 50 gallons of benzol yielded by this process, it would be found the quantity was not 800, it might be 3,000 c.p. per gallon. What he had always tried to do was to make experiments not with the view of obtaining the largest amount of candle power, but the largest amount of aromatic hydrocarbons; but even by his experiments the candle power was 832, and at the same time the quantity of tar was very much larger. He contended that in using Russian oils for the purpose of gasification they must be treated gently. He had not referred in his paper to his patent because he did not wish to mix up the practical point of view with the scientific, his object being to bring the question before chemists for discussion, especially as it was such a large subject that the whole of it was beyond the grasp of any one individual. German tar gave a very much larger yield of benzol than English tar, because the German engineer worked hand in hand with the chemist, and he thus learnt that it was not necessary to get a large yield of cubic feet per ton, but it was much better to obtain a less quantity, and at the same time to obtain very valuable by-products. It was known that German gas engineers never went beyond 8,000 cubic feet per ton, whilst the English got 10,000 and 11,000, and some were said to go to 15,000 and 16,000, and thought they obtained the best results. It was wrong from the scientific point of view and also practically, for whatever was wrong scientifically was sure to be wrong practically, and one could not obtain good results unless one worked on scientific lines. As to gasification of coal, it was much more practical to distil off first all the hydrocarbons contained in the coal, and then to use the hydrocarbons for gasifying; the amount of candle power would be much larger and the by-products would be more valuable. In his calculation about the 10,000 cubic feet he had calculated the gas as at 12 candle power, and he was referring to ordinary coal, not to gas coal. He was obliged to Prof. Foster for his remarks, and was sorry he had not quoted the other tables, but time was too short, and he followed the Russian proverb, "Never do to-day what you could do to-morrow." The quantity of gas per ton mentioned was not a mistake at all. He gasified at a very low temperature, as low as possible, and in that way he had obtained only 5,000 cubic feet of 17, 20, and 22 candle power, averaging 20 candles from ordinary coal, not gas coal. It was quite right that a low temperature gave a large quantity of heat. He had tried to distil, not to gasify at all, but to prevent gasification as much as possible. With regard to Mr. Sutherland's question as to sulphur, he had a sample of coke obtained from the process he described quite free from sulphur. In conclusion, he might say that he found this method of using hydrogen or a mixture of hydrogen and carbonic oxide very useful as a method of analysing coal, as he obtained an exact result, and in a very short time.

ESTIMATION OF TANNIC AND GALLIC ACIDS.

BY W. P. DREAPER, F.C.S.

The estimation of tannic acid has been a task which chemists have failed to entirely surmount for several reasons. There are a great many tannic acids known, and their number constantly increases, yet it may be safely said that not one of them has ever been prepared in the pure state. Accordingly there is great doubt as to their exact chemical composition and behaviour towards reagents. There is also no known method of separating one acid from the other, so that one is never quite sure with which acid or acids one is dealing.

Many methods of analysis have from time to time been suggested, and all of them, with one or two notable exceptions, reluctantly abandoned as useless.

The methods hitherto proposed can be divided into two classes, viz.:—

(1.) Those which act by precipitating the tannic acid as an insoluble compound.
(2.) Those which act by oxidation.

To the former class belongs the well-known "hide" process, and to the latter Löwenthal's permanganate method, which has been modified by Procter and others. These fairly represent the two classes, and are the only ones in general use at the present day.

Mention must, however, be made in this paper of Darton's process, the novelty of which consists in precipitating the tannic acid by means of an ammonio-copper sulphate solution, after a preliminary treatment with sulphuric acid to remove the ellagic acid and then a treatment with ammonia, filtering after each treatment. Procter states that this preliminary treatment is unnecessary in the case of some extracts, and I have never found any precipitation to take place in the case of the so-called "pure" tannic acids, probably owing to the removal of the impurities during the process of purification. The original solution and the filtrate are titrated with permanganate as in Löwenthal's method, the difference in the two results being due to the tannic acid present. The copper tannate may be dried at 110° C. and weighed, or else ignited and weighed as copper oxide. Fleck states that the tannic acid can be calculated from this by multiplying by the factor 1·034.

I was led to experiment in other directions with the object of obtaining a process which would be simpler than the hide or permanganate methods in manipulation, but at the same time as accurate in results, and to shorten the time taken up by the analyses. Also to make an attempt to estimate the gallic acid at the same time; this being of some importance to dyers and also indicating within certain limits the origin of the tannin and the age of the extract, tannic acid being oxidized to gallic acid on prolonged exposure to the air.

I also recognised the difficulty that extract manufacturers and others were under in not having at their command a rapid method for determining the strength of their extracts and liquors, which only vary in strength and not in kind. The usual method of taking the specific gravity of the extract only indicates the total density of the liquor and not the percentage of tannic and gallic acids present. This assay can be rapidly performed by the process to be described in this paper, the titration only taking 5 minutes to perform.

The method in general use for calculating the results obtained by Löwenthal's method is to express the result in terms of oxalic acid. This is very inconvenient, the oxalic acid only playing a minor part in the titration, namely, to standardise the permanganate, and I prefer in the under-mentioned process to use figures which will more directly represent the quantity of tannic and gallic acids present. At the same time it is quite impossible in the present state of our knowledge to use factors which will give results in gallo-tannic, querci-tannic, or other tannic acids.

The following process deals with the direct precipitation of the gallic and tannic acids by means of a copper salt, using an outside indicator, preferably ferro-cyanide of potassium. If a standard solution of copper sulphate be run into a solution of the mixed acids, a certain amount of copper tannate and gallate will be precipitated, depending on the dilution of the solution and the amount of acid set free from the copper sulphate. The precipitate is, under these circumstances, of a bulky nature and ill adapted to any separation by quick filtration, so necessary in a process of this description. I have found that when a solution of copper sulphate is added to a solution of the mixed acids in the presence of an insoluble carbonate, which also gives an insoluble sulphate, that the precipitation proceeds with the utmost regularity. The carbonate immediately forms insoluble sulphate with the free acid, and also helps to consolidate the precipitated copper salts, so that towards the end of the reaction they fall rapidly to the bottom of the vessel, leaving the supernatent liquor clear. This separation is a good indication that the end of the titration is near, and is supplemented by the ferrocyanide test.

A modified method of testing for the excess of copper in the solution, and which as far as I can find out has not previously been published in any text-book, is as follows:— Pieces of stout Sweedish filter-paper 1 in. square are folded across the middle, and a drop of the liquor to be tested taken up on a glass rod and gently dropped on to the top surface. The liquor will percolate through to the under fold, leaving the precipitate on the upper one. It is then only necessary to unfold the sheet and apply a drop of ferrocyanide to the under surface. If the reaction is complete a faint pink colouration will take place, which is perhaps more easily recognised by transmitted light.

The results obtained by duplicate experiments tend to show that the copper salts are perfectly constant in composition when precipitated in this manner, and the results equal in accuracy any obtained with other processes.

"Cross" analyses are as impossible with this process as with any yet devised.

It was found necessary to test the action of soluble barium salts on the accuracy of this method, barium carbonate being found to be the most suitable for the purpose. Free mineral acids other than sulphuric would decompose the carbonate, forming soluble salts, and tannic and gallic acids also seem to act in the same way at a temperature of

50° C. or thereabouts. The results obtained show that no disturbing action takes place.

Weight of Tannic Acid.	Weight of $BaCl_2$ added.	Cc. of Standard Solution required.
Grm.	Grm.	
0·5	0·00	25·2
0·5	0·25	25·3
0·5	0·50	25·3

About 1 grm. of barium carbonate was added in each case and the solution heated up to 90° C. before titration. The temperature at the end of the titration should not be less than 30° C. This was the general procedure in all the experiments recorded in this paper, unless special mention is made to the contrary.

Similar results were obtained with free hydrochloric acid, care being taken that the barium carbonate was added in excess before titration.

These experiments show that the separation of the tannic acid by means of an acid solution of gelatine and salt will not affect the general results obtained, and this method for want of a better was used in the following experiments, Procter's modification being considered the most accurate, and therefore adopted.

The following table was prepared from experiments, showing the error due to the indicator in cc. of standard solution added to different quantities of water:—

Cc. of Water.	Cc. of Standard Solution required.
20	0·3
30	0·4
60	0·7
100	1·0
150	1·5

The above correction was made in all cases.

Although it is not absolutely necessary to separate the tannic and gallic acids for results in dyeing, yet in the general run of cases it is advisable to do so. It should be of great service to know the proportion of tannic to gallic acid present, and I believe that this is possible for the first time under this process, at any rate as far as practical results go. It may be objected that the matter other than tannic acid precipitated by the copper may not be pure copper gallate, but may contain other substances precipitated by copper salts. Before finally settling this question it must be thoroughly gone into, and I am afraid that the time at my disposal has precluded me from doing so in this paper. At any rate, it will be very useful for dyers to know the amount of matter other than tannic acid precipitated by mordants; and for the present I think we are justified in calling it gallic acid. In Löwenthal's method organic matter other than gallic and tannic acids certainly react on the permanganate, especially if the operation be conducted at a high temperature as recently proposed.

The following results have been obtained in practice with my process, the figures obtained by Löwenthal's method and the "hide" process being inserted in some cases for comparison. The figures obtained by the "hide" process are not those obtained by evaporating to dryness and weighing the residue, as in the case of Procter's method, but by titrating before and after with copper sulphate in the usual way. This was thought preferable in this case, as the figures obtained could be directly compared with those obtained by the other methods.

A standard solution of copper sulphate was prepared by dissolving 30 grms. of the crystallised salt in 1 litre of water. This is practically a $\frac{N}{4}$ solution, and is well suited to the purpose.

The barium carbonate should be free from calcium salts, as these precipitate some of the tannic acid present and so interfere with the result.

A sample of so-called "pure" tannic acid gave the following results:—

Weight taken.	Cc. Required.
Grm.	
0·5	25·0
0·5	25·2
0·5	25·2

Slightly lower results were obtained when the operation was conducted in the cold, probably owing to the slower action of the carbonate on the free acid; but the rate of running in of the solution had no appreciable effect on the quantity required.

A sample of the purest gallic acid that could be obtained gave the following figures:—

Weight taken.	Cc. Required.
Grm.	
0·5	45·0
0·5	44·8

Allowing that the acid was of 90 per cent. purity, these results would give a value for each cc. of 0·0111 grm. This figure must of course only be taken as approximate. It will be seen that more solution is required to precipitate the gallic than the tannic acid. This is also noticed in Löwenthal's method.

After the extract had been titrated in the usual way for mixed acids, 50 cc. of the solution were taken and 28·6 cc. of a 20-grm. to the litre solution of gelatin added, and the solution saturated with dry salt, and 10 cc. of a $\frac{1}{20}$ solution of sulphuric acid added. The contents which according to Procter amount to 100 cc. were then well shaken and 5 grms. of barium sulphate added to facilitate the precipitation of the gelatin-tannic acid compound. I find that it is better to add the barium sulphate before the gelatin and to add the latter in small quantities with constant stirring. After filtration 50 cc. of the liquor were treated with copper sulphate solution, and 5 cc. with permanganate, and the results tabulated in paralell columns.

It will be noticed that the hide powder removes some of the gallic acid, especially when this is present in large quantities, as for example in the so-called "gallic" extract. The figures for tannic acid being much too high, and those for gallic acid correspondingly low, when compared with those obtained by the gelatin and salt separation. This seems to be the great defect in the hide process, and it is difficult to see how it can be got over, I am inclined to think that the process of the future will have to be based on some different method of separation. Perhaps Darton's method will come into more general use. I obtained the following figures with the method:—

One grm. "gallic" extract precipitated 0·1323 grm. CuO.
One grm. "gallic" extract precipitated 0·1308 grm. CuO.

These results do not agree with the corresponding figures for tannic acid obtained with the gelatin, or hide, separation, and if they are correct point to high tannic acid results in both the latter cases. This is not improbable. A method that might be useful would be to titrate the original solution for total matter precipitated by copper sulphate, and then to precipitate the tannic acid as copper tannate in an ammoniacal solution, filter off, ignite, and weigh as copper oxide. Thus one would get useful results, but the whole method rests on the assumption that the precipitate in the latter case is pure copper tannate, and that all the tannic acids present are precipitated. In the following table results are calculated on one grm. of sample taken:—

Substance taken.	New Process.		Löwenthal's Method.		Hide Process.	
	T.A., Equivalent in Grms. of CuO.	G.A., Equivalent in Grms. of CuO.	T.A., Equivalent in Grms. Oxalic Acid.	Matter not T.A., Equivalent in Grms. Oxalic Acid.	Tannin Removed by Hide Powder in Grms. of CuO.	Matter not Removed by Hide Powder in Grms. of CuO.
Chestnut extract, solid, pure	0·4465*g*	0·0665*g*	..	..	..	..
Sumac extract, 51° Tw.	0·2061*g*	0·0266*g*	..	..	..	..
Myrabolam extract, 51° Tw.	0·2280*g*	0·0542*g*	..	..	..	..
Tannin extract, pure B. 25°	0·1662*g*	0·0807*g*	0·9554*g*	0·2258*g*	0·1804*g*	0·0665*g*
"Gallic" extract, 25° pure	0·1634*g*	0·1263*g*	0·9495*g*	0·2760*g*	0·2297*g*	0·0600*g*
Tannic acid, pure S., solid	0·6270*g*	0·1425*g*	3·3858*g*	0·3787*g*	0·6885*g*	0·0885*g*

The figures obtained with the "new process" and the "hide method" can be directly compared with each other with very suggestive results. As regards the results obtained with Löwenthal's method comparison is not so easy. For reasons which are obvious I should lay myself open to serious criticism if I used factors for converting the equivalent of tannic acid in grms. of oxalic acid, into the same expressed in copper oxide. I therefore prefer to avoid the subject in the present paper, and only give the results as I obtained them.

The chief advantages of this method over Löwenthal's seem to me to be as follows:—

(1.) Both the tannic and gallic acids are estimated.
(2.) Rapidity of estimation where a simple assay is sufficient.
(3.) The results are expressed in terms of the copper oxide precipitated.
(4.) The standard solution keeps well, and there is no correction necessary for indigo-carmine solution or gelatin.
(5.) Larger quantities of the solution can be titrated, thus reducing the working error.

It seems to be possible to use this method for substances other than tannic or gallic acids, *e.g.* Fustic.

The following results were obtained with a sample of pure Fustic extract 51° Tw.

0·5 grm. taken required 11·5 cc. of standard solution.
0·5 grm. taken required 11·6 cc. of do.

The end of the reaction was sharp when the titration was carried on at the boiling point and the precipitate settled well. It might be possible to estimate the tannin matters added to other extracts in this way, and the process might with modification be useful in the estimation of basic colouring matters.

Ferric salts do not give satisfactory results when substituted in the place of copper sulphate solution. They act on the barium carbonate. Nickel salts do not answer well. Of course it might be possible to devise a process or processes in which other metallic salts could be used, but I am inclined to think that the copper method would be more easily worked, and therefore I have confined myself to that process in this paper.

The copper solution can be used for testing the purity of gallic acid. I think it is advisable to use a slightly higher temperature in this case, say not less than 50° C.

In conclusion my thanks are due to Professor Meldola for his kindness in allowing me to work out the above process in the Technical College laboratories, to those gentlemen who have come forward with their advice, notably, Mr. H. R. Procter of Yorkshire College, and to those firms who have prepared pure extracts of tannin matters for the above work.

DISCUSSION.

Dr. S. RIDEAL said a method of titration was very desirable as the present methods were very unsatisfactory and laborious. A year or two ago he had occasion to review the different methods existing (Industries XI., 452; XII., 211), and came to the conclusion that for rapid estimation a method of titration such as that proposed by the author was a desideratum. Zinc and lead salts had both been used for the titration of tannine solutions, but there was a difficulty in finding the end of the reaction and in ensuring completion. The copper sulphate would give a very good reaction, but there was a possibility he thought of reduction by means of sugar, and thus giving low results if as he understood the titration took place in the boiling solution and in the presence of barium carbonate. He would also like to ask if he had made any experiments with gambier. Mr. Procter during the last year or two had been trying along with continental chemists to get some standard method of analysis for that substance, and if this were applicable it would be very useful.

Mr. J. HERON said they now knew that many of the tannins gave different reactions with the usual reagents. Therefore, so far as he could see, up to the present, the value of any one reagent proposed or any of the methods adopted for the estimation of tannin in any particular substance could only be at best comparative, and from that point of view he should think the method now brought forward would be very useful if, as Dr. Rideal said, they had proof that it had no action on other substances accompanying the tannin or the gallic acid in the solution. In his opinion the presence of sugar or any other carbohydrate would be fatal to such a process. He had gone very fully into the estimation of tannic acid in hops and was of opinion that Löwenthal's method as adopted by Procter, with a few slight modifications was really as accurate as any yet devised. There were one or two points in the paper he should have liked to have gone into, but it was impossible at that late hour. He might say that if the author were to carry on his experiments a little further, and test the process in different ways it might be a very useful method for the rapid estimation of tannin where absolute accuracy was not so much required as a quick and approximate method.

The CHAIRMAN said he thought most of them had had difficulties in estimating tannin, which was a most troublesome substance, the difficulty arising very much from the want of definiteness in its chemical reactions. There were other things associated with it which resembled it with sufficient nearness to upset nearly all equations and methods of titration. An improved method would be very welcome.

Mr. W. P. DREAPER, in reply, said Dr. Rideal had referred to the use of zinc; as he thought he mentioned in his paper other metals could be used as well as copper. Iron salts could not be used because mutual decomposition took place between them and the barium carbonate; as far as gambier was concerned, he had tried one or two experiments on cutch, but the process did not answer very well in that case. He had not tried any experiments with sugar but had assumed that Darton's statement, that sugars had no disturbing effect on his ammonia-copper process, would apply to this process also; the solution was not boiled, but heated up to, say 80° C., and it naturally cooled down during the titration. As a matter of fact one could work at 40° or even lower, but in that case the free acid was not so readily removed from the solution by the barium carbonate. One might even work in the cold if it was found necessary.

Mr. McEwan asked if cutch and gambier were used as synonymous terms in dyeing, for as a matter of fact they were totally different substances?

Mr. W. P. Dreaper said they were treated as synonymous and he took them together for dyeing purposes. As the chairman had said there was a great want for a new process that would give correct results, the difficulty being that tannic and gallic acids acted in much the same way towards reagents, but it seemed to him that the difficulty was to a great extent got over by separation by gelatine or hide powder. Cuprous oxide was only precipitated by reducing sugars from an *alkaline* solution. As the solution in the above process was always slightly acid or at most neutral no disturbing action could take place from that cause.

Liverpool Section.

University College, Brownlow Street.

Chairman: *H. Brunner.*
Vice-Chairman: *E. Carey.*
Committee:

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E. Carey.
V. C. Driffield.
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E. K. Muspratt.
G. Schack-Sommer.
A. Watt.

Hon. Treasurer: W P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* E. Carey; *Vice-Chairman:* H. Brunner; *Committee:* P. Bateson, Frank Tate, H. Tate, jun., E. Scott, and A. Smetham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892–93.

Meeting held Wednesday, May 3rd, 1893.

MR. HENRY BRUNNER IN THE CHAIR.

ACTION OF LIGHT ON PHENOL.

BY ARTHUR RICHARDSON, PH.D.

In the interesting paper by Dr. Kohn and Mr. Fryer, on "The Cause of the Red Coloration in Phenol" (this Journal, 1893, 107), the authors draw attention to the similarity between the colour products formed by the action of moist air and sunlight on phenol, and that produced by the addition of hydrogen peroxide. In the absence of any direct proof, however, that the peroxide is formed in phenol during exposure, they wisely refrain from advancing any theory to account for the darkening action of light on the supposition that this substance is present.

During the last two years I have had occasion to study the action of light on a considerable number of organic bodies, the main object being to discover to what extent hydrogen peroxide is formed during exposure. As phenol was one of the substances used, I thought it might be of interest to give the results obtained in this case.

In order to detect minute traces of hydrogen peroxide which might be formed in the liquid during exposure, the titanic acid reaction was first made use of. This reagent, which gives a deep yellow colour with the peroxide, affords an exceedingly delicate test, and also has the advantage that other oxidising agents, such as ozone, oxides of nitrogen, &c., are without action on it.

Lèvy (Annales de Chemie, April 1892) has, however, shown that solutions of phenol, and some other organic compounds, in strong sulphuric acid, produce a deep red coloration with titanic acid; on dilution with water, however, the coloured compound is decomposed. It was found, in practice, that this reaction did not in any way interfere with the reliability of the test for the peroxide, since the titanic acid solution (which was made up with dilute sulphuric acid), failed to give any trace of yellow colour when added to phenol which had not been exposed to light. When the presence of hydrogen peroxide was indicated by this means, it was always confirmed by the potassium iodide and chromic acid tests. In the first experiments the substance sold as pure absolute phenol was used. About 5 cc. of the melted crystals were made up to 100 cc. with water and exposed in the open air (S. aspect) in a white flat glass bottle, placed in a slanting position, to expose a large surface of liquid to the influence of oxygen and sunlight. The mouth of the bottle was protected by a cap of tinfoil. The action of the light was further augmented by placing a plane silvered glass mirror behind the bottle.

The following are the results obtained:—

Before exposure no reaction with titanic acid.

Exposed October 8, 1891.

Tested with titanic acid, October 14, 1891, no reaction.
Tested with titanic acid, November 2, 1891, slight but decided yellow colour.
Tested with titanic acid, November 20, 1891, slight but decided yellow colour.
Tested with titanic acid, March 15, 1893, few drops diluted to 50 cc. gave intense yellow coloration.

The solution after this time was coloured deep brown, and brown flakes adhered loosely to the sides of the bottle. On March 20 my attention was again turned to the liquid (after reading Kohn and Fryer's paper) and further tests for the peroxide were applied.

(1.) A solution of potassium iodide was added to a portion of the liquid; iodine was liberated, turning starch solution blue.

(2.) Another portion of the liquid was shaken with pure ether, in which the brown substance dissolved, leaving the aqueous solution nearly colourless. The latter was then run into a test tube, and again shaken with fresh ether, which remained perfectly colourless. A few drops of a dilute solution of chromic acid were then added, and the liquid again shaken; the ether which separated out was coloured intensely blue, the chromic acid solution, however, remained nearly as yellow as before.

These tests seem to prove conclusively that hydrogen peroxide was present in the liquid. The ether used in these experiments had been previously tested for hydrogen peroxide, and gave no reaction either with titanic or chromic acid. These results have been further confirmed by more recent experiments continued over a much shorter period.

A sample of commercially "pure absolute phenol," which was beatifully crystallised and perfectly white, was taken (the bottle bore the name of Calvert), and was exposed in bulb tubes plugged with pure cotton wool. The exposure lasted from March 22, 1893, to March 25. During these three days the sunshine was intense, and the sky cloudless. Mirrors were placed behind the bulbs as before. The following are the conditions under which the exposures were made, and the results obtained—

(1.) Five cc. melted phenol taken and 1 cc. of water added. After exposure, the crystals were coloured dark brown. They were treated with water, and a portion tested with titanic acid, this gave a deep yellow coloration. Another portion was shaken with ether and tested with chromic acid as before. The ether was tinged slightly blue.

(2.) Water containing 30 per cent. phenol. The liquid was coloured brown after exposure. The aqueous solution gave a very distinct though less intense yellow colour, with titanic acid.

(3.) Water containing 3 per cent. phenol. Was only slightly coloured after exposure, and gave a faint reaction with titanic acid.

(4.) Similar samples kept in the dark gave no reaction with titanic acid.

These experiments not only confirm the first results, but also show that dilution with large quantities of water diminishes the rate of formation both of the peroxide and of the darkened product.

It should be mentioned that where the titanic acid test was applied to the brown liquid, two quantities (contained in nessler glasses) of equal depth of colour, were taken, titanic acid was added to one and the colour compared with that to which the reagent had not been added.

Since writing this paper I have been in communication with Dr. Kohn, who has most kindly put at my disposal a quantity of the chemically pure product, which had been specially prepared and subsequently distilled three times from glass vessels. I have therefore been enabled to ascertain how far the peroxide is formed, by the action of light and moist oxygen, on chemically pure phenol, and also to observe the rate at which darkening takes place. The following experiments were made with this sample :—

(1.) Phenol, to which a few drops of water had been added, was contained in bulb tube, and neck plugged with pure cotton wool, and protected by small inverted breaker (exposed for three days, April 29—May 1). Mirror placed behind bulb (maximum temperature 35° C.). After exposure the phenol was coloured deep orange-yellow. It was mixed with water and shaken with pure ether; to one portion of the clear aqueous solution chromic acid and ether was added, when the latter was coloured most intensely blue, the chromic acid solution remaining yellow.

To another portion titanic acid was added, this gave an intense yellow reaction.

To a third portion potassium iodide was added, when iodine was liberated.

(2.) Dr. Kohn informed me that he had found in later experiments that no darkening of the phenol occurred behind ruby red glass. To test the formation of hydrogen peroxide under these conditions a second quantity of phenol and water in plugged bulb-tube, as above, was exposed for three days behind two thicknesses of ruby glass (maximum temperature, 45° C.). After exposure the phenol was perfectly white, and when treated with water and shaken with ether the aqueous solution gave no trace of blue colour with chromic acid and ether. Titanic acid gave no reaction. Dr. Kohn's observation is thus confirmed.

It is thus seen that in pure phenol, as in the commercial product, hydrogen peroxide is formed under the influence of light, oxygen and water, and further that the rays which bring about its formation are those at the violet end of the spectrum. In comparing these results with those obtained by Kohn and Fryer, it must be remembered that the present results were obtained under the most favourable conditions as regards light, viz., a sky generally free from smoke, very intense sunlight, and augmented illumination of the bulbs due to the use of mirrors. It therefore seems probable that the want of agreement between the results obtained by Kohn and Fryer and myself is due to the widely different conditions under which the exposures were made in the two cases. Dr. Kohn also tells me that a degree of darkening in phenol, such as was obtained by me after three days exposure in Clifton, would only be produced after many weeks under the conditions under which he has exposed it in Liverpool.

With regard to the amount of peroxide formed, it seems most probable that the intensity rather than the total quantity of light will influence the result, for as the peroxide reacts slowly with phenol (with formation of the coloured product) the amount present, as such, at any one moment, will depend (1) on the rate of formation of the peroxide due to the intensity of the light; (2) on the rate of decomposition of the peroxide by the phenol. Where exposures are made in light of feeble intensity, the second reaction may overbalance the first, and darkening of the phenol will occur, yet no peroxide will be found in the product.

In conclusion, it may be noticed that although in some cases oxidation is brought about by rays of low refrangibility, yet in those instances where the change only occurs in presence of free oxygen and water, as in the present case, it appears to be due to the rays at the violet end of the spectrum; this is so where metallic sulphides are oxidised to sulphates, *e.g.*, PbS to $PbSO_4$, and also where ether is oxidised with formation of hydrogen peroxide.

Discussion.

Dr. Kohn said it was of great interest to himself and Mr. Fryer that Dr. Richardson had, under conditions of exposure somewhat different to their own, been able to detect the presence of hydrogen peroxide in phenol exposed to light in presence of air and moisture. That this was the active agent in producing the coloration they had little doubt when their paper was read, but the tests for the presence of hydrogen peroxide which they had made from time to time during the course of their experiments, showed so very faint a trace of it that they did not consider its presence sufficiently established. Further, the rate of formation of the colour under conditions favourable to the production of hydrogen peroxide, *e.g.*, the presence of ether, did not give a sufficiently decisive result. That Dr. Richardson had detected the presence of hydrogen peroxide (which presence he was glad to be able to confirm from an exposed sample Dr. Richardon had kindly sent him), he considered due to the fact that Dr. Richardson had exposed his phenol under particularly favourable circumstances, and in the open air, whilst in his own experiments the exposures had been made more under the conditions under which the usual reddening of phenol occurs. The samples were exposed in the south windows of a well lighted room, and the quantity of water added only sufficient to just moisten the phenol. Although Dr. Richardson's results showed that the rate of formation of the hydrogen peroxide decreased with an increasing amount of water, still, it appeared that a certain quantity was needed for the formation of the hydrogen peroxide to take place sufficiently rapidly for it to be detected; otherwise, as Dr. Richardson suggested, it was used up for the oxidation of the phenol as quickly as it was formed.

In regard to the titanic acid test for hydrogen peroxide, it applied quite well to the present instance provided the phenol was completely in solution.

In the paper read on this subject it was stated that the action of any special rays of light on phenol had not been tried; later experiments he had made, as Dr. Richardson had mentioned, had shown that the coloration was not produced by the less refrangible rays and his (Dr. Richardson's) finding that under this condition no formation of hydrogen peroxide occurred, was an interesting confirmation of the mutual dependence of the two phenomena.

Newcastle Section.

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The names in italics are those of members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* T. W. Lovibond and W. Martyn.

SESSION 1892–93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held Thursday, 11th May 1893.

MR. A. ALLHUSEN IN THE CHAIR.

ON THE COMPARATIVE EFFICIENCY OF ABSORBING-APPARATUS, ESPECIALLY COKE-TOWERS AND PLATE-COLUMNS.

BY G. LUNGE.

Dr. Hurter's paper on coke towers and similar apparatus (this Journal, 1893, 227) again exhibits his thorough grasp of the scientific bearings of such parts of chemical technology as he is familiar with. My admiration for this almost unique attempt to apply pure mathematics and physics to phenomena taken from the practice of manufacturing chemistry, is only tempered by the regret that, owing to the nature of the case, it is as yet, and will be for a long time to come, impossible to submit all the conditions of the manufacturing operations to such mathematical scrutiny as Dr. Hurter, probably alone among living chemical technologists, is able to bestow upon them. The consequence of this is, that whilst we are by his labours greatly enlightened on some of the functions of our appliances, and whilst I am sure any practical man who takes the trouble to master Dr. Hurter's disquisitions will derive great benefit from them, there is always a more or less considerable residuum of conditions which cannot be submitted to mathematical treatment, and which must be elucidated by less stringent scientific or even entirely empirical ways. And that unscientific residuum may be so extensive that a one-sided contemplation of those parts of the subject which can be scientifically examined by the light of mathematical treatment might actually mislead us, and cause us to adopt or reject some apparatus or process without good reason. I am quite sure that Dr. Hurter himself will be the first to admit this; indeed any of his readers can see that he is always careful to compare his theoretical results with those obtained in actual practice, wherever that is possible.

Dr. Hurter's calculations and reasonings are intended to prove that the most economical way of treating liquids with gases is not that in which the gas bubbles through the liquid, and still less that in which the liquid divided into fine drop falls through a column of gas, but that in which the liquid is spread on solids with extensive surfaces and interstices, the gas passing through the interstices. The mechanical work, he tells us, is least in the third case, and greatest in the second, and the rate of efficiency is in the same order. Still, we are in some cases from the outset obliged by practical reasons to employ one of the two former methods, even if we had to concede that it is theoretically inferior to the third. Nobody, for instance, would think of treating Weldon mud in apparatus of the third class, similar on principle to the coke-tower, for the very good reason that such an apparatus would be instantly choked up, not to speak of other considerations. But in cases where two or all three of the just-mentioned classes of apparatus are applicable, and where we are doubtful which of them to employ, Dr. Hurter's reasoning tends to show that we should decidedly choose the third class, of which the coke-tower is the most general, and, in his opinion, the most efficient representative.

I must, however, beg leave to mention some decidedly important points which are left out in Dr. Hurter's remarks and calculations, and which, I am afraid, greatly impair the value of both. Thus, in comparing the subdivision of gas in bubbles and that of liquid in drops, he quite rightly points out that the volume of the gas is always at least 100 times that of the liquid, and that consequently, in order to produce the same contact surface, the drops would have to be one-tenth the diameter of the gas bubbles. He continues: "To me, this consideration alone is sufficient to show the superiority of the process of subdividing the gas generally over the method of drops." This I cannot understand; for it is evident that the diameter of the globules of liquid in a "spray," such as we can produce by various means, is most easily brought down, not merely to one-tenth, but to a much smaller fraction of the diameter of the smallest gas bubbles producible by ordinary technical means, let alone the comparably very large bodies of gas in the interstices of coke in a coke-tower. It is true that a good many of those minute globules of liquid coalesce into bigger drops, but so do the bubbles of gas forced through a liquid. The practical objection that a spray-producer easily gets out of order, the orifice getting stopped by obstructions, has been greatly reduced by modern inventions, and this is also claimed for another probably more serious objection not mentioned by Dr. Hurter, viz., that the liquid issuing under great pressure from a narrow orifice gradually enlarges the latter, sometimes at a rather rapid rate, and thus causes much more liquid to issue than is intended. I have been told by one of my former students who uses Körting's spray-producers, as shown in my "Sulphuric Acid aud Alkali," 2nd ed., Vol. I., page 424, that these are free from the above objection; I myself have no experience with them.

Dr. Hurter further tells us that the kinetic theory of gases proves that the effectiveness of any process of absorption is proportional to the absorbing surface, to the time, and to the pressure of the gas. He further shows that the contact obtained by the subdivision of a gas is as much greater than that obtained by dividing the liquid into drops, as the volume of the gas is greater than that of the liquid, multiplied by the number of times which the average velocity of the gas exceeds that of the liquid drops. Probably only few of those who have had to deal with absorbing processes have ever heard of the kinetic theory of gases, and very few of them indeed could understand it, but I think every one of them will have taken the above three conditions for granted, as being dictated by the ordinary common-sense way of looking at the matter. I am the very last to say that it was superfluous to *prove* accurately what before that had been only a more or less vague belief; I am grateful to Dr. Hurter for once more strengthening the scientific foundation of technology. I must frankly confess my great inferiority to him in that respect; I cannot, like him, wield the kinetic theory of gases and other mighty engines of the human mind, and I am obliged to take many things on trust which he can verify for himself. But after all, my so much humbler mathematical and physical training enables me to discover some gaps in Dr. Hurter's reasoning which seriously endanger the foundation of his comparison of the various systems of absorption of gases by liquids.

Dr. Hurter, in comparing the efficiency of the two first systems—viz.: 1. Forcing the gas, divided into small bubbles, through the liquid; and 2. Dividing the liquid into small drops and allowing these to fall through the gas,—commits the error of basing his calculation of the two cases on totally different and incomparable premises. Quite correctly he takes for the velocity of the gas in the liquid the figure of 0·3 metre per second which he had experimentally ascertained (*cf.* this Journal, 1885, 641). We must, by the way, be all specially grateful for that investigation, which will, in many cases, aid us in our estimates. But, on the other hand, for the velocity of the drops falling through the gas, he assumes the value $\sqrt{\frac{2H}{g}}$; that is the time which the drops would fall in the empty space. Whilst in the first case the friction between gas and liquid is taken into account, the velocity being derived from experimental data representing the actual conditions of the case, in the second case the resistance of the air is entirely neglected, and it is tacitly assumed that the drops will fall through the air just as fast as in the empty space. Furthermore, the retarding action of the *vis viva* of the ascending gaseous current on the fall of the droplets suspended therein is also entirely overlooked. What most serious error this difference between the premisses involves in the case before us, where the liquid is purposely divided into as fine a spray or cloud as possible, must be patent even to an unlearned mind, as soon as the word "fog" or "cloud" is pronounced. A fog or cloud is nothing but an extremely great number of extremely minute drops of liquid, and that these do not fall with the velocity of rain drops (which itself is very much less than $\sqrt{\frac{2H}{g}}$), but on the contrary sink down with extreme slowness, is known to every small child. Of course, I do not mean to say that it is easy to artificially produce a spray of the same degree of fineness as a natural fog or cloud; but the very existence of the "spray-producer" as a toilet implement presupposes a very slow fall of the liquid in question. I am not, of course, capable of the absurdity of assuming that I am now telling any news to Dr. Hurter; but I can all the less understand why, in his calculations, he has chosen to neglect that enormous difference between the velocity of spray drops in the vacuum and in the air, a difference which vitiates his comparison to such an extent that all mathematics are entirely thrown away here.

Of course Dr. Hurter could not have introduced the real velocity of the spray drops in his calculation, simply because that velocity is not known, and because it depends upon so many various causes (the size of the drops, the specific gravity of the liquid, the presence or absence of currents in the gas, &c.), that it is utterly hopeless to find it out by mathematical formulæ. But then he ought, in my humble opinion, to have abstained from the use of mathematics in this case, or at least to have pointed out their inconclusive character; whilst, as it is, his hearers seem to have thought that they were listening to an absolutely reliable mathematical demonstration, as true as the kinetic theory of gases itself.

The only valid proof which Dr. Hurter adduces for his preference of the first before the second method of bringing gases into contact with liquids, is taken from practice and nothing but an instance of rule-of-thumb experience. He has tried a spray-producer for supplying an empty Gay-Lussac tower, and has met with complete failure. I accept this proof all the more readily as I am personally acquainted with a case identical to that quoted, but only for what it is worth. The platinum spray-producers supplied for the patent in question (of which I possess one) do not act very well; they produce rather a coarse spray, and they are very easily stopped up. But apart from that, drops of sulphuric acid of at least 1·7 sp. gr. will fall much more quickly in a current of gas than drops of water of equal size. Hence a process which is a failure with such a heavy liquid and with a gas containing only fractions of a per cent. of the substance to be absorbed, might do very well with a liquid of less specific gravity and with more concentrated gases. Besides, such a spray in the case of hydrochloric acid may act very beneficially in cooling the gas and in saturating it with aqueous vapour.

From all these reasons I am not disposed to accept Dr. Hurter's sweeping condemnation of the spray system of absorption, either in theory or in practice. I have never either applied or proposed that system in any technical process which I have been connected with, and I am therefore thoroughly impartial in this matter; but I consider myself bound to raise my voice against a dogmatical opinion which may do harm in stopping technical progress by deterring inventors from a certain course without sufficient reason.

The case lies differently for me in another portion of the field where I am personally interested, and to this I beg to draw attention now. Dr. Hurter pronounces his decided belief in the fact (which he seems to think he has proved to demonstration) that of the third class of absorbing-apparatus (that in which the liquid is spread over large solid surfaces, and the gas passes through the interstices of these solid surfaces) the coke-tower is, of all the known apparatus, far away the best. I, for my part, shall in the first instance show that mathematics do not help us very far in this case. We shall at once agree upon the point that the rough, blistered surface of coke is very efficient in retarding the flow of the liquid, but when we come to actual figures we must be content with mere assumptions and rough estimates. The same holds good of the surface exposed, but in this case Dr. Hurter is careful to reckon only with a minimum, and he thus avoids any possible objection to that part of his calculation; nor is it possible to find fault with his calculation of the time which the gases are in contact, and other similar matters.

We are on far more uncertain ground when coming to Dr. Hurter's and Mr. Carey's experiments concerning the spreading of a liquid descending in a coke-tower. I will not make them responsible for the execution of the diagram on page 230, which would utterly mislead the ordinary reader, who rarely dives deeply into the sea of figures contained in such a paper, into the belief that the water running out of a single central jet is almost uniformly distributed over three-quarters of the area of a coke-tower of 4 ft. diameter. Whoever takes the trouble of going over the table of figures found on the same page, sees at once that 82 per cent. of the water descend in the two central troughs placed perpendicularly below the jet, and only 18 per cent. find their way to the area beyond. We have, of course, no right to say that these two central troughs (the whole number being eight) represent a quarter of the area of the tower; we are logically forced to assume that if the bottom of the tower had not been provided with eight longitudinal channels, running from one side to the other, but if it had been uniformly covered with 64 pans, 6 in. by 6 in. each, then by far the greater part of those 82 per cent. would have been found in the four central pans, that is, in $\frac{1}{16}$th of the area of the tower; and even that would mislead us very much as to the real spreading power of the coke-packing. As the perpendicular line from the jet strikes the partition between two channels, 6 in. wide each, we must credit an area of twice 6 in. width with receiving 82 per cent. of the water; but we have no notion how much of this water belongs to the central and how much to the peripheric part of that area. If the experiment had been arranged (as, in my humble opinion, would have been more conclusive) in such manner that the area perpendicularly below the jet were provided with a circular pan, say 6 in. diameter, and a series of annular pans were arranged concentrically with the first, we should most certainly, to judge from the figures given in Dr. Hurter's paper, have collected the great bulk of the water in the central pan, representing an area of 28·27 sq. in., or $\frac{1}{80}$th of a tower 4 ft. by 4 ft. square. And even if we had made that central pan 12 in. wide, that is, equal in width to the two central channels in Hurter and Carey's experiments, its area would be only 113 sq. in., or $\frac{1}{20}$th of the total area of the tower, and it would have caught 82 per cent. of the water, less the very slight amount represented by the corresponding sectors of the outer concentric circles.

Nor should it be overlooked that the spreading over a certain area, whatever its actual amount may be, is not, as superficial readers of Dr. Hurter's paper might infer, a specific property of coke. Any other packing of somewhat rational nature must, of course, have a similar action, and it is scarcely necessary to say that a properly designed and executed geometrically regular scheme of packing must in that respect be superior to the extremely irregular pieces of coke. I have endeavoured to devise such a geometrical scheme in my "plate-column," and the trials made at Mr. Rohrmann's works prove that it does act as intended. The drops, forming in each of the small holes, fall upon the point of division of four tiny basins containing as many holes in the next lower plate; they splash over and divide themselves over the four basins and make the liquid overflow into the corresponding 13 basins on the plate below, and so forth. The network of ledges surrounding the holes keeps each tiny basin separate from the other and causes the system to act as intended, even if the plates are not (which would be difficult to effect) on a mathematically true level. The objection which might be made, viz., that the drops will not fall perpendicularly but run along the bottom side of the plates, is overcome by the contrivance of furrowing that side in such manner that each drop must fall where it is intended to. Probably this will not invariably take place as described; but supposing only half of the drops to fall and divide themselves as they ought to do, we have, on a square foot of surface, containing about 300 holes, 150 repetitions of the process, whilst a square foot of coke, on the maximum assumption of a regular packing of 4-in. pieces, offers but nine repetitions. Moreover, in the case of the plate-column, its design makes its impossible for any drop to fall through more than 4 in. of depth before it strikes another solid surface and is spread out again, whilst nobody will deny that in a coke-tower it must frequently occur that the drops fall through a greater depth before they strike another piece of coke. In fine, as far as the division of the liquid is concerned, it stands to reason that the plate-column must be superior to a coke-tower of the same cubic space, although the surface of the pieces of coke is probably rather larger than that of the pottery in the plate-column.

I lay, however, much greater stress on the infinitely better subdivision of the gases in the plate-tower. I must beg leave to repeat a few of the salient passages in my first paper on the plate-column, of 1887, referred to by Dr. Hurter himself (this Journal, 6, 586). In a coke-tower the individual gas channels are too wide, and the inner portion of the gaseous current does not enter into reaction with the absorbing liquid. This is unavoidable, because the interstices between the pieces of coke are quite irregular, and therefore the section of the tower must be made wide enough and the pieces of coke large enough to secure a sufficiency of draught for the worst case. . . . . Hence, coke towers must be made very wide and high, thus offering a long time and corresponding opportunities of mixing the gases and of their contact with liquid; and in this way the reaction is certainly very complete at the end. But this enormous enlargement of space can be avoided by the systematical way in which in my new apparatus the gaseous current is split up in each circular plate of 2 ft. 6 in. diameter or 2 ft. by 2 ft. square, into upwards of a thousand very thin and exactly equal jets which must continually alter their direction, and must, therefore, be thoroughly mixed every time they pass through a new plate. The gas is compelled to pass through them all, and can never seek false channels. In a coke-tower, on the other side, the interstices between the pieces of coke are pretty large and very irregular; unless it is well packed the tower acts very badly indeed, for naturally the gas ascends by preference in the widest and straightest channels, and just these are evidently least supplied in comparison with the air space. But even in a properly packed coke-tower the channels are comparatively very large, and especially very irregular; for this reason it is necessary to procure a very large condensing area, and to leave the gases in very long contact with water by constructing the towers of very large dimensions.

I must confess I do not see how these sentences can be controverted. Dr. Hurter says, it is true, that the irregularities referred to "average themselves in a way that makes them the feature of the apparatus"; but that seems to me merely another way of saying what I did—that a coke-tower must be made very wide and high in order to equalise those irregularities, whilst in a plate-column no such irregularities exist, and it can hence be made much smaller. Dr. Hurter further contends that the irregularities cause eddies and vortices in the gas, which will secure a more intimate mixture. But is it possible to cause more "eddies and vortices" than in a plate-column, by the thousand shocks suffered by the gas issuing from a thousand holes in each 2-ft. plate against the solid places of the plate next above, especially when these are furrowed at the bottom, but even without that contrivance? If he taxes me with error as follows: "It is a great mistake to suppose that because there are a few wide channels the gas will go through these by preference," and that "a careful consideration of the laws of motion of elastic fluids" proves that "the gas will divide itself between the various channels," I must beg leave to say that this reasoning does not present the case in its true light. Nobody in his sane senses will deny that the gas will theoretically "pass through every crevice" and "divide itself between the various channels." But how will it divide itself? Even if for a moment we take no notice of friction, it stands to reason that the quantity of gas passing through channels of various width must be in proportion to that width, and that of a given quantity of gas by far the greater proportion will pass through an equal number of the wider than of the narrower channels; whilst, on the other hand, the surface of contact with liquids is proportionally much larger in the narrower than in the wider channels. Can this possibly be contradicted? But this consideration certainly does not exhaust the case, for the friction, which we have not taken into account, plays an important part in this matter; so much so that I for my part must maintain that "that it is a great mistake to suppose" that a sensible quantity of gas will pass "through every crevice." Suppose, for instance, that we cover up a portion of a grid of some sort, say one formed of pieces of coke like those used in an acid-condenser, by a layer of a few inches of fine sand, anybody who has the slightest idea of practice will know that unless an excessive pressure be employed no gas will pass through the part covered with sand, although a mathematical calculation would show a good deal of channel-space in the sand; as a matter of fact, all the gas passes through the larger interstices of the grid. Such "sand-lutes" form quite a feature in chemical engineering. A careful consideration of the laws of motion of elastic fluids ought to take in that fact as well. Where is, therefore, my "great mistake" in saying that the gas will go by preference through the wider channels? I maintain as strongly as ever that I am right in that statement, even if the expression "by preference" may not sound quite scientific to a fastidious ear. Is it not well known that if the coke in a coke-tower crumbles down, and the interstices become too small over a portion of its area, practically no gas passes up through this, and that part of the tower becomes entirely inactive?

The case in point is therefore entirely one of degree. So much is certain that, with unequal interstices, much more gas will pass through the wider than through the narrower channels, but in what proportion it is quite impossible to say with such irregular material as coke, principally as the part played by friction is in this case inaccessible to any reliable calculation. Indeed, the use of mathematics will here, as in the majority of manufacturing chemical reactions, very easily mislead us, since only the minor part of the conditions present can be subjected to mathematical treatment, and the results brought out by such treatment may be in flagrant contradiction with the actual facts of the case. Not merely in technological, but in the great majority of scientific matters, we are on very unsafe ground so long as we trust to mathematics alone, without continuous verification by experimental data. This is a truism in the eyes of thoroughly scientific men like Dr. Hurter, but I am not sure whether all his readers are equally conscious of that fact.

I think I have at all events established my position that, from the nature of the case, a space filled with more or less irregular pieces of coke must be inferior for absorbing purposes to a space filled with the geometrically-designed kind of pottery in the plate-tower, where the division of the liquid, and more especially that of the gases, is brought about in an incomparably more complete and rational way.

If, as I have declared in my first paper, and repeated above, the reaction in the coke-tower is certainly very complete in the end, this is brought about by immensely increasing, for a given quantity of work, both the surface and the time of contact, as was done from the dictate of common sense by Gay-Lussac and Gossage a whole generation before Kroenig, Clausius, and Maxwell, by their immortal scientific achievements, established the foundations for a theory of the case. In other words, a properly built and packed coke-tower is a splendid piece of apparatus for its purpose, provided you make it big enough. Precisely the same holds good of a vitriol-chamber. But here my modest efforts come in—not as if I boasted or imagined that I have been the first in that field. Both coke-towers and acid-chambers are awfully clumsy and expensive pieces of apparatus, and a technologist must really be excused if he does not rest and be thankful to do as his spiritual forefathers have done, but tries, first, to understand why such huge apparatus has been devised, and, secondly, attempts to reduce their size by modifying some of the conditions which have led to the employment of such large spaces. Of course, one may be wrong as to the particular remedy tried, and most inventors manifestly have been wrong, as evidenced by the unimpaired existence of big coke-towers and vitriol-chambers; but should we be snubbed for acting on that grand and truly British principle, "try, try again"? How many years has Dyar and Hemming's process been a lamentable failure in ever so many hands and countries, and have not those two men been right after all? And that chlorine process which for many years has been universally acknowledged as far away the best among those actually supplying the market, and with which Dr. Hurter's name will for ever be gloriously connected, has it not passed through a stage where it was believed to be demonstrated that it could not work on a practical scale? Nothing but perseverance will avail, and only experience can pronounce the final verdict.

Well, it will be said, why has the plate-column, which has been announced to the world in 1887, not made more way? Where is the test of experience invoked by myself? I beg leave here to make some explanatory remarks of a very personal character. I am neither owner nor manager of a chemical works, and I have thus no opportunity of trying my own inventions as I like, and of following up any experience gained by new improvements. I am hundreds of miles away from the nearest chemical works where I have any chance of getting anything tried, and 30 hours by rail from my co-patentee who makes the stoneware. My professional duties have never left me the chance of devoting to the plate-towers the time necessary for thoroughly developing them. I cannot travel about and talk to people, look at my apparatus at real work, find out the causes of any difficulties arising in practice, communicate the experience gained in one place to another, and so forth; all I can do is to try doing a very little of that by letters. My co-patentee is one of the most skilful and successful earthenware manufacturers in the world, but he cannot assist me at all in the development of my ideas on the chemical side. Any improvement suggesting itself to us or to any of our friends cannot be made at once, as our material, stoneware, cannot be altered when once put into shape, and it takes thus very much time and expense to try something fresh. Looking at the immensely greater facilities which other inventors have enjoyed for developing and making known their inventions, and the extensive personal propaganda which they generally make for them, I am really astoniahed that, in the absence of all that "business" element, the plate-columns have had such a comparatively large amount of success in the few years since they have been offered to the public. Mr. Rohrmann has already sold more than 100 plate-columns for various purposes, and has several times got repeated orders from the same place.

Apart from that indirect evidence in favour of my invention, I have a good deal of direct evidence of the same kind, of which I quote a few samples, referring to various uses of the plate-tower.

In the very same number of the Journal in which Dr. Hurter's paper appeared, we find a communication from Mr. Oscar Guttman, in which he states that a Lunge tower, 10 ft. high, showed the same absorbing power as a coke tower, 48 ft. high. The acid resulting from the former tested 1·260, that from the latter 1·380 sp. gr. The diameter of the coke-tower was apparently the same as that of the plate-tower, so that the latter, for equal space, showed an enormous superiority over the former.

This example refers to that use of the plate-tower to which it has been most widely put, viz., the recovery of nitric acid from the lower oxides of nitrogen by means of air and water, a process requiring a most intimate mixture of the gases and an equally intimate contact with the water. Let us now look at their use for the condensation of hydrochloric acid, about which I can testify to the following fact from my personal observation.

On the very first trial of the plate-columns, in their then very imperfect form, at the Griesheim Chemical Works, it was found that two superposed columns, of about 60 cub. ft. each, with a total plate surface of 58 sup. ft. (reckoning both the top and bottom side of the plates), effected the condensation of 90 per cent. of the gases coming from a salt-cake pot, decomposing 14 cwt. of salt every four hours. The trial was continued for 27 hours in succession; the strength of the hydrochloric acid obtained varied between 23° and 36°, and averaged 32·4° Tw. at 15° C. I suppose in England two such pots would have been connected with only one coke-tower of 7 ft. by 7 ft. by 40 ft.; but then such a coke-tower would have a cubic capacity of about 2,000 cub. ft., and, according to Dr. Hurter's calculation, 21,168 sq. ft. of condensing surface. Compare that with my 60 cub. ft. and 58 sq. ft. of condensing surface, which did 90 per cent. of the work.

Let us look at another proof from another quarter. At the Buchsweiler Chemical Works they burn spent gas-oxide equal to about 20 cwt. of real sulphur per day, yielding a very poor gas of 4 or 5 per cent of SO_2. Their special difficulty was that the ammonia salts contained in the gas oxide, even after washing, volatilise in burning, and destroy much nitre in the Glover tower, according to the well-known reaction $N_2O_3 + 2NH_3 = 4N + 3H_2O$. The manager, Dr. Petri, had the idea of overcoming this drawback by effecting the bulk of the denitrating work in a small plate-tower put in the top of the ordinary Glover tower. In that tiny "Lunge tower," containing only 13 layers of two plates each, and altogether holding about 40 cub. ft., as much as 80 per cent. of the denitrating work is regularly effected, and that at such a low temperature (the gases enter with 90° C. and leave with 60° C.) that the destructive effect of the ammonia cannot be exerted. An ordinary Glover tower of 8 ft. by 8 ft. by 25 ft. has 1,600 cub. ft. capacity, or 40 times as much as Dr. Petri's column, which does 80 per cent. of the denitrating work. Of course the last 20 per cent. will require much more contact surface than an equal percentage at a higher degree of concentration, but surely only a fraction of the 40 times in question.

Still another instance. At a vitriol works at Pittsburg, Pa., Dr. Stahl employs for a set of chambers of 212,000 cub. ft., a Gay-Lussac consisting of a plate-column of 20 by 10 plates, or 280 cub. ft. of active space; he gets nitrous vitriol of 1·0 per cent. of $NaNO_3$, and he contemplates to put the gases from another set of 132,000 cub. ft. through the same column, as he has reason to believe that it will suffice for the purpose. Now, for 344,000 cub. ft. of chamber space we should not allow less than 3,400 ft. of Gay-Lussac space, preferably two or three times as much; but even the lower figure is 12 times the size of the plate-column actually employed.

Concerning those plate-columns which are placed between the chambers, in order to increase the working capacity of a given set of vitriol chambers, we have now reason to believe that they perform as much work as a chamber space of at least 100 cub. ft., up to 230 cub. ft., for every single plate, corresponding to slightly over 1 cub. ft. of space in a Lunge tower. This case is not quite comparable to that of coke-towers, as the space in vitriol chambers is otherwise empty, but it may serve as another instance of the efficiency of the plate-columns, which is undoubtedly brought about in this case as well by its effecting a most intimate contact between liquids and gases, and an incessant mixture of all the ingredients, with constant impacts of the minute liquid globules, floating about in the shape of mist, against solid surfaces, where they collect into real drops and act upon each other.

Was I, then, so far wrong when risking the opinion, with which Dr. Hurter finds so much fault, that a plate-tower will do ten times as much work as a coke-tower of the same size? Does not the proof of the pudding lie in the eating of it, and must not theoretical calculations referring, it should be borne in mind, only to part of the various conditions present, but leaving other most important conditions aside, give way to established facts?

Possibty some one of my readers will exclaim: "Oh, I know of a case where a Lunge tower has been tried, but it has failed, and has been stopped some time ago!" I, for my part, know of only one case of that kind, but I should not be surprised if there were several; but then I beg to point out that such occasional failures occur with almost every new invention, and that in the present case it could cause no surprise if they were far more numerous than they appear to be. I, personally, have not seen one plate-column out of 20 sold by Mr. Rohrmann; of the majority I do know what they are used for, and in very few cases have I been in a position even to hear somewhat exact news as to their doings; not in one single case has it been possible for me to start or superintend the working of the process. Need I tell any reader of this Journal that the very best apparatus is useless unless it is worked in the proper way? Have not failures occurred with some apparatus and processes which it would be ridiculous to ascribe to any but accidental and avoidable circumstances? How many works, for instance, have 20 years ago introduced the Deacon process and given it up again as totally unworkable after vast expenditure? I claim that in cases like mine, where an inventor is altogether unable to superintend the starting and working of his invention, where everything must be left in the hands of strangers at a great distance, and where the inventor is even mostly ignorant of the purposes to which his process is being applied, one success should count more than ten failures. I have, however, every reason to believe that the proportion of successes and failures is, at the very lowest, the reverse of the above, and I have hence the right to invoke the test of practical experience in the cause of plate-towers *versus* coke-towers.

Thus far we have compared plate-columns and coke-towers as if they were both composed of materials indifferent to the chemicals with which they come into contact. This is absolutely true of Mr. Rohrmann's stoneware, which is not affected by any acid, whether cold or hot, liquid or in the state of vapour, diluted or concentrated. That ware is also indifferent to changes of temperature within such ranges as plate-columns are ever exposed to. I do not know how that ware would behave at the bottom of a Glover tower, where gases of 300° meet acid of 120° or 130° C.; but we need not trouble ourselves on this head, as nobody would think of employing our plates where they must be soon stopped up by dust. Higher up in the Glover, where there is no more dust, our plates behave admirably, especially in the shape of a separate small tower put on the top of the ordinary Glover, as shown above, and I must therefore rectify the statement made by Dr. Hurter, on the authority of opinions formerly held by myself, that the principle of plate-columns is not adapted to Glover towers. Even if a plate should crack it is still held in its place by the bearers, and performs its service all the same.

Now, is coke equally indifferent to the chemical action we submit it to in our coke-towers? As far as hydrochloric acid condensers are concerned, we may take it for granted that carefully picked pieces of well-burnt oven-coke will stand for a very long time, although hardly for ever. At all events, any slight waste of the coke does not materially affect the process. But it is otherwise where nitric acid or the lower oxides of nitrogen are concerned. I have at various times given experimental proof that the coke reduces nitric to nitrous acid, and that at a little higher temperatures the latter is further reduced to NO, with formation of CO_2. The waste of the coke consequent thereon causes a gradual crumbling of the packing and in some factories necessitates re-packing once a year; at others the waste is certainly much slower. At the same time, of course, a certain amount of nitre is lost in the shape of NO. This reducing action of the coke, formerly probably quite overlooked, seems to account, at least partially, for the fact that Gossage's proposal of filling the vitriol-chambers with coke has proved abortive, whilst my plate-towers have been successful; for, in the chambers, the nitrogen acids, owing to the higher temperatures, are far more acted upon by the coke than in the Gay-Lussac, and their destruction, as well as the formation of much CO_2, and together with the crumbling of the coke, would be an intolerable nuisance, none of which drawbacks are possible with Rohrmann's indestructible stoneware. Moreover, Gossage and all others neglected the fact that the very increase of chemical action, brought about by multiplying the contact surfaces, causes a corresponding rise of temperature which acts as a check on the vitriol-forming process, besides increasing the action on the coke and the lead. I, for my part, obviate this, and I even utilise that otherwise injurious heat by running water or dilute acid down the plate-tower, where the superfluous heat is removed by converting water into steam.

I have from the first, as mentioned by Dr. Hurter, admitted that it is a disadvantage of the plate-towers that they contain only a small amount of liquid, and are in that respect inferior to coke-towers, whose large stock of liquid equalises to a certain extent the variation in the feed and in the composition of the gas. But that disadvantage, which is principally apparent in the case of hydrochloric acid condensers, is just in their case easily removed by combining with the plate-tower a number of stone vats or stoneware receivers, preceding it in the same way as the same kind of apparatus is used with the coke-towers. The stock of acid contained therein, and coming into contact with the gases fresh from the pots, acts as a regulator similar to the lower part of a coke-tower.

Altogether apart from the application of plate-towers for reducing the vitriol-chamber space, which is a matter by itself, I have really never claimed, as it is hinted, that Gay-Lussac's and Gossage's inventions will be totally forgotten over my invention of the plate-towers. I have, indeed, in many cases recommended a combination of those two kinds of towers, although I have become bolder now. All I claim is, that my own towers should be tried and judged on their merits, and retained where they are found suitable, but not *à priori* rejected on the strength of theoretical considerations which I believe to have shown to be entirely inadequate for forming a definite judgment. And I am glad to say that the trials going on in many countries assure me that my invention has come out far better in actual work than those ingenious, but incomplete, theoretical reasonings make it out to be. I cannot blame Dr. Hurter if he, who has in his professional capacity examined so many worthless proposals, is sceptical in the face of newfangled matters generally, and holds on to apparatus which he observes doing excellent duty in the numerous works he is cognizant of; but others may be more desirous of adopting new apparatus which performs the same work in a much smaller space and at much less cost. I do not flatter myself that any alkali works will pull down its existing coke-towers in order to erect plate-columns, but I hope that more and more chemical manufacturers, when they have occasion to erect new or to enlarge existing plant, will save space, foundations, and prime cost, by employing plate-towers, which offer the additional advantage of requiring less pumping work and being more easily watched in their functions, owing to their inconsiderable height. I have at all events the satisfaction that in one kind of manufacture, the recovery of nitric acid from the lower oxides of nitrogen, the "Lunge towers" are now acknowledged beyond contradiction to be the best means for attaining the end; and so many extensive and hitherto successful trials are being made with them in the manufacture of sulphuric, sulphurous, hydrochloric, acetic acid, and so forth, that I am confident of overcoming the objections of those still holding out against them, even those of my learned friend Dr. Hurter, who is held by nobody in greater esteem than by myself.

Nottingham Section.

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The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* J. M. C. Paton; *Vice-Chairman:* C. Spackman; *Treasurer:* J. T. Wood; *Committee:* L. Archbutt, F. Clowes, and J. O'Sullivan.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1892—93.

Meeting held Wednesday, April 19th, 1893.

MR. L. ARCHBUTT IN THE CHAIR.

FURTHER CONTRIBUTION ON THE NATURE OF BRAN FERMENTATION.

BY J. T. WOOD AND W. H. WILLCOX, B.SC., LOND.

The paper which one of us had the honour of reading before this Section on December 11th, 1890 (this Journal 1890, 27), dealt chiefly with methods of bacteriological research, but especially in connection with the fermentation of bran as applied in the manufacture of light leathers. The object of the present paper is to give an account of further research into the nature of the fermentation and its products, the former communication being very incomplete. In further investigating the matter we endeavoured—

1st. To obtain a complete knowledge of the products of the actual fermentation as it takes place in practice.

2nd. To discover in what way the ferment acts, both on the materials fermenting and on the skins.

3rd. To examine in the same way the products of a pure cultivation of the bacterium causing the fermentation.

I. *The Products of the Actual Fermentation.*—These may be divided into three groups:—(1.) Gases. (2.) Volatile bodies. (3.) Non-volatile bodies. It was stated in the former paper that the ferment produced an inflammable gas along with considerable quantities of CO_2, H_2S, &c. The inflammable gas was thought by analogy from the researches of Tappeiner (Zeits. für Biologie, xxiv. 105) to be methane; it has, however, proved to be pure hydrogen. The absence of hydrocarbons was shown by the following method:—Some of the gases were collected, the CO_2 and SH_2 removed by absorption with KOH, and the remaining gases exploded in an eudiometer tube with oxygen. The gases which remained after explosion did not diminish in volume after standing over KOH solution, showing absence of the paraffins and olefines.

For the purpose of analysis about 1½ litres of the gas were collected at a time in a large flask fitted with a caoutchouc stopper and a funnel having an area of 28 sq. in. This was inverted, filled with the drench liquid, over the vat. The gas when collected was transferred immediately in the vat to a glass-stoppered bottle, sealed with a small quantity of the fermenting liquid and examined at once. Nine analyses have been made, most of them in duplicate. The following table gives the results of three of these duplicate analyses, which have been performed by Hempel's method, the hydrogen being estimated by combustion in air over heated palladinised asbestos:—

Gases.	A.	B.	C.
CO_2 and H_2S	21·9	25·2	42·4
O_2	1·0	2·1	3·6
H_2	53·1	46·7	28·2
N_2	24·0	26·0	25·8

A. is from a vat containing no skins, 1—2 days.
B. from a vat containing skins, 2—3 days.
C. from a vat containing skins, 3—4 days.

We find that the gases given off during the fermentation are practically the same, with or without skins. The H_2S is present only in small quantities from 1—2 per cent. Its presence was shown by aspirating the gases dissolved in 1 litre of drench through a dilute solution of lead acetate containing a few drops of acetic acid. The gases were liberated by heating the liquid, and at the same time aspirating air through it. The H_2S is present both in the gases evolved from drenches which do *not* contain skins, and from those which do, though to a slightly greater extent in the latter. The amount of CO_2 given off increases as the fermentation proceeds; the oxygen also increases, the nitrogen remaining practically constant. We consider that some of the nitrogen given off is that dissolved in the water, the oxygen being partly used up by the ferment in its earlier stages; the remainder of the nitrogen is probably produced from the decomposition of the nitrogenous bodies contained in the bran. It may be noted here that the bran fermentation under ordinary circumstances ceases on the fourth day and sometimes earlier.

Frankland and Frew, in a paper on a pure fermentation of mannitol and dulcitol (Jour. Chem. Soc. 1892, Trans. 254), have shown the hydrogen and carbon dioxide given off were produced by the decomposition of formic acid, the ferment producing formic acid and the latter immediately splitting up into an equal number of molecules of carbonic anhydride and hydrogen. We have every reason to believe, from experiments which will be included in the third section of the paper, that the source of the H and CO_2 is the same in the fermentation we are considering.*

II. *Volatile Bodies.*—These may be divided into (1) acids, and (2) amines. We had previously shown the absence of aldehyde by the rosaniline reaction, and of alcohol by Lieben's iodoform test.

In the first experiment to determine the acids, 15,670 cc. of the liquid from a normally fermenting vat was taken when the fermentation was at its height; this was submitted to distillation and to the last portions distilled water added and 16,200 cc. distilled over; the distillate was neutralised with sodium carbonate, and the whole was then evaporated in a porcelain dish, the residue dried first at 100° C., then over strong sulphuric acid, the weight of the sodium salts of the volatile acids thus obtained being 18·07 grms.

These salts were treated with 200 cc. absolute alcohol and 20 cc. strong H_2SO_4; heat was evolved, and there was a strong smell of ethyl acetate and butyrate (Der Gerber. xvi. (368), 4). The mixture was allowed to stand for 24 hours and then distillate on the oil-bath, the temperature for a long time remaining at 81° C., finally rising to 96° C. 219 cc. of distillate was obtained, and to this a saturated solution of common salt was added, but the esters of the volatile acids did not separate out. The whole was again redistilled with the same result.

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* For facilities in carrying out some of the gas analyses, we are indebted to Mr. Chester, manager of the Nottingham Corporation Gas Department and to Mr. Wharton, of the Laboratory at Basford.

Failing in this way to separate the acids in the form of their esters, the mixture of esters and alcohol was examined qualitatively; 75 cc. was taken and saponified with 80 cc. **N**NaOH in a distilling flask, with inverted condenser, for half an hour, until all the fragrant smell of the esters had disappeared. Seventy-one cc. **N**HCl was then added and the apparatus connected with a condenser in the usual way. The distillate was acid. Eight hundred cc. was taken off, forming fraction I. The remainder of the acid required to neutralise the sodium hydrate was added, and another 800 cc. distilled off, forming fraction II. Fraction I. smelt strongly of butyric acid, fraction II. of acetic acid. The fractions were then each boiled for half an hour with excess of barium carbonate; this was filtered off and washed, the filtrate evaporated to dryness, and dried at 130°.

A portion of barium salt of fraction I. was heated with alcohol and sulphuric acid and gave the characteristic pine-apple smell of ethyl butyrate.

The solution of the barium salts of fraction II. was concentrated by evaporation, and to a portion excess of H_2SO_4 was added, the $BaSO_4$ filtered off, and the filtrate carefully neutralised with ammonia and a portion added to a solution of neutral ferric chloride. It was coloured dark red, and a finely-divided precipitate of basic acetate of iron came down on boiling. A second portion of the concentrated solution was heated with sulphuric acid and gave off a strong smell of *acetic acid.* To a third portion silver nitrate was added, and a slight excess of acetic acid; a little silver was deposited in the form of a film, showing a trace of *formic acid.*

Having thus shown the presence of butyric, acetic, and formic acids in the drench, we proceeded to ascertain the quantities formed in a normal fermentation of bran without skins. For this purpose a drench was made in a clean vessel with 10 litres of distilled water and 200 grms. of bran mashed at a temperature of 38° C., and after cooling to 33° inoculated with bacteria from an actual drench which was fermenting vigorously; this was kept in the drench house so that the fermentation and general conditions might be exactly similar. In 48 hours all gases had ceased to be evolved, and the true fermention was at an end. The liquid had an acid, not unpleasant smell, and was acid to litmus paper. The bran was strained off through muslin, washed with a little water, and well squeezed; the liquid measured 10 litres. Three litres of this were taken for the separation and estimation of the volatile acids, the remainder being set aside for examination and estimation of the non-volatile acids, &c. Two of the three litres were placed in a distilling flask with 5 grms. of pure $CaCO_3$, and distilled down to one litre. The distillate was *alkaline* to litmus, and had a peculiar fishy smell; the remaining litre of drench was added, and the liquid taken down until the distillate ceased to be alkaline and only had a faint smell. The alkaline distillate gave a yellow precipitate with Nessler's solution, as well as the following reactions:—

$AgNO_3$...A faint brown precipitate.
$HgCl_2$....A yellowish-white curdy precipitate.
PbA .....A brownish-white precipitate.
$CuSO_4$ ...A dirty blue precipitate, which changed to a brownish turbidity on boiling.

HCl was added to the distillate in slight excess and the the liquid evaporated to a small bulk; to a portion chloroform and alcoholic potash were added, and the liquid heated; no smell of isocyanides was given off; the body is, therefore, not a primary amine. Phospho-molybdic acid gives no precipitate, therefore the body is not an alkaloid. From the above tests and its characteristic smell, we conclude that the body is *trimethylamine.* The platinum salt was formed by evaporating the above concentrated solution of trimethylammonium hydrochloride with excess of platinum chloride, a precipitate of the platinum salt insoluble in alcohol being formed. There was not, however, a sufficient quantity from the three litres to ascertain the molecular weight.

Proceeding with the estimation of the volatile acids, 100 cc. **N**HCl being required to completely neutralise the $CaCO_3$ used, 50 cc. were first added and the distillation continued; the distillate was only very faintly acid. Four fractions were now distilled off, using respectively 10, 10, 10, and 20 cc. **N**HCl.*

Fraction I. was boiled with excess of barium carbonate, filtered, the $BaCO_3$ washed with hot water, and the filtrate evaporated to dryness, and the Ba salts dried at 130° C. till the weight was constant; the salts were then decomposed with strong sulphuric acid, ignited, and the barium sulphate weighed.

Fractions II., III., and IV. were treated in an exactly similar way, the barium salts obtained and the weight and percentage of barium sulphate being shown in the following table:—

Fraction.	Weight of Salts.	Weight of $BaSO_4$	Per Cent. $BaSO_4$
I.	0·5585	0·4991	89·365
II.	0·5060	0·4618	91·265
III.	0·31675	0·29415	92·86
IV.	0·4475	0·4252	95·02

Calculating the fractions I. and II. as mixtures of barium butyrate and acetate, and fractions III. and IV. as mixtures of barium acetate and formate, we may summarise the results thus:—

Fraction.	Weight of Salt.	Ba Acetate.	Ba Butyrate.	Ba Formate.
I.	0·5585	0·4904	0·0681	..
II.	0·5060	0·5030	0·0030	..
III.	0·31675	0·2749	..	0·04185
IV.	0·4475	0·2629	..	0·18460
Total ...	1·82875	1·5312	0·0711	0·22645

or as free acids:—

Fraction.	Acetic.	Butyric.	Formic.
I.	0·2308	0·0385	..
II.	0·2367	0·0017	..
III.	0·1293	..	0·0170
IV.	0·1237	..	0·0748
Total........	0·7205	0·0402	0·0918

Proceeding now to (3) non-volatile bodies, we find these to consist of (1) acids, and (2) soluble carbohydrates. For examination the remaining 4 litres of experimental drench were evaporated down to 1 litre and filtered; the residue (consisting of starchy matter) was well washed and the washings added to the filtrate, the whole placed in a large distilling-flask and distilled with continued addition of distilled water until the distillate was no longer acid (this required the addition and distillation of 4 litres of distilled water). A further deposit of solid matter rendering boiling dangerous, the liquid was again filtered and the residue washed free from acid. This residue was found to consist of nitrogenous organic matter and *calcium phosphate,* together with a trace of *calcium oxalate,* both being derived from the bran.

The clear liquid containing the non-volatile acids and other bodies was further concentrated and made up to 500 cc.; it was dark brown in colour and was very acid to litmus; owing to a trace of flocculent matter it was again filtered.

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* Method recommended to us by Dr. Frankland. *Vide* Jour. Chem. Soc. Trans. 59, p. 94. Appendix II. Determ. of Vol. Acids by dist. with HCl.

The presence of lactic acid was shown in the following manner:—10 cc. of the liquid were placed in a small distilling-flask along with 2 cc. strong H_2SO_4 and about 0·5 grm. potassium chromate in a little water. This was distilled and the vapours received in a test-tube surrounded by cold water; on adding magenta solution decolorised by SO_2 to the liquid in the test-tube, a red colour was produced by the aldehyde formed from the lactic acid; aldehyde was also recognised by its smell. We find this an exceedingly delicate test for lactic acid, and as far as we know it is quite new in this form.

For 10 cc. of liquid to be examined we find 2 cc. strong H_2SO_4 and 1 grm. of potassium chromate to be the best proportions. Formic, acetic, propionic, butyric, valerianic, succinic, malic, tartaric, and citric acids do not give the reaction.

The liquid was now tested for *succinic* and *malic* acids. 25 cc. was taken and decolorised by treatment with pure animal charcoal for half an hour; the liquid was then filtered, the charcoal washed free from acid, and the filtrate concentrated; ammonia was added in slight excess, the precipitate of calcium phosphate filtered off. To the filtrate $CaCl_2$ was added in slight excess to remove the remainder of phosphates, the liquid filtered, and the filtrate cautiously neutralised with HCl: the addition of neutral ferric chloride to a portion gave no precipitate, showing the *absence of succinic acid*. To the remainder an equal volume of absolute alcohol was added and the liquid boiled; there was no precipitate. Twice the volume of absolute alcohol was then added and gave no precipitate. On the addition of four times the volume of absolute alcohol a slight white precipitate came down, which evidently consisted of dextrin, from the manner in which it settled round the sides of the tube, and from its insolubility on adding HCl. We therefore conclude that there is no malic acid present, and that the only non-volatile acid produced is *lactic* acid.

The acidity was first determined by titrating 10 cc. of the solution with $\frac{N}{10}$ sodium hydrate, using glazed litmus paper to determine the point of neutralisation. The 10 cc. required 6·66 cc. $\frac{N}{10}$ NaOH, equivalent to 0·666 of **N** lactic acid = 0·7481 grm. per litre of original drench.

In order to separate the lactic acid from the colouring matter and other bodies (dextrin and soluble starch) present, 100 cc. of the concentrated liquid was decolorised with 10 grms. of animal charcoal, the mixture filtered and the charcoal well washed, the filtrate evaporated to dryness, and 15 drops of $\frac{N}{10}$ H_2SO_4 added to decompose any salts of lactic acid present; this was now extracted with ether, the ethereal extract of lactic acid placed in a distilling flask, the ether distilled off, and the residue boiled with distilled water and pure calcium carbonate. The small amount of calcium sulphate present was removed by boiling the filtrate from the $CaCO_3$ with barium carbonate and filtering. The filtered liquid now consisted of a solution of calcium lactate; it was exaporated to dryness in a platinum dish, and the residue dried at 110° C.; it was then washed first with ether, then absolute alcohol.[*]

The insoluble residue was dried at 110° C. till the weight was constant.

The total weight of calcium salts obtained was 0·7661 grm. (= from $\frac{4}{5}$ litre of drench), of which 0·5493 grm. yielded on ignition 0·1398 grm. CaO = 25·45 per cent. Theory requires for calcium lactate $(C_3H_5O_3)_2Ca$ = 25·69 per cent. CaO.

0·7661 grm. calcium lactate in the quantity used = 0·9576 grm. per litre = 0·7907 grm. lactic acid per litre. The difference between this and the preceding amount of lactic acid found by titration, viz., 0·0426 grm., is probably accounted for by the presence of a small quantity of salts of lactic acid in the drench.

The second part of the subject which we proposed to consider was "In what way does the ferment act on the bran and on the skins?" The average composition of bran is shown in the following table:—

	Per Cent.
Water	14
Fibrin, &c.	15
Starch	44
Fat	4
Lignose and cellulose	17
Ash	6

It will be seen, as stated in the former communication (this Journal, 1890, 27), that the starch must be the principal body acted upon; but the cellulose is also an important constituent, and before going further it was necessary to ascertain if it took part in the fermentation. For this purpose some pure cellulose was prepared from cotton wool in the usual way, and small portions placed in tubes containing yeast-water[*] as a nutrient material. These were sterilised by steaming; two tubes were inoculated from a pure cultivation of the bacteria obtained in 1889, two were inoculated from an actual drench, and three left uninoculated; all of them were placed on the incubator at a temperature of 30°—33°. On the second day the inoculated tubes were cloudy, but no gas was given off nor was any acid formed; in 10 days the cellulose had not disappeared, nor on examination with the microscope could any action be detected. The experiment was repeated with peptone as a nutrient medium, but with the same result. The conclusion is that the bacterium does not attack the cellulose, which thus takes no part in the fermentation. The starch and nitrogenous bodies of the bran are therefore the only bodies acted upon by the bacteria in this fermentation.

From the fact that bran drenches ferment in the same way when mashed at all temperatures from 20° C. to 40° C., and that in all cases the starch is decomposed, it was supposed that the ferment was capable of attacking the starch in its undissolved condition. To ascertain if this were so it was necessary to use pure cultivations in the laboratory.

The usual methods employed had thrown no light on this part of the subject, as in order to sterilise the solutions they had been repeatedly boiled, and were thus not comparable with the fermentation as it takes place in the works.

In order to get rid of this difficulty the starch was sterilised in a dry condition in the hot-air oven, by heating for several hours on successive days to 110° C.

This sterile starch was mixed with sterilised water in tubes plugged with sterile cotton wool. Eight tubes were taken, as follows:—

1. Sterile starch and water.
2. Sterile starch and water inoculated pure culture.
3. Sterile starch and yeast water inoculated pure culture.
4. Sterile starch and asparagine inoculated pure culture.
5. Yeast water alone inoculated pure culture.
6. Dextrin[†] and yeast water inoculated pure culture.
7. Soluble starch[‡] and yeast water inoculated pure culture.
8. Starch mucilage and yeast water inoculated pure culture.

These were allowed to stand on the incubator at 33°—35° C., and examined for acid each day by the method described in the previous communication for starch testing. They all remained neutral, although the bacteria developed in all but No. 1. These experiments were repeated several times, with the same result in every case. They show that that this ferment is unable to act on starch either in its insoluble or soluble condition, alone or in the presence of nitrogeneous bodies.

Now it has been known for a considerable period that bran contains an unorganised ferment called *cerealin*,[§] which is capable of changing starch into dextrin and other carbohydrates; but the information to be obtained about it was very meagre, and as it appeared that this body might play an important part in the fermentation, we proceeded to prepare some pure cerealin and to ascertain its action on pure starch. The cerealin was prepared by taking a kilo. of bran and extracting it with 2 litres of distilled water at 30° C.; the extract was filtered clear and 2 litres of strong spirits of wine containing 90 per cent. alcohol was added, when a flocculent precipitate separated, which was washed on a filter with alcohol, dehydrated with absolute alcohol, and dried over H_2SO_4. The cerealin thus prepared is an amorphous substance not quite white, difficultly soluble in water, though we think this is due to its having been coagulated, and that it might be prepared in some other way which would show it to be more soluble than that which you now see.

---

[*] Julius Wladika. *Vide* Der Gerber, XVI. 28. Zur Kentniss der Organ. Säuren in Fichtenbrühen.

[*] 7 grms. of yeast boiled in 100 cc. H_2O.

[†] Prepared by precipitation with alcohol.

[‡] Prepared by heating starch and water to 50° C. for 18 hours and filtering.

[§] *Watts' Dict.*, Old Ed. Cerealin discovered by Méje Mouriés, Comptes rend. 37, 351; 38, 505; 43, 1122; 48, 431; 50, 467.

To show its action on starch we took 10 grms. of pure starch in 200 cc. water at 40° C., and placed equal quantities in two flasks; to No. 1 about 0·1 grm. of the cerealin was added; No. 2 was left blank. These were kept at 40° C. for 10 hours, the clear liquid filtered off, and examined with Fehling's solution. No. 1 reduced it strongly, showing that *glucoses* were present in considerable quantity. No. 2 had no effect whatever.

Addition of alcohol to No. 1 gave a white precipitate; this was thrown on to a filter, washed with alcohol, and dried at 100°, again dissolved in water, and inverted by boiling the solution with $\frac{1}{20}$ part of strong sulphuric acid and then neutralising with sodium hydrate. The resulting solution reduced Fehling's solution, showing that the body was dextrin. Strong bran infusion (which of course contains cerealin) acting on a thick starch mucilage, liquefies it, and forms glucoses and dextrin.

We have thus shown that the cerealin produces *glucoses* as well as dextrin, both from solid starch and from starch mucilage. This is most important, as it has been previously shown by one of us that the ferment attacks glucose very easily.

The drenches were now examined in order to ascertain the presence of glucose and dextrin; in the former communication it was stated that these were absent. We find, however, that by concentrating the liquid, that both are present in the early stages. Samples were taken one hour after mashing, and at 3, 6, 12, and 18 hours, while the drench was working.

These were evaporated to $\frac{1}{3}$ bulk, filtered, and divided into two portions, one of which was examined with Fehling's solution; to the other alcohol was added; the white precipitate after addition of alcohol was filtered off, washed with alcohol, dried at 100° C., redissolved in water, and boiled with sulphuric acid to invert it, then examined with Fehling's solution.

The following results were obtained :—

Hours.	1.	3.	6.	12.	18.
Glucoses or sugars reducing Fehling's solution directly.	Present in considerable quantity.	Present in small quantity.	Absent.	Absent.	Absent.
Dextrins Fehling's solution reduced after inversion.	Present in considerable quantity.	Present.	Traces.	Faint traces.	Absent.
Soluble starch	Absent.	Absent.	Absent.	Absent.	Absent.

In a bran infusion kept from fermenting by a little ether or chloroform, the formation of glucose and dextrin goes on continuously, the glucose increasing in quantity; the action is, however, much slower than in the case of diastase; at the end of 12 hours, at a temperature of 40° C., about half the starch is transformed.

It appears from this and a number of other experiments that glucoses and dextrin are formed by the cerealin, the former only being decomposed by the bacteria almost as fast as it is produced, for after three hours no glucose is found in the drenches.

We have thus shown that the acids and gases are produced from the starch contained in the bran, the starch being first changed into glucoses by the action of an unorganised ferment or ferments; and that the glucoses are decomposed by a specific organism, the nitrogenous material in the bran serving for its nutriment; that the action is the same with or without skins although there appears to be a little more H_2S gas given off from drenches containing skins, than from those containing none.

The ferment has no direct action on the skins. This may be shown by taking a piece of limed skin, in which a considerable portion of the lime exists as carbonate and submitting it to the action of the ferment; in this case the action goes on much longer than in the drenches, being complete in about 15 days, but the skin may be left in the resulting liquid for three months without undergoing further change than solution of the lime, provided that suitable means be taken to exclude moulds, which by destroying the organic salts and acids produced enable putrifactive fermentation to begin.

It has been thought that the bran itself exercised some peculiar action on the skin, and possibly this may be so to a slight extent (vide der Gerber XIV. 257 Sässe kleienbeize), as the "sweet bran drench is occasionally used on the continent, but if skins are placed in a mixture of bran and water, (in the proportions for drenching) which is prevented from working by the addition of a minute quantity of $HgCl_2$ $\frac{1}{100000}$, such a drench has no action on them, and when tanned they are harsh and hard, similar experiments have been made on a smaller scale using ether and chloroform to prevent fermentation with the same results.

In order to show whether the acids alone were the cause of the action on the skins an artificial drench was made up of the following composition—

0·5 grm. per 1,000 glacial acetic acid.
1·0 „ „ „ lactic acid sp. gr. 1,210.

In this skins were worked intermittently for 1½—2 hrs., and it was found that in this time they were in a similar condition to skins which had been in a drench from 12 16 hrs. They were afterwards tanned and found to be good leather and in every way equal to similar skins which had been "drenched." A number of experiments have been tried with sulphuric and hydrochloric acids in order to ascertain if these had a similar action, but the results have not been satisfactory.

With regard to the third portion of the research, viz., the products of a pure cultivation of the bacteria, we have obtained a good number of results; but as the description of the experiments is of a greater length that we anticipated, and as there is still some work to do in verifying them, we are obliged to leave this portion for another paper, which we hope to have ready by the next session.

In conclusion, we may summarise the results obtained up to the present in the fermentation of bran by the organism we have used; remarking that there may be other organisms capable of fermenting bran in a somewhat similar manner.

1. It has been shown that the fermentation investigated is due to a specific organism, of which we find no account, and which, pending further experiments, we have therefore provisionally named *Bacterium Furfuris*.

2. That the starch and nitrogenous bodies in the bran, alone take part in the fermentation, the starch being first transformed into glucoses and dextrin by the action of an unorganised ferment or ferments; the glucoses and nitrogenous bodies only, being decomposed by the bacteria, with the formation of formic, acetic, butyric, and lactic acids, and the simultaneous evolution of hydrogen, carbon dioxide, nitrogen, and a small quantity of sulphuretted

hydrogen. The following table shows the quantities found in an experimental drench per 1000 cc.

	Grms.
Formic acid	0·0306
Acetic acid	0·2402
Butyric acid	0·0134
Lactic acid	0·7907
Total	1·0749

We find in actual work that the quantity of acid produced varies from 1 to 3 grms. per litre.

3. That if these acids are applied to the skins in the same proportions as they occur in the drench, the action on them is the same, and much quicker than an ordinary drench.

4. That the gas therefore, has no action on the skins *per se*, with the exception of floating and distending them, and so enabling them better to take up the acids.

We are indebted to Mr. H. R. Procter, of the Yorkshire College, Leeds, and to Dr. Percy F. Frankland for valuable suggestions in carrying out some of the work.

Discussion.

Dr. Clowes asked with regard to the test for lactic acid, if precautions were taken to avoid the presence of other substances besides it, which by oxidation would furnish aldehyde, he considered the test a very important one. Was cerealine different from diastase; the effects produced by it appeared to be very similar. As far as he could make out the same results could be obtained on the skin by the artificial preparation as by the bran preparation. Could this artificial preparation be substituted for the bran fermentation.

Mr. Whiteley thought there was no reason for regarding cerealin as a complex ferment, and pointed out that those present in madder root, bitter almonds, and other natural substances were considered simple bodies. With regard to the lactic acid test he said that aldehyde was not the only compound which would yield the coloration, and therefore great care must be taken that other substances which yielded on oxidation such compounds as acetone or acrolein were not present.

Mr. Crofts said he had known skins that had been "pured," when put into a bran drench, to become affected by acid soonest. What was the shortest time for the bran, if put with a skin, to turn acid. Did lime cause fermentation to increase or decrease?

Mr. Wood stated, in answer to Mr. Whiteley, that nothing but lactic acid was present when the test was applied. With regard to the question of the similarity between cerealine and diastase, he pointed out that the wheat contained the ferment as such, but that diastase was formed by the germination of the seed. With respect to the question about bacteria the speaker said that in the former paper it was stated that there was no such organism known for producing the fermentation of starch in that way. Since then, however, several organisms had been found which decomposed glucoses, and he believed that Dr. Frankland was at the present time investigating a fermentation of bran.

In answer to a question from the chairman at this point Mr. Wood said he could not say whether the lactic ferment found in milk produced the desired effect upon bran.

Mr. Croft said he had read that sour milk would serve the same purpose as a bran drench.

Mr. Wood replied that this only confirmed his previous remarks. With lime the fermentation generally continued longer the more carbonate of lime was present. The suggestion made by Dr. Clowes was hardly practicable, as although the purpose would be answered it would be too expensive.

Yorkshire Section.

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Jas. Sharp.
G. W. Slatter.
G. Ward.
T. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman*: A. Smithells; *Vice-Chairman*: T. Fairley; *Committee*: J. E. Bedford, F. Branson, W. Mackay, and C. Rawson.

SESSION 1892–93.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

Meeting held Monday, May 1st, 1893.

PROFESSOR SMITHELLS IN THE CHAIR.

SILK, ITS CHEMICAL CONSTITUTION AND ESTIMATION IN FABRICS.

BY F. W. RICHARDSON, F.C.S., F.R.M.S., ETC.

Constitution of Silk.

The subject to which I wish to direct your attention may not be of very general interest but may furnish useful considerations to those who care to consider some of the applications of organic chemistry to technology.

It is perhaps unnecessary to do more than preface the substance of my paper by referring in brief to the subject of sericulture.

There are very many varieties of silkworms producing silks of very different quality. The silkworm which lives principally upon the leaves of the white mulberry tree (*Morus alba*), and is therefore known as *Bombyx Mori*, is the chief producer of silk.

Passing with mere reference the Atlas, Eria, and Actias groups we find next in importance to the mulberry-feeding silkworms the well-known Tusser ("Tasar," "Tussar," or "Tussah") group. The Tusser silkworm is extensively distributed over the Indian provinces, and in a wild state is said to feed on plants with such unfamiliar names as "ber" (Zizyphus jujuba), "asun" (Terminalia alata), and the "Seemul" (Bombax heptaphyllum). By the word "ber" I suppose is meant a plant of the buckthorn order (*Rhamnaceæ*), bearing edible fruits known as "jujubes."

The plant termed asun belongs to the Combretaceæ or Myrabolan order.

The seemul doubtlessly refers to the silk-cotton tree of India.

The Bombyx worm is produced in spring from the egg, and after casting its skin three or four times it secretes a thread from two glands situated near the head. The glutinous secretion rapidly coagulates in the air and as it flows from two glandular apertures the thread produced is double, being united by a species of varnish known as "silk-glue," "silk-gum," or "Sericin." (It is perhaps but little known that the disciples of Izaak Walton were anciently accustomed to cut up the bodies of silkworms in order to draw the silky contents therefrom, as a string of a few inches in length speedily acquiring consistence and capable of use as an almost invisible line to beguile the unwary fish.) Chappe triturated the contents of the glandular organs of silkworms with about one-third their weight of water, and was thus enabled to blow permanent globes and diversely shaped vessels. (Annales de Chemie, **11**, 113.)

The composition of mulberry leaves is an interesting feature in a consideration which has for its object the discovery of the chemical constitution of silk. M. Péligot gives the following summary analyses of dried mulberry leaves and of dried silk-worms and their excreta.

—	Leaves.	Worms.	Excreta.
Carbon	43·73	48·10	42·00
Hydrogen	5·91	7·00	5·75
Nitrogen	3·32	9·60	2·31
Oxygen	35·44	26·30	36·14
Mineral matters	11·60	9·00	13·80
	100·00	100·00	100·00

Referring to these figures Léo Vignon points out that the nitrogen has accumulated in much greater proportion (9·6 per cent.) in the worm than in the excrement.

The mineral portion of mulberry leaves consists chiefly of phosphates of potash, lime and magnesia with from 5 to 20 per cent. of silica.

The worms appear to particularly assimilate the phosphates of potassium and magnesium, while the silica and lime are principally excreted. My own results have given such varying proportions of mineral matter as 2·5 to 26·8 per cent. upon the weight of the silk in its ordinary condition; it is scarcely necessary to say that John Chinaman had added his quota to the work of the silkworm in producing the higher figure.

The analyses which I have made of silk-ash are but little different to those already published, and I need only remark that the principal mineral matters present in silk are potash, lime, magnesia, silica and phosphoric acid; recently I have found as much as 10 per cent. of the last-named constituted in a mulberry-silk ash.

By far the greater portion of the mineral matter in raw silk is simply adherent to the fibre; indeed after removing the silk-gum by prolonged boiling with solutions of curd soap I find as little as 0·6 per cent. of mineral matter in the fibre.

The published analyses of the organic portions of the silk-fibre are somewhat conflicting. The results obtained by Mulder are frequently given in the text-books, but it is well to note that these results are unreliable as far as the proportions of silk-gum and fibroïn are concerned. Mulder submitted the fibre to the prolonged action of boiling acetic acid, and it is now admitted that his so-called "albumen" and "glue-yielding matter" did not exist in the fibre in the form in which he obtained them, and his result of 54 per cent. of fibroïn is much too low.

M. Paul Francézon obtained a much more truthful result by removing the sericin or "gum" by successive boilings with soap and, after washing with water, dilute acetic acid at 8° B. In round numbers Francézon thus obtained 75 per cent. of fibroïn and 25 per cent. of sericin, and it is said that these figures are in complete accordance with those obtained by dyers in their treatment of silk.

The soluble portion of silk is termed "sericin," the insoluble portion "fibroïn," and the ultimate analyses of these substances furnish the following results:—

—	Sericin.	Fibroïn.
Carbon	42·60	48·80
Hydrogen	5·90	6·23
Nitrogen	16·50	19·00
Oxygen	35·00	25·00
	100·00	99·03

The excess of oxygen in the sericin over that in the fibroin is probably due to the greater oxidation of the surface of the fibre; the conversion of fibroin into sericin is supposed to take place by assimilation of water and oxygen:—

$$\underset{\text{Fibroin}}{C_{15}H_{23}N_5O_6} + H_2O + O = \underset{\text{Sericin}}{C_{15}H_{25}N_5O_8}$$

A good mulberry-silk recently gave me:—

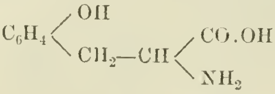
	Per Cent.
Water	12·50
Fatty substances	0·14
Resinous „	0·56
Sericin	22·58
Fibroïn	63·10
Mineral matters	1·12
	100·00

Léo Vignon in his recent work, La Soie (p. 143), remarks in referring to egg and silk albumens:—

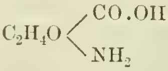
"Their study forms the most difficult problem of modern chemistry. In spite of its difficulties the synthesis of albumen will one day be effected, and that of fibroïn will follow without doubt."

These are hopeful words, and there is some little reason for believing that we are certainly nearer a more intimate knowledge of the chemical constitution of silk, but the synthesis may be far off; the so-called artificial silks are of a widely different character to either fibroïn or sericin. On this subject the work of such chemists as Staedeler, Cramer, Schützenberger and Weyl must be considered.

By the action of dilute sulphuric acid on silk gum Cramer obtained 5 per cent. of tyrosine, that is oxyphenyl-*a*-amido-propionic acid—



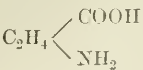
and 10 per cent. of a substance which he termed "sérine" or "amido-glyceric acid"—



This body, like silk itself, has a neutral reaction, as the amido and carboxyl groups neutralise each other, and combines both with acids and bases.

Thus 85 per cent. of the silk-gum remained as *terra incognita* to Cramer.

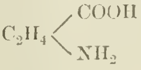
Cramer's "sérine" and alanine, or amidopropionic acid—



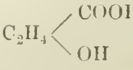
differ only by one atom of oxygen:—

Sérine	$C_3H_7NO_3$
Alanine	$C_3H_7NO_2$

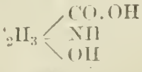
By the action of nitrous acid alanine furnishes lactic acid, and under similar conditions sérine gives glyceric acid



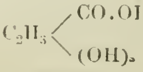
Alanine



Lactic acid



Sérine



Glyceric acid

Therefore sérine may be monamido-glyceric acid.

Th. Weyl (Berichte **21**, 1407—1529) by boiling de-gummed silk with dilute sulphuric acid (1:5) in connection with an inverted condenser for 18 hours obtained—

	Per Cent.
Tyrosine	5·2
Alanine	15·0
Glycocoll (amido-acetic acid)	7·5
	27·7

Thus 72 per cent. of the fibroïn resisted inquiry. Staedeler had previously obtained Leucin and Tyrosin by the action of dilute sulphuric acid on fibroïn, and his discoveries were fully confirmed.

In the Comptes rendus de l'Académie des Sciences for 1875 to 1888, M. Schützenberger published a number of valuable researches on the constitution of silk. This chemist used boiling mixtures of barium hydrate and water to affect the dissociation of the complex proteic substances. By this treatment albumen gave free ammonia, carbonic acid, acetic acid, and a mixture of several amido acids.

The amounts of ammonia, carbonic acid, and oxalic acid were always found to have a constant relation to each other; thus for each molecule of oxalic or carbonic acid two molecules of ammonia were obtained; exactly as with urea or oxamide:—

$$\underset{\text{Urea.}}{CO(NH_2)_2} + H_2O = CO_2 + 2NH_3$$

$$(CO_2)_2(NH_2)_2 + 2H_2O = \underset{\text{Oxalic acid.}}{(CO\,OH_2)} + 2NH_3$$

M. M. Schützenberger and Bourgeois analysed the fibroïn prepared by Francezon, and arrived at the formula, $C_{71}H_{107}N_{24}O_{25}$.

Under the influence of the boiling barium hydrate and water, the fibroïn is said to have given the following very complex result—

$$C_{71}H_{107}N_{24}O_{25} + 24H_2O = \underset{\text{Oxalic acid.}}{5C_2H_2O_4} + \underset{\text{Carbonic acid.}}{H_2CO_3} + \underset{\text{Acetic acid.}}{5(C_2H_4O_2)}$$
$$+ 3\,NH_3 + \underset{\text{Amido mixture.}}{C_{68}H_{141}N_{21}O_{43}}$$

and the amido-mixture to have yielded—

$$C_{68}H_{141}N_{21}O_{43} = \underset{\text{Tyrosine.}}{C_9H_{11}NO_3} + \underset{\text{Glycocoll.}}{7(C_2H_5NO_2)} + \underset{\text{Alanine.}}{7C_3H_7NO_2}$$
$$\underset{\text{Amido butyric acid.}}{2C_4H_9NO_2} + \underset{\text{Amido acid of the acrylic series.}}{4C_4H_7NO_2}$$

A little later M. P. Richard proved the presence of the amidogen group in silk by diazotising the fibre with a solution of sodium nitrite containing hydrochloric acid; after 24 hours' exposure to the nitrous acid the silk had received a characteristic pale yellow colour, and after being washed and plunged into the alkaline solutions of different phenols (phenol, resorcin, pyrogallol, and α- and β-naphthol) it was dyed differently with each.

My own experiments have given very similar results to those thus brought to your attention; but I have also obtained some results which appear to be worthy of notice. I can only regret that I am only on the threshold of investigations which I believe are likely to prove of some little importance.

At first I attempted to unbar the complex molecules of the silk by lengthy soaking in pure cold sulphuric acid, which did not carbonise, but merely dissolved the fibre. After dilution and boiling for some time, the acid was removed with milk of lime, and the filtrate was evaporated to dryness. In this manner about 15 per cent of glycocoll, leucin, and tyrosin was obtained, with 85 per cent. of a substance having the odour and appearance of glue, readily soluble in water but quite insoluble in alcohol. This substance closely resembled the amido-mixture of Schützenberger and Bourgeois.

A Tussur silk, the fibres of which I found to have a diameter of $\frac{1}{1100}$th to $\frac{1}{550}$th of an inch, was de-gummed by soaking for half an hour in a 2 per cent. solution of caustic soda, and the well-washed fibroïn was dried and used for the purposes of experiment.

Without entering into the details of the experiments, I may state that portions of the Tussur fibroïn were boiled in connection with an inverted condenser with alcoholic potash (half normal); the alcohol was finally distilled off and titrated for ammonia while the residual portion was taken up with absolute alcohol, filtered, and the filter washed with the same menstruum; the insoluble residue on the filter was washed with water and the filtrate was titrated for potassium carbonate using methyl-orange as indicator.

The alcoholic filtrate was titrated with normal sulphuric acid and phenolphthaleïn, the sulphuric acid being used in preference to hydrochloric, as chloride of potassium is much more soluble in alcohol than the sulphate.

The neutralised liquid was freed by filtration from the excess of potassium sulphate, and the filtrate was evaporated to dryness at 212° F., the residue was again extracted with absolute alcohol and again concentrated on the water-bath. The well-dried potassium salt gave an analysis—

Carbon	37·08
Hydrogen	4·96
Nitrogen	9·47
Oxygen	25·27
Potassium	23·30
	100·00

Assuming the organic constituents to form a univalent radical (R^1) the composition of this radical will be:—

Carbon	48·38
Hydrogen	6·45
Nitrogen	12·35
Oxygen	32·20
	100·00

It will be noted that the percentage of nitrogen is seemingly low, but I have no doubt as to the accuracy of the result; repeated estimations by Dumas' method giving closely concordant figures.

The nitrogen by the soda-lime method was uniformly 1 per cent. less; Kjeldahl's orginal process gave a like result, while Gunning's and Stock's modifications gave still smaller figures; indeed it appears to me that some uniform modification of Kjeldahl's process capable of giving accurate results all round is still a desideratum.

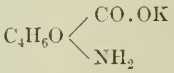
What I may term the "silk salt" thus obtained was, as its mode of preparation implies, readily soluble in absolute alcohol, and also in water.

Only 42 per cent. of the Tussur fibroïn dissolved in the alcoholic potash, and the remaining 58 per cent. constituted a glue-like mass which required a fortnight's washing to free it from alkali; this, as will be seen, is very different to mulberry fibroïn. The alcoholic distillate from the saponification contained ammonia equal to 0·44 per cent. of amidogen (NH_2); as the amido-group in amido-acids is not set free as ammonia by boiling with alkalies, this is probably due to an acid amide, M^1CONH_2.

The formula of the Tussur silk salt thus produced I calculate to be $K_8C_{42}H_{66}N_9O_{21}$, or, in simpler but less accurate form, $K(C_5H_8NO_3)$.

Assuming the radical to be univalent, its molecular weight is approximately 129, and in the simplest expression of the potassium salt it is 130.

In the normal amido-acids the carboxyl and amido groups are equal in number; and in this salt, where we have a hydrogen atom of the carboxyl replaced by potassium, the same condition exists; indeed we are tempted to give the tentative formula—



$$C_4H_6O\begin{cases}CO.OK\\NH_2\end{cases}$$

More accurately the full formula allows of the following expression—

$$(C_{35}H_{47}O_3)(NH_2)_9(CO.OH).(CO.OK)_8$$

leaving a carboxyl group in potential.

This formula, which I regard as merely suggestive, explains some otherwise perplexing results. I observed that the potash absorptions of the same lot of both Tussur and mulberry fibroïn varied with the length of the heating operation within certain limits, 36 per cent. of potassium hydrate being the extreme quantity taken up; this is equivalent to about 25 per cent. of potassium. By calculation the saturation of the ninth carboxyl group of the amido-acid will give an absorption of 25·4 per cent. of potassium. I observed that a certain amount of the potash was converted into carbonate, and from a consideration of Schützenberger's results I was inclined to regard this as due to the liberation of carbonic acid from the silk; but by repeated boilings of the same volumes of alcoholic potash under exactly the same conditions I found an exactly similar carbonation of the alkali to take place. This no doubt accounts for some of the somewhat divergent potash absorptions for fats and oils obtained by different analysts. Without the operation of saponification is conducted in a stream of perfectly pure hydrogen very closely concordant results are not attainable.

My next experiments were with a good mulberry silk, the fibres of which I found to measure from 1/t200th to 1/1000th of an inch in diameter.

Under exactly the same conditions as those recorded above I obtained a most satisfactory result, no less than 86 per cent. of the fibroïn taken being converted into a potash-salt readily and completely soluble both in absolute alcohol and in water; 14 per cent. remaining as a greyish powder insoluble in water and alcohol.

Ammonia equal to 2·08 per cent. of amidogen was found in the alcoholic distillate. By barium hydrate saponification Schützenberger obtained 3 per cent. of ammonia. This probably points to the presence of an acid-amide in the fibroïn, as we know that acid-amides, such, for example, as acetamide, furnish ammonia and the characteristic acid on saponification—

$$\underset{\text{Acetamide.}}{C_2H_3O.NH_2} + H_2O = CH_3CO.OH + NH_3$$

Eight per cent. of acetic acid (reckoned upon the fibroïn) was obtained from the silk salt, and this, curiously enough, is almost the corresponding amount of acid necessary to give acetamide with the amidogen.

Calculating the amidogen as acetamide we find that on saponification 7·67 per cent. of acetamide was formed.

The fibroïn gave—

Empirical formula $C_{60}H_{94}N_{18}O_{25}$

Carbon	48·00
Hydrogen	6·30
Nitrogen	19·00
Oxygen	26·70
	100·00

and the silk potassium salt—

Empirical formula $K_3(C_{18}H_{27}N_5O_8)$

Carbon	37·80
Hydrogen	4·96
Nitrogen	13·00
Oxygen	23·04
Potassium	21·20
	100·00

The radical $\frac{R}{3}$ = 147 molecular weight.

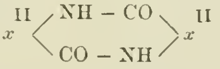
By the potash absorption its molecular weight is 145, and we may assume the salt to have the mass formula of $C_{14}H_{16}(CO.OK)_3(CO.OH).(NH_2)_5$; in which case there are only four carboxyl groups to five amido groups. As one carboxyl is in potential a still higher potash absorption is possible and has been obtained.

It is interesting to note that as much as 46 per cent. of iodine was absorbed from Hübl's solution by the potash salt of the Tussur silk; the exact importance of this result remains to be determined. Also the glue-like substance obtained by sulphuric acid treatment of fibroïn occasioned the disappearance of 39·3 per cent. of bromine from an alkaline solution of this element, afterwards decomposed by acid.

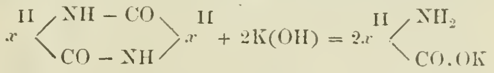
A. W. Hofmann (Die Berichte XVII., p. 1406, &c.), has shown that acid-amides when treated with soda-lye and bromine take up of the latter element proportions varying with the quantities used; one molecule of bromine uniting with one molecule of acid-amide when these are present in equivalent proportions. As it is possible that the bromine produced oxidation (a matter to be determined) nothing of a constitutional character can yet be deduced from this experiment. Combed and well-purified mulberry silk absorbed 30 per cent. of its weight of iodine from Hübl's solution, and remained of a deep yellow colour even after thorough washing with solutions of potassium iodide and water.

Numerous attempts were made to ascertain if silk had any so-called "acetyl-value" by the method of Benedikt and Ulzer. I was aware that Dr. Lewkowitsch has clearly shown the unreliability of the so-called "acetyl-value" of fats and oils, as it is evident that not only acetylisation, but also condensation takes place, the anhydrides of the fats being produced. Nevertheless the attempt to acetylise purified fibroïn was made, with a purely negative result, although the fibroïn was boiled for 24 hours with acetic anhydride in connection with a reflux condenser. The potash salt obtained from the silk gave a copious precipitate with lead acetate, and after purification and decomposition with sulphuretted hydrogen in the usual manner gave a yellowish, amorphous amido-acid; this acid conducted itself very much like the so-called "lanuginic acid" obtained from wool.

In concluding this portion of my subject I would observe that in this mode of resolving silk into its amido and carboxyl constituents by the instrumentality of alcoholic potash, we have, what appears to me, a readier method of arriving at a more intimate knowledge of the chemical constitution of silk, which is more probably an amido-anhydride than an amido-acid; a theory supported by the fact that silk lost nothing by boiling with acetic anhydride. The various reactions I have given seem to point to some formula as this for fibroïn—x representing a hydrocarbon residue—



The equation depicting the decomposition which takes place on saponification with potash would then be—



For the diagrams I have been enabled to show you my best thanks are due to Mr. Thomas Wardle, the President of the Silk Association, and for various samples of silk I am indebted to the kindness of Mr. Arnold Conder of Congleton. My pupil, Mr. Adolf Jaffé, has zealously performed a number of these experiments and of those now to be described.

Estimation of Silk in Fabrics.

Amongst remarkable suggestions for the estimation of silk in fabrics I may mention that of A. Lidow (Berichte, **17**, Ref. 255), who states that melted oxalic acid can be used to separate silk from wool and cotton, as it dissolves the former and leaves the two latter unaffected! Another chemist suggests the use of strong hydrochloric acid, which he says dissolves silk but does not affect cellulose; my criticism of this suggestion consists of the statement that a piece of cotton lost 28 per cent. of its weight by immersion in cold strong hydrochloric acid.

The whole question of the estimation of silk, wool, and cotton in fabrics is much more difficult than most analysts suppose. It is practically impossible to find any reagent for the solution of one of these materials without in some way affecting the others.

Dr. C. Otto Weber has recently shown (this Journal, February 28, 1893) that boiling alkaline solutions have a very considerable action upon cellulose owing to the production of an oxycellulose, or probably a number of oxycelluloses. I have heard that on the continent some chemists estimate silk in plush by boiling with 2 per cent. caustic soda. By this method lengthy boiling is required, and when I state that if purified cotton is boiled for half an hour with 2 per cent. caustic soda solution, 2 per cent. of the cellulose is dissolved, it will be seen that such a process ought to be abandoned. We find that cotton loses 12 per cent. of its weight by boiling for half an hour with 12 per cent. caustic soda.

A solution now extensively recommended in the text-books is made as follows:—16 grms. of copper sulphate is dissolved in from 140 to 160 cc. of water, 8 to 10 grms. of pure glycerin is added, and a solution of caustic soda is gradually poured in until the precipitate first formed dissolves, excess of soda being avoided. It is said that this solution has no action on wool and cotton, while it readily dissolves silk. These are the real facts of the case —Purified cotton heated with the soda-copper solution for 20 minutes (the time necessary to dissolve silk from plush) loses from 1 to 1½ per cent. of its weight, and becomes very friable and dusty. This is perhaps a somewhat pardonable result, woollen fabrics treated with this soda-copper solution lost from 9 to 16 per cent. of their weight; therefore this liquid must be ruled out of court as far as the analysis of fabrics containing wool is concerned.

The next solution used for estimating silk in fabrics is basic zinc chloride, which is best prepared as follows (Dr. Elsner's "Praxis des Chemikers," p. 418):—1,000 grms. of zinc chloride, 40 grms. of zinc oxide, and 850 cc. of water are mixed and heated together until the solution is effected; the resulting cold solution should have a specific gravity of 1·72. I find that it is necessary to have the solution sufficiently basic and concentrated if even moderately good results are to be obtained.

The fabric from which it is intended to remove the silk is plunged two or three times into the boiling zinc chloride solution, the whole exposure being not more than one minute.

In this manner the losses are—

	Per Cent.
Purified cotton..............	0·45 to 0·60
Purified wool.................	1·5 to 2

This solution comes well within the realm of possible reagents for separating silk, even from wool.

The fabrics so treated are purified by heating with 1 per cent. hydrochloric acid until the zinc is removed.

Although I have discovered a number of references to ammoniacal oxide of nickel as a means of separating silk from wool and cotton, I have been unable to discover any directions for the preparations of the solution.

After several more or less unsuccessful experiments, I have found a method for preparing a solution which gives excellent results.

Twenty-five grms. of crystallised nickel sulphate is dissolved in about 500 cc. of water; the nickel is then completely precipitated as hydrate by caustic soda; the hydrate is thoroughly washed with water, then rinsed into a 250 cc. flask with 125 cc. of water; the flask is then filled to the mark with 0·880 ammonia and well shaken. I find that silk dissolves rapidly even in the *cold* solution, a desideratum, as will be admitted. With this solution, on exposure for two minutes, the time necessary to completely dissolve silk from fabrics other than plush, the losses are—

	Per Cent.
Purified cotton	0·45
Purified wool	0·33

In order to dissolve silk from plush, 10 minutes boiling in connection with a reflux condenser is required; in this manner cotton loses 0·8 per cent. of its weight.

For the analysis of plush I therefore recommend brief exposure of the fabric to a boiling solution of basic zinc chloride (1·72 sp. gr.), but for the estimation of silk in light fabrics, particularly if wool is present, the best method is exposure for from one to three minutes (according to the nature of the material) to a cold solution of ammoniacal nickel oxide prepared as above directed.

A plush which according to the manufacturer's statement contained a slight excess of silk over the cotton, and which by picking showed a similar result, gave—

——	Ammoniacal Nickel Solution.	Soda Copper Glycerin.	Basic Zinc Chloride (1·72 sp. gr.).
Moisture, dye and finish.	11·34	10·04	11·00
Silk	45·60	47·06	45·00
Cotton	43·06	42·90	44·00
	100·00	100·00	100·00

The estimation of the "dye and finish" admits of no very general method, as the analyst must be guided by the nature of the mordants and dyes present, some solvents being preferable to others in special cases. Generally, a preliminary boiling for 10 minutes with 1 per cent. hydrochloric acid is useful. In this time cotton loses 0·4 per cent. of its weight. Three per cent. hydrochloric acid on boiling produces a too great action on wool and cotton to be used with advantage.

Metallic mordants are for the most part not removed by this method, and must be estimated as ash, and deducted from the other results.

It is also advisable to boil some dyed fabrics with methylated spirit, and finally with ether, to remove certain dyes and oleaginous substances.

A woollen and silken fabric, after thoroughly cleansing from extraneous matter and drying, gave—

——	Ammoniacal Nickel Solution.	Basic Zinc Chloride.
Silk......................	25·4	27·0
Wool	74·6	73·0
	100·0	100·0

The result with the nickel was undoubtedly accurate; the zinc chloride had excessively acted upon the wool. After dissolving the silk by means of the cold ammoniacal nickel solution, in the case of fabrics containing wool, silk, and cotton, the fabric is digested for two or three minutes in a boiling solution of 1 per cent. hydrochloric acid; it is then washed, dried and weighed. The wool is separated from the cotton by boiling for about seven minutes with a 2 per cent. solution of caustic soda, and the cotton is then washed, dried and weighed. The superior utility of the nickel solution over the other solvents for silk in fabrics is well shown in the following analyses:—

——	Actually Present.	Ammoniacal Nickel.	Zinc Chloride.	Soda-Copper-Glycerin.
Silk....................	5·84	5·92	5·52	18·80
Wool....................	76·31	76·58	80·08	64·05
Cotton	17·85	17·50	14·40	17·15
	100·00	100·00	100·00	100·00

The material was but very superficially dyed and its constituent fibres were easily separated and weighed. It will be observed that the only all-round reliable results are with the nickel solution; the wool is 3½ per cent. too high and the cotton 3½ per cent. too low with the zinc chloride, while with the soda-copper-glycerin solution the silk is three times too high and the wool 12 per cent. too low. I believe these results are of sufficient importance to be considered by analysts who have to deal with fabrics.

It is perhaps scarcely necessary to add that all these basic solutions dissolve silk because they dissociate the amidoanhydride of which it is composed and form soluble metallic amido compounds.

Discussion.

The Chairman remarked that he was always inclined to be sceptical about constitutional formulæ for such complicated substances as fibroïn and albumen. It was, indeed, often possible to infer the existence of certain groups in the molecules of these compounds, but it was improbable that we should be able to completely determine their constitution with the present means at our disposal; some new method of attacking the problem would first have to be devised. But of course every experimental fact bearing upon the question was to be welcomed. Mr. Richardson had been moderate in his conclusions and refrained from doing anything like what he had once seen done by a chemist, who, on the basis of a single reaction, constructed a structural formula for albumen which covered two large black-boards.

Mr. G. W. Slatter commented upon the great difficulty of obtaining suitable solvents by which to effect the separation of silk, wool, and cotton, and congratulated Mr. Richardson upon his discovery of a new solvent of this kind. He himself had at one time used soda and potash (in plush analysis) as is still frequently done on the continent, where solutions as strong as 10 per cent. are employed. In experiments made with the plain cotton backing of plush fabrics, he had found that the material suffered a loss of 10—11 per cent. when boiled for 10 minutes with 10 per cent. potash, and the result was practically the same, whether the material was previously washed quite free from acid, or a trace of acid left. For separating silk from cotton he used copper-glycerine-soda solution, and always obtained good results. Was not soap a better material for removing the gum than soda?

Mr. Rawson asked if the numerical results quoted were the means obtained from a number of experiments. And whether the material experimented on was dried at 100° or only air-dried. If the latter, the variation in the weights of air-dried fabrics was so great that, in comparison with this variation, the small differences between the weights of wool dissolved by ammoniacal nickel hydrate and basic zinc chloride would not be large enough for any meaning to be attached to them. Caustic soda had a remarkable effect upon cotton after it had been first treated with hydrochloric acid. In some experiments carried out a few years ago, he had found cotton to lose from 5 to 10 per cent. by this treatment. He was of opinion that even 2 per cent. potash was too strong; to dissolve pure wool he found a 1 per cent. solution quite strong enough when boiled for 10 minutes, and the loss of cotton was but slight.

Mr. Glendinning suggested that silk might not behave as a homogeneous substance towards reagents, but as a mixture of fibroïn and sericin, each reacting separately and differently with acids and alkalis.

The methods of separating bodies of the albumen class were certainly very crude; no sharp line could for instance be drawn between coagulable and non-coagulable albuminoids, whilst those who still placed confidence in the present imperfect methods of separation were constrained to express a certain variable quantity of an albuminoid body as "unknown nitrogenous matter."

Mr. Fairley asked if some difficulties might not be avoided by using a solution stronger than 2 per cent. but at a temperature lower than the boiling point, e.g. 80° C.

Mr. Procter remarked that Reimer had proposed formulæ for the fibre and cementing matter of hide which were related to one another in a similar manner to those proposed by Cramer for the fibroïn and sericin of silk, which assumed an absorption of oxygen in the conversion, where a simple hydration was much more in accordance with his analytical figures. Preconceived notions were apt to influence the interpretation of results. Had Mr. Richardson tried the alkaline sulphides as solvents for wool?

Mr. Richardson, in reply, said that in his investigation he had purposely left the albuminoids untouched, and he regarded the elucidation of their structure as a present impossibility, but of the constitution of silk fibre he thought some knowledge might be obtained. With reference to the Chairman's scepticism it should not be forgotten that a similar attitude might have been assumed towards the investigation of those complex molecules—the sugars—which have been synthesised through the splendid labours of the Fischers. Like Mr. Rawson, he had found that potash occasioned a much greater loss of cotton after previous treatment of the material with hydrochloric acid. Perhaps it would be better to carry out the solution of the wool in a current of hydrogen, as Weber had shown that the solution of cellulose is due to an absolute oxidation. Plush backs were much harder than most cotton fabrics, and with them successive treatment with acid and the soda-copper-glycerin solution gave good results, but this solution was not to be recommended for use with other cotton goods, and wool especially is dissolved by it in large amount. It was only in the case of plush that the results with the nickel and zinc solutions exhibited but slight differences. The results quoted in the paper represented the mean of many experiments. He was surprised that a 1 per cent. potash solution was strong enough to dissolve wool when the boiling was continued only 10 minutes; in his experience at least 30 minutes was necessary with such a solution, but much depended on the nature of the material submitted to analysis. He had tried strong solutions at temperatures below 100°, but the wool was then converted into a slimy substance and dissolved but slowly; it was best to use a 2 per cent. alkali solution and boil for 7 minutes. Fibroïn and sericin were similar chemical compounds and the action of reagents on them probably similar. Wool would not dissolve in cold alkali even as strong as 10 per cent.; it was only rendered slimy. To remove the silk-gum he generally used soap, but to ensure the complete removal of the sericin he used cold 2 per cent. potash, which did not chemically decompose the fibroïn. In his formula there was no question of the absorption of a molecule of oxygen. He had no experience of the alkaline sulphides as solvents of wool. With reference to Mr. Rawson's question as to the condition of the fabrics on weighing, he would add that he always dried at 100° C., as equivocal results may be obtained by the method of exposure before weighing. In some cases it is necessary to take the greater hygroscopicity of wool and silk than cotton into account.

Glasgow and Scottish Section.

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G. Watson.

Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Committee:* J. Clark, G. G. Henderson, W. I. Macadam, and D. R. Steuart.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Meeting held in the Societies' Rooms, 207, Bath Street, Glasgow, on Tuesday, May 2nd, 1893.

PROF. EDMUND J. MILLS IN THE CHAIR.

NEW ASPECTS OF PHENOLPHTHALEÏN AS AN INDICATOR.

BY R. T. THOMSON, F.I.C.

The researches on indicators which have been carried out of late years show the futility of speaking of the neutrality, acidity, or alkalinity of a solution in absolute terms, as the results of a large number of experiments go to show that the conditions of testing, as well as the indicator employed, must be carefully registered. Thus, among other facts of a similar class, I had occasion to show that when sulphurous acid was titrated with caustic soda, a wide difference, amounting to half of the total acid present, was observed between the indications of phenolphthaleïn and methyl-orange respectively; and also that in a hot solution the end-reaction was both altered and vitiated. Such an experiment shows the effect of difference of indicator and difference of condition as regards temperature. But there is another class of facts of which special note has not yet been taken, and which refers to the alteration of the point neutral to phenolphthaleïn caused by the addition or presence of certain neutral substances in the solution being titrated. It is a well-known fact that if an alcoholic solution of soap neutral to phenolphthaleïn is diluted freely with water, the solution becomes strongly alkaline to that indicator, and the same is true of a glycerin solution of soap. This has been generally explained by assuming that on dilution acid soap was precipitated and basic soap remained in solution, thus accounting for the change from a neutral to an alkaline reaction. It is doubtful, however, whether this theory gives a full explanation of the phenomenon, as I have observed the same thing taking place with salts produced from weak mineral acids, and in circumstances precluding the correctness of any similar theory. Thus if we take a strong solution of borax, colour it by adding some phenolphthaleïn, then add dilute sulphuric acid until the pink colour is just gone, and finally dilute freely with water, it will be found that on performing the last operation the pink colour will return. The further addition of acid will now prove that alkali has been produced in considerable quantity by simple dilution with water. If the neutralized strong solution were diluted with a limited quantity of water until a distinct pink is developed, then this colour discharged by addition of more acid, it will be found that further dilution with water again brings out an alkaline reaction, and so on, up to a certain point at least. Solutions of soap behave in the same manner towards phenolphthaleïn when diluted with water, and the extent to which soaps decompose in this way with different proportions of water has been worked out by Messrs. Wright and Thompson (this Journal, 1885, 630). I have observed a similar reappearance of alkaline reaction towards phenolphthaleïn with sodium silicate and sodium arsenite when the previously neutralised and moderately strong solutions of these salts were diluted with water.

On what principle, then, can these facts be explained? In the case of the mineral salts it is quite plain that the theory of the production of an insoluble acid salt and a soluble basic salt cannot be applied, as no insoluble compound is formed. It is probable that the salt is really decomposed to a greater extent as the dilution with water proceeds, and that the strong base being set free exerts a greater influence on the indicator than the weak acid, and an alkaline reaction is the result. Such a view would be corroborated if a converse case were established, that is, if a neutralized compound of a weaker base and a stronger acid gave rise to a more acid solution on dilution with water. This is actually what occurs with sulphate of ammonium. If phenolphthaleïn be added to a moderately strong solution of that salt, and then sodium hydrate until a distinct pink colour appears, and finally the solution be diluted with water, the pink colour will disappear, and before it can be restored an appreciable quantity of sodium hydrate will have to be added. In this case it would appear as if the ammonium sulphate had decomposed by dilution with water, and that the stronger acid liberated had overcome the influence of the comparatively weaker base.

It is worthy of note that, so far as tests have been made, these peculiarities are only observed in cases where the end-reaction is of an eminently unsatisfactory character. When sharply defined end-reactions are obtained, as, for instance, in the titration of sulphurous, phosphoric, and arsenic acids, no alkaline reaction is developed on diluting the neutralized solution with water. Of course it does not follow that these compounds are not decomposed by water because phenolphthaleïn does not show it, any more than we would assume that ammonium sulphate was not decomposed because methyl-orange did not exhibit the peculiarity that phenolphthaleïn does.

It is a generally recognised fact that while water decomposes soap, alcohol or glycerin when added in sufficient quantity will cause re-combination, as is evidenced by the pink colour of phenolphthaleïn being bleached when this treatment is resorted to. The same thing may be observed by dissolving a little boric acid in water, adding phenolphthaleïn and then caustic soda until a distinct pink colour is produced. If to this mixture some glycerin be added the pink colour will disappear at once, and a considerable quantity of caustic soda will be required to restore it. In a former paper I had occasion to show that when boric acid was titrated with caustic soda in a water solution, the end-reaction was so indefinite as to be entirely useless for accurate analysis; but recently I observed that when a certain proportion of glycerin was present the end-reaction was quite sharp and reliable. Some experiments were made with the view of noting the effect of various proportions of glycerin on the titration of boric acid with sodium hydrate when phenolphthaleïn was employed as indicator. For each test 0·1 grm. of pure crystallised boric acid, dissolved in water and glycerin in the various proportions given in the following table, was employed, and the determination was made with fifth-normal sodium hydrate. The following results were obtained:—

Table I.—Showing Results of Titration of 0·1 grm. of Boric Acid in Solutions containing varying proportions of Glycerin and Water.

Grms. of Glycerin present.	Cc. of Water present.	Cc. of $\frac{N}{5}$ NaOH consumed.	Grm. of H_3BO_3 found.	Nature of the End-Reaction.
None	42·5	1·0	0·0124	Extremely indistinct.
1·0	41·5	4·9	0·0608	Very indistinct.
2·5	40·0	6·8	0·0843	„
5·0	37·5	7·8	0·0967	Indistinct.
10·0	32·5	8·0	0·0992	Not very distinct.
15·0	27·5	8·1	0·1004	Very distinct.
20·0	22·5	8·1	0·1004	„
25·0	17·5	8·1	0·1004	„

In the last three experiments one drop of the $\frac{N}{5}$ soda was quite sufficient to give a distinct end-reaction when the neutral point was reached, while another drop added corroborated this reading by intensifying the pink colour. It will be observed from these results that even when glycerin is present in the solution to the extent of 2 per cent. it has a remarkable effect in increasing the apparent acidity, although the end-reaction remains indistinct. As the percentage of glycerin is increased the apparent acidity also increases, until when about 30 per cent. of the glycerin is employed, the compound $NaBO_2$ is produced by titration with soda, just at the point when the red colour showing alkalinity is developed. Increase of glycerin, up to about 50 per cent. of the total solution, has no further effect, so that the point to be observed in a successful determination of boric acid in this way is that the solution after titration is completed ought to contain about 30 per cent. of glycerin at least.

Other substances which show much greater acidity in glycerin than in water solution are arsenious and silicic acids and ammonium sulphate. But even in a stronger glycerin solution than 50 per cent. the end-reaction with each of these is still very indistinct, and no definite salt appears to be produced when that point is reached in the titration.

Again, in addition to glycerin there are other substances which confer greater apparent acidity on boric acid. Curiously enough alcohol has only a slight effect in this direction, thus differing in this respect from its action on the fatty acids. It was found that 70 per cent. of alcohol had not more than one-fourth of the influence of 2 per cent. of glycerin. The only other substances tested were starch-glucose and cane-sugar, the result being that both were found to have marked power in raising the acidity of boric acid. The results obtained with cane-sugar are embodied in the following table :—

Table II.—Showing Results of Titration of 0·1 grm. of Boric Acid in Solutions containing varying proportions of Cane-Sugar and Water.

Grms. of Cane Sugar present.	Cc. of Water present.	Cc. of $\frac{N}{5}$ NaOH consumed.	Grm. of H_3BO_3 found.	Nature of the End-Reaction.
5	20	3·8	·0471	Very indistinct.
10	20	5·6	·0694	„
15	20	6·7	·0831	Indistinct.
20	20	7·0	·0868	„

Starch glucose gave similar results to those obtained with cane-sugar.

To determine boric acid in articles of commerce it will then be necessary to use methyl-orange, to which indicator I formerly showed boric acid to be perfectly neutral. To determine boric acid in borax dissolve 1 grm. of the latter in water, add a little methyl-orange, and then dilute sulphuric acid till the pink colour just appears. Boil for a short time to expel carbonic acid, cool, and add normal or fifth-normal sodium hydrate till the pink colour of the methyl-orange (a little more of which should be added if necessary) just assumes a pure yellow tinge. At this stage all the boric acid will exist in the free state. Add glycerin in such proportion that the total solution after titration will contain 30 per cent. at least, then add a little phenolphthaleïn, and lastly normal or fifth-normal sodium hydrate from a burette until a permanent pink colour is produced. More glycerin may be added during the estimation if it is found necessary. The proportion of boric acid present is calculated from the number of cc. of sodium hydrate consumed, the following being the strength of normal caustic soda:—

1 cc. normal NaOH = 0·0620 grm. H_3BO_3
1 cc. do. = 0·0505 grm. $Na_2B_4O_7$
1 cc. do. = 0·0955 grm. $Na_2B_4O_7 + 10H_2O$

In the case of boric acid of commerce, which generally contains salts of ammonium, 1 grm. may be dissolved in hot water, a slight excess of sodium carbonate added, and the solution boiled down to about half its bulk to expel ammonia. Any precipitate which appears may then be filtered off, and the filtrate titrated as already described.

The method may also be applied to boracite or borate of lime by dissolving 1grm. of either of these minerals in dilute hydrochloric acid with the aid of heat, nearly neutralizing with caustic soda, boiling to expel carbonic acid, cooling, exactly neutralizing to methyl-orange, and continuing the determination as in borax. If much iron is present, however, it may be removed by a preliminary treatment with carbonate of sodium and removal of oxide of iron as well as the carbonates of calcium and magnesium by filtration.

I have also attempted to apply the process to the estimation of boric acid in milk and other foodstuffs. This of course necessitates the removal of phosphoric acid from the ash of the milk, for which purpose I have found a barium salt to be a successful precipitant, and if the solution be sufficiently dilute will leave the boric acid in solution. I have not yet completed my experiments on this point.

Discussion.

The Chairman congratulated Mr. Thomson, not only for having so admirably overcome the difficulty of accurately titrating boric acid, but also for having contributed to the knowledge of the dynamics of solution. It seemed to him that the viscosity of the solutions had much to do with the excellence of the results attained by Mr. Thomson in his experiments. He ventured to suggest that by the use of saponin similar results would be obtained without the necessity of having so large a quantity of extraneous matter in the solution. The method appeared to him to be specially applicable to the estimation of the acidity of potable waters, the accurate estimation of which was a problem of extreme difficulty.

Mr. Hamilton asked if, from the results of his researches, Mr. Thomson could give a satisfactory definition of a neutral salt.

Mr. Thomson, replying, said he was unable to comply with Mr. Hamilton's request. He thanked the Chairman for drawing attention to the viscosity of the solutions as being the probable cause of the variations in the results of titration. He would certainly investigate the matter further, because he had noticed that mobile liquids, such as alcohol, did not increase the acidity.

Communication.

CARBON DEPOSITS ON GAS BURNERS.

BY E. G. LOVE, PH.D.

The formation of hard, carbonaceous deposits in the slits of steatite flat-flame burners is one of the annoyances which many gas engineers in the United States have encountered.

The difficulty first shows itself in the ragged outline of the flame. This increases, more or less rapidly, until the flame is very much forked, and ultimately the slit is practically closed. The holes of the fish-tail burner appear to offer less favourable conditions for this deposit than the slits of the different types of bat-wing burners.

The remedy commonly applied is to cut out the deposit with a fine saw or steel ribbon, but this is never satisfactory, for even if the slit itself is well cleared the inner chamber of the burner tip usually retains so much of the deposit as to interfere with the proper flow of the gas. The deposit is very hard, and if it exists in any considerable quantity the chances are that the tip will be broken in the effort to clean it.

This difficulty is so serious in some places as to necessitate the substitution of a metal tip in place of the steatite, the former, so far as I know, not being subject to these deposits.

The most interesting fact connected with these deposits is that sometimes they are not confined to the burner slit, but grow up into the flame on the outside of the burner itself. These growths are most commonly found on burners consuming the carburetted water-gas, although occasionally they occur when coal-gas of high candle power is used, especially if naphtha is employed as an enricher.

The growth first appears as a fine black splinter attached to the edge of the slit, but as it grows it spreads out into some curious shape, increasing in size until the weight becomes too great for the delicate pedicel and it falls off, or from some change in the conditions it gradually wastes away.

Occasionally it grows up in a single night, but usually it is several days in forming. The average height of these growths is perhaps about one-half inch, and the weight from one-half to one grain. Several years ago I raised one which was nearly an inch high and weighed 2·6 grains, but it is very seldom they grow to that size.

Up to the present time I have not been able to find any satisfactory explanation for the formation of these curious growths, but I am hoping that a line of experiments which I am following out will throw some light upon the matter.

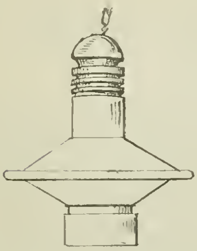
The immediate cause of the deposit is the dissociation of hydrocarbons at the high temperature attained in the steatite tip, and is doubtless similar to the deposition of carbon in the retorts used for "fixing" the naphtha vapours. This, however does not explain the conditions necessary to the formation. They are not, as might be supposed, the most common in those gases having the highest candle power and containing the largest quantity of hydrocarbon vapour. Neither can they be depended upon in a gas which has shown a tendency to produce them. They may grow, one after another, for a month, and suddenly the deposits will stop, and not reappear for several months, or even years. Some ten years ago one of the gases in New York City produced some very large deposits for about a month, but since that there has not been a trace of any.

These growths are composed practically of pure carbon; they are entirely consumed on ignition, and are free from iron, which would not be the case if iron carbonyl had a part in their formation.

The accompanying diagrams show the general character of these growths. Each group of four represents a single deposit photographed at different stages of its growth, and in both cases the deposits dropped off soon after the photographs were taken.

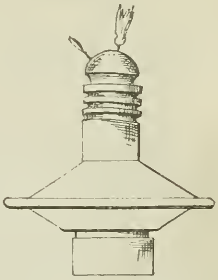
In general they were of a dull black colour, but small portions of each had a bright metallic lustre much resembling silver, and when examined microscopically showed a beautifully concretionary structure.

Fig. 1.



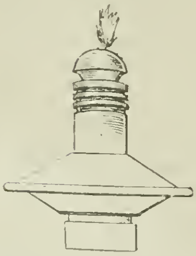
December 5th, 1891.

Fig. 2.



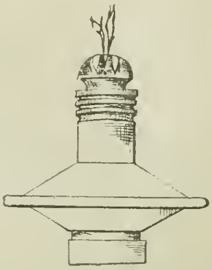
December 7th, 1891.

Fig. 3.



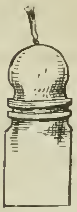
December 10th, 1891.
Front.

Fig. 4.



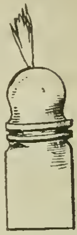
December 10th, 1891.
Side.

Fig. 5.



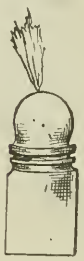
December 19th, 1891.

Fig. 6.



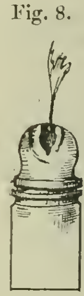
December 21st, 1891.

Fig. 7.



December 23rd, 1891.
Front.

Fig. 8.



December 23rd, 1891.
Side.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Boiler Explosions in Germany during 1891. Chem. Zeit. **16,** 1356—1357.

During 1891 ten boiler explosions took place in Germany, besides one explosion of a steam-heater. These explosions were in all probability due—

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* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

In 6 cases to water being allowed to get too low.
„ 1 case to age of boiler (36 years in use).
„ 1 „ to excessive pressure.
„ 1 „ to combined effect of great age, excessive work, and high pressure.
„ 1 „ to inferior material of which boiler was made.

Ten persons were injured by these explosions, of whom three died.

The low water-level causing so many explosions was due apparently in all cases but one to the gauge-glasses not showing the actual water-level in the boiler through becoming blocked with dirt or scale.—K. E. M.

PATENTS.

Improved Apparatus for Dyeing or Chemically Treating and Drying Paper, Felt, and other Fabrics. W. Searle and W. H. Elliott, London. Eng. Pat. 2096, February 3, 1892.

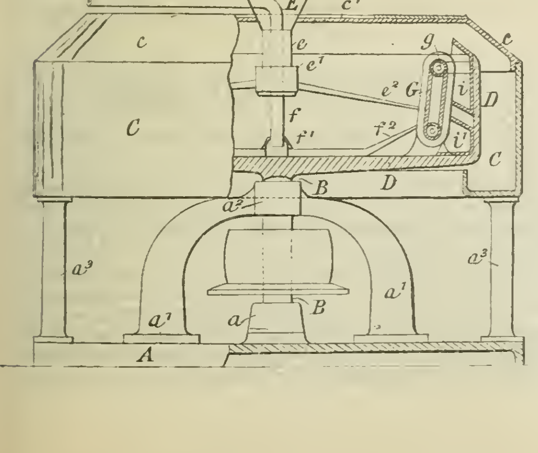
The proposed machine is for saturating tissue paper with a solution of any substance and for drying the said paper after saturation. It is also applicable to dyeing, drying, damping, dressing, starching and varnishing paper and felted, woven, or knitted fabrics. The patentees claim the combination of an endless web or blanket in contact with a heated roller with a series of adjustable guiding rollers, and the combination of a heated drying roller, a saturating roller, a bath for containing the solution, rollers for transferring it, and an endless web or blanket.—Ed. T.

Improvements in Means for Operating the Cocks and Valves of Cylinders and Vessels containing Gases under Pressure. "The Manchester Oxygen Company, Limited," and W. M. Jackson, Manchester. Eng. Pat. 7125, April 13, 1892.

The subject of this invention is a portable and easily applied and removed means or device for securing a slow and certain opening of the cocks and valves of vessels, such as gas cylinders or bottles containing gases under pressure. For this purpose the employment of "a worm and worm wheel or quadrant or other analogous or equivalent arrangement" is claimed, as also the improved portable and easily applied and removed "shackle bracket furnished with a worm or worm quadrant" and carrying the outlet attachments for slowly turning the valves and cocks of cylinders of compressed gas as described at length and illustrated.—O. H.

Process of and Apparatus for effecting the Concentration and Separation of Solids. J. A. Mays, London. Eng. Pat. 9234, May 16, 1892.

In this invention centrifugal force is introduced to assist the action of gravity employed in ordinary "frue vanners" for separating the "concentrates" of ores from the "tailings." The apparatus proposed for the purpose is represented in the accompanying illustration.



Within the rotary drum D of a centrifugal machine constructed for the purpose, are disposed, equidistant from the axis, a number of travelling belts G, the inner surfaces of which are made to travel in a downward direction whilst the drum rotates around its axis. The pulp of ore and water reaches the belt from the funnel E through the pipes e, $e1$, and $e2$, whilst the stream of water for washing away the lighter materials reaches the belt through the pipes f, $f1$, and $f2$. The concentrates pass round the bottom of the belt G into the receiver $i1$, and the tailings pass over the top roller into the receiver i, whence they are removed from time to time. Modifications are shown of an apparatus with continuous action, of arrangements for varying the motion of the travelling belts, and of other details.—B.

Improvements in and relating to Thermostats. C. de Zang Howard, Syracuse, U.S.A. Eng. Pat. 23,895, December 27, 1892.

The improved thermostat consists essentially of a thermostatic plate "constructed of two contiguous sheets of a material of different expansible properties." By preference sheet iron and hard rubber or vulcanite rivetted or otherwise firmly united, are employed. The plate is of triangular shape and its base is securely fastened to any fixed support, while the apex is free to move and is connected to a suitably weighted damper, so that expansion of the plate, caused by increase of temperature, allows the damper to automatically close. When the temperature falls the contraction of the plate raises or opens the damper.—O. H.

Improvements in and Apparatus for Separating by means of Lightly Compressed Air Fluid from Solid Substances, or Lighter from Heavier Particles of Liquid Bodies. J. Y. Johnson, London. From A. Boinholdt and J. Glatz, Brooklyn, U.S.A. Eng. Pat. 145, January 3, 1893.

In the ordinary process it requires a temperature of about 150° F. to distil alcohol. According to this invention the crude spirit is placed in a suitable tank or vessel adapted to withstand high internal pressure, and provided with an adjustable valve which controls the outlet or escape pipe, and which can be set to maintain the desired pressure in the tank. Air is then forced in up to a pressure of say 300 lb. The liquid may be warmed by heating the air, or by direct heat of a furnace or otherwise, to a temperature of about 100° F.

Under these conditions the air passing through the liquid becomes saturated or impregnated with the vapours thereof. As the pressure increases the air passes more slowly through the liquid, remaining for a considerable time in contact therewith, and thus becomes completely charged or saturated.

It is claimed that the separation of the lighter from the heavier constituents of the liquid is effected at a temperature much lower than that ordinarily required, and economy of fuel is the result, and condensation of the vapours is accomplished more easily and expeditiously than in ordinary processes. By raising the pressure above the limit to which the valve is adjusted the air saturated with vapour is allowed to escape into a condensing vessel: the sudden expansion causes a fall of temperature, aiding the condensation of the vapours to such an extent that but little water for condensing is required.

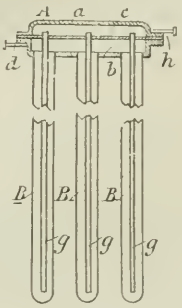
The invention is not limited to any particular degree of temperature or pressure, varied within certain limits and must be regulated to suit the particular liquid under treatment.

The same principle is also applied to an apparatus called a "pneumatic press." In this apparatus solid material, such as brewers' grains, is placed in a perforated cylinder provided with perforated shelves. The cylinder is enclosed in a vessel capable of withstanding a pressure of at least 1,000 lb. per square inch.

The *modus operandi* is practically the same. In this latter case the process is one of evaporation, the air acts as a drying medium or vehicle and becoming saturated with the liquid, carries it off, either as vapour or in suspension.
—O. H.

Improvements in Apparatus for Heating and Cooling Fluids. H. D. Fitzpatrick, Glasgow. From F. A. Kleemann, Berlin, Germany. Eng. Pat. 513, January 10, 1893.

The improved apparatus is for heating and cooling liquids and especially such as are apt to deposit solid matters. It consists of a hollow chamber A, divided by a horizontal partition *a* into two compartments *b*, *c*. Inserted in the bottom of the compartment *b* are a number of tubes B closed at their lower ends, and in each of these tubes hangs a small tube *g*, attached to the partition *a*, and in communication with the upper compartment *c*. The inside tubes are open at both ends except when condensed steam or other condensed vapour is used as the heating or cooling medium, foot valves being then fitted to the bottom ends to prevent the liquid returning to the tubes B. The heating or cooling medium enters at *d*, and, passing consecutively through compartment *b*, tubes B and *g*, and compartment *c*, leaves at *h*. This apparatus is suitably inserted into and adjusted to an external vessel through which the liquid to be heated or cooled, flows.



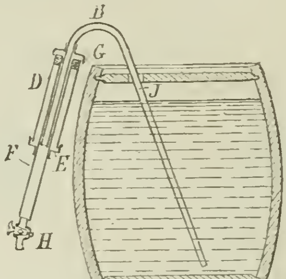
Various modifications, in which the apparatus is made to rotate, and other arrangements for stirring the liquid, are described.—O. H.

Improvements in Filtering Apparatus. W. P. Thompson, Liverpool. From M. Sonnenschein, Vienna, Austria. Eng. Pat. 1124, January 18, 1893.

Closed chambers made of filtering material are joined at their lower ends to a tube through which the filtered liquid can be withdrawn, and are inserted in an open cistern containing the liquid to be filtered. The tube is made in the shape of a siphon, by the action of which the liquid is drawn through the filtering material, leaving the impurities deposited upon the outer surfaces of the chambers.—B.

Improvements in Siphons. J. W. Micheel, Duisburg, Germany. Eng. Pat. 1347, January 21, 1893.

This is an invention for mechanically starting a siphon for drawing off liquid from casks, instead of as usual starting it by human inhalation.



To the outer leg of the siphon is attached the cylinder D, closed at its lower end by the cover E, through the centre of which passes loosely the tube F, surrounding the short siphon leg and carrying at its upper end a piston which fits closely in the cylinder D. The lower end of the tube has the stop-cock H, which is opened when the siphon is first inserted in the cask. Upon closing it and pulling the tube downwards the liquid is drawn into the siphon and flows out upon the opening of the cock.—B.

Method of and Apparatus for Heating or Evaporating Liquids. E. Herz, Vienna, Austria. Eng. Pat. 1467, January 23, 1893.

In this apparatus a number of vertical hermetically sealed tubes, each containing a small quantity of liquid, are inserted with their lower ends into a furnace, whilst their upper ends rise into the vessel which holds the liquid to be evaporated.

On the lower parts of the tubes being heated the greater portion of the liquid contained within them is turned into steam, which, rising into the upper parts, gives up its heat to the liquid contained in the said evaporating vessel, thereby being itself condensed and falling back into the lower ends of the tubes for re-evaporation. The quantity of liquid contained in each tube is calculated with regard to the heating surface so as never to be entirely evaporated, thus preventing the over-heating of the steam produced therein.—B.

Apparatus for Preventing Spontaneous Ignition or Combustion of Readily Combustible Materials. C. von Balzberg, Ischl, Austria, and B. Egger, Vienna. Eng. Pat. 1587, January 24, 1893.

This apparatus is intended to be placed in the midst of substances liable to spontaneous ignition, such as coal, to indicate any dangerous rise of temperature.

An iron cylinder, filled with oil, mercury, zinc, or other substance more expansible by heat than the cylinder, is closed at each end by an elastic diaphragm of hammered cast steel, secured in place by covers. The lower cover is fitted with a screw bearing against the centre of the diaphragm, with a head divided into degrees, and provided with an index. By means of this screw the apparatus can be set to act at any required temperature. At the upper end the cylinder is connected by a steel pipe of narrow bore. The other end of the pipe carries a valve with a reservoir containing liquid carbonic anhydride, the spindle of which bears against the upper steel diaphragm; this valve is normally closed by a spring in a small chamber above, provided a powerful whistle. If the diaphragm is forced up by the expansion of the oil, the spindle is raised, opening the valve into the small chamber, and the gas rushing in blows the whistle. Simultaneously, the pressure of the gas being relieved, a spring-supported plug fitted into the side of the horizontal pipe rises slightly and makes contact with a metal strip arranged to actuate an electrical alarm. Meanwhile the out-rush of gas cools the materials around by its absorption of heat, and as the apparatus cools, the valve closes, and the passage of the gas ceases.—E. S.

II.—FUEL, GAS, AND LIGHT.

On the Point of Ignition. A. Mitscherlich. Ber. **26**, 160—164.

The author, on the strength of some thousands of observations, comes to the following conclusions with regard to the ignition-point of a gaseous mixture of hydrogen and oxygen.

The point of ignition of hydrogen and oxygen mixed in various proportions is within the limits of the experiments described, as nearly as possible 674° C. These experiments (for which the original paper must be consulted), were carried out under a great variety of conditions numbered in the original paper 1 to 11 and gave practically

the same result, no matter what form of vessel was used, independently of the manner in which the gases were prepared (so long as they are pure), independently of the influence of light, of the protracted influence of heat below the point of ignition, and of the motion of the gases.
—K. E. M.

Ignition Temperatures of Explosive Gaseous Mixtures. V. Meyer and F. Freyer, Chem. Ges. zu Heidelberg. November 18, 1892. Chem. Zeit. 16 (1892), 1808.

The authors have already shown that the ignition temperature of electrolytic gas when flowing slowly, is between 650° and 730°, whereas when the gas is at rest in a closed bulb it ignites at 606°; for obtaining the fixed temperatures necessary in these experiments, stannous chloride, zinc bromide, and zinc chloride boiling at 606°, 650°, and 730° respectively were employed.

The ignition temperatures of a number of other explosive gaseous mixtures, prepared by mixing the several gases named below with an equivalent quantity of oxygen, have now been determined with the following results:—

——	Flowing freely.	In Closed Vessels.
Hydrogen....................	650°—730°	About 606°
Methane.....................	650°—730°	„ 606°—650°
Ethane	606°—650°	„ 530°—606°
Ethylene	606°—650°	„ 530°—606°
Carbonic oxide...............	650°—730°	„ 650°—730°
Hydrogen sulphide	315°—320°	„ 250°—270°
Chlorine detonating gas (H_2+Cl_2).	430°—440°	„ 240°—270°

The striking fact that slowly flowing electrolytic gas ignites with much greater difficulty than the same gas in a state of rest, is borne out by the behaviour of six out of the above seven gaseous mixtures. That this difference is in no way dependent on unequal heating was proved by special experiments; the flowing gaseous mixture moves so slowly that its temperature is the same as that of the gas at rest. That the difference is not due to a difference in pressure is shown by the fact that electrolytic gas, when at rest in an open vessel, ignites at the same temperature as when it is placed in a sealed vessel, although the pressure in the latter rises to several atmospheres. Possibly this interesting phenomenon is due to vortex formation, which may take place in a different way under different conditions.—F. S. K.

Examination of "High flash-point" Burning Oils (Safety Oils). R. Kissling. Chem. Zeit. 16, 1070.

See under XXIII., *page* 467.

PATENTS.

Improvements in Apparatus for and the Method of Preparing Peat or Turf for Use as Fuel. O. G. Blunden, Chiswick. Eng. Pat. 21,481, December 8, 1891.

The fibres of the peat can be cut and the mass compressed into hollow cylindrical blocks or tubes, so as to facilitate drying and aid combustion when used as fuel.

The peat is fed through a hopper into a cutting and compressing machine, from the end of which it is delivered in the form of the finished peat tube. The machine is cylindrical, tapering towards the delivery end, and provided with a revolving screw blade and cutting knives, the former of gradually decreasing diameter towards the end.

By means of suitable apparatus the continuous tube of peat thus delivered is divided into lengths. The peat tubes are supported during the drying process upon wires stretched in horizontal pairs, in such a way that they only come in contact with the wires at two points. The shape of these tubes and this arrangement, it is claimed, aid the drying process very materially.—D. A. S.

Improvements in the Manufacture or Production of Carburetted Hydrogen for Illuminating Purposes and Apparatus therefor. Professor V. B. Lewes, Greenwich, Kent. Eng. Pat. 21,598, December 10, 1891.

The apparatus is a combination of two furnaces. One of these, the "superheater," contains an upright iron retort into which the mixed gases produced in the other furnace pass, to be "fixed" at a higher temperature, maintained by the combustion of fuel in a superheating furnace, supplemented at intervals by gases coming from the furnace proper. A coil, conveying high-pressure steam from a suitable generator, may be cast in the wall of the retort, or embedded in an iron casing. The steam, highly superheated in the coil, is led by a suitable pipe to the adjoining furnace. This furnace is divided into three parts by two partition walls, reaching nearly to the top, forming openings. The central part is charged with fuel, such as coke, and into the other compartments, iron, or readily reducible iron compounds are placed, as described in Specifications No. 20,752 of 1890 (this Journal, 1891, 824) and No. 4134 of 1891 (this Journal, 1891, 824). A pipe for supplying liquid hydrocarbons (such as crude petroleum) enters the inner compartment, and branches fitted with injectors are connected to different parts of the chamber. The steam pipe from the superheating coil is connected to the oil-supply pipe, so that oil may be injected, and are connected to branches for supplying steam to the chambers charged with the iron. An air-blast pipe enters the central compartment and suitable cocks and valves are provided throughout.

When the fuel in the central chamber is brought to incandescence, the products of combustion, largely consisting of carbon monoxide and nitrogen, traverse and heat the outer compartments, where they exert a reducing action on any iron oxides previously formed, and pass on to the superheater, where any remaining carbon monoxide (with residual oil vapours from previous workings) assist combustion. When the proper temperature has been attained throughout, the air-blast is cut off, and the steam from the superheater operating the oil injectors, enters the iron-charged compartments forming hydrogen, which combines with the gases formed in the inner compartment by the joint action of the incandescent fuel and steam. The proportion of carbon monoxide in the resulting gases is thus greatly reduced by the hydrogen produced and the gases resulting from "cracking" the hydrocarbon oils. The gases thus produced pass on to the iron retort in the superheating furnace, where they are "fixed" by the high temperature. When the heat becomes too low for proper working, the steam is shut off, and the air-blast turned on, to repeat the first-described stage.—E. S.

Improvements in Arrangements for Treating Smoke and Fumes. H. Salmon, Leeds. Eng. Pat. 2908, February 15, 1892.

This apparatus is intended to treat smoke, fumes, or acid vapours. Two or more suitable fans or propellers are provided, one of which injects the smoke into the apparatus whilst the other forces in a stream or spray of water. The smoke thus driven down upon the second propeller is forced through water contained in a tank or cylinder.
—D. A. S.

An Improved Method of and Apparatus for the Treatment of Peat and the Conversion of Peat into Charcoal. T. Zohrab, London. Eng. Pat. 3619, February 24, 1892.

The peat is ground or pulped in a machine which also moulds the peat into any desired shape. It is then carried upon a travelling band working within a long tube or chamber into which either hot or cold air is injected. The peat when thus dried is in condition for charring.

Peat from the bog is placed in a mill of circular form provided with steel blades carried by a central vertical shaft and below the blades an Archimedean screw. The peat is delivered at the bottom in the form of blocks, and carried upon a travelling belt into a drying chamber. In the chamber there are endless belts, placed one above the other, so that the peat block falls from belt to belt, thus traversing the length of the chamber several times. At the end of each belt, and fixed to the side of the chamber, a thin wooden or iron bar causes the peat blocks to turn over in their fall. Pipes from a blowing engine enter the drying chamber at intervals, and hot or cold air can be injected as desired.

The charring ovens are of brick, into which the peat is introduced on a travelling carriage. The inventor claims that peat may be dried in this way at a cost low enough to make it commercially successful, that the final product can be used for blast furnaces, puddling furnaces, &c., instead of charcoal or coke.—D. A. S.

Improvements in self-regulating Apparatus for the Manufacture of Oil-Gas for Domestic and General Illuminating and Heating Purposes or for Motive Power.

J. Lee, Askrigg, Yorkshire, and S. Lancaster, Bainbridge, Yorkshire. Eng. Pat. 4922, March 12, 1892.

Liquid hydrocarbons of density not less than 0·7 are used to produce the required temperature in the "dissociator." An automatic device is proposed for controlling the production of gas in the machine.—E. S.

Improvements in the Manufacture of Peat Fuel.

G. Angel, Jönköping, Sweden. Eng. Pat. 4982, March 14, 1892.

The turf is heated in closed chambers, retorts, or kilns, without outlets for the gases, which may be evolved at a temperature of from 50° to 400° C. for from one to six hours, according to the quality of the peat. The apparatus is then cooled, or the fuel may be raked out and cooled.

The peat used should have been previously dried.

The inventor claims that "the fuel produced is more or less glossy and clean to the touch, and is nearly equal to coal, not only in appearance, but in warming power."
—D. A. S.

Improvements in or relating to the Treatment of Fuel.

W. D. Scott-Moncrieff, London. Eng. Pat. 6819, April 9, 1892.

In this process bituminous coal is subjected to the usual treatment for the production of coal-gas. The distillation, however, is stopped when the coal is in the most suitable condition for compression into a solid mass; the time will vary with the nature of the coal, but one-third to one-half of the usual time for complete distillation is sufficient. The coal is either removed from the retort through openings, into closed vessels or moulds of suitable size. The partially distilled coal thus obtained is subjected to a high pressure by suitable means. If the retort is of sufficient strength to resist the pressure applied to its contents the compression may be directly effected in the retort.

It is claimed that a fuel of great commercial value is thus produced of greater heating power than ordinary coal, and comparatively smokeless, while during the treatment the gases and by-products are preserved and utilised.—D. A. S.

Improvements in Apparatus for the Manufacture of Gas for Illuminating and Heating Purposes, applicable also for the Distillation of Liquid Hydrocarbons.

P. Dvorkovitz, Highgate, London. Eng. Pat. 7983, April 27, 1892.

Oil is vaporised in horizontal tubes contained in a chamber through which fire-gases pass, connected alternately end to end outside the chamber by short vertical pipes, so as to be continuous. At the top of the chamber, a horizontal pipe is connected to an external pipe provided with a valve, through which superheated steam may be admitted. Connections are made from a central and elevated horizontal pipe to a series of somewhat larger tubes than the cross tubes, set vertically in and communicating with two parallel horizontal pipes, of considerable diameter, set immediately over the fireplace. Any tar or condensed products drip into these two lower pipes, extending beyond the furnace at both ends, having at one extremity a valve by which the tar may be removed, and at the other extremity a flange and valve for connection to a pipe conveying water-gas from an independent source. Chambers, loosely packed with bricks distribute and fix the gases, and adjoin the compartment containing the tubular system. They are heated on all sides except on the top, whence the fixed gases issue. These chambers are open at bottom to the lower horizontal pipes, into which any tar produced drips. The heated oil vapour issuing from the tube system into these pipes, mingles there with the water-gas that enters, and the mixed gases then traverse the fixing chambers. The apparatus may be cleaned out by admitting superheated steam. If it is desired only to distil oils, water-gas is not admitted and a lower temperature is maintained, and superheated steam is admitted to meet the oil vapour in the upper horizontal tube, and assist the distillation. The oil vapour and steam pass from the apparatus to suitable condensers for separation. Eng. Pat. 13,089, 1891 (this Journal, 1892, 152).—E. S.

Improvements in Coke Furnaces.

F. J. Collin, Dortmund, Germany. Eng. Pat. 17,419, September 29, 1892.

This invention relates to coke furnaces in which the furnace-chambers are arranged in two rows, between which there are air- and gas-collecting channels. The coking chambers are arranged in an inclined position and taper towards the top. The bed-plate is less inclined at the lower than the upper portion, so that while the coke slides down of its own accord it is loosened, broken up and discharged in lumps or pieces, a sudden rush of the whole contents being thus avoided. An auxiliary chamber is arranged in front of each coking chamber, into which the coking gases enter through a vertical flue. From here they are conducted through channels or flues controlled by dampers into combustion chambers provided in the intermediate walls. Here the gases are mixed with the air required for combustion, and rise up through coil-shaped passages, from which they descend again into the channel below the bed-plate of the coking chamber. The air flues are so arranged that while air is being admitted into the one, the other is closed at both ends and only connected with the first by means of a vertical channel. Special precautions are taken to avoid thin flames (jet flames) by admitting predetermined quantities of the hot air, and by causing it to enter through perforated plates, thus ensuring an immediate and thorough mixture of gas and air.—D. A. S.

The Manufacture of an Improved Artificial Fuel.

H. Pazolt, Ramagen-on-the-Rhine, Germany. Eng. Pat. 21,914, November 30, 1892.

Twenty parts of coal-dust or powdered or granulated coal are mixed with one part of dolomite, marl, magnesite, burnt lime, gypsum, or the oxides or hydrated oxides of calcium or magnesium, either alone or in combination, and from one to five parts by weight of rice or sugar is added.

In some cases sulphuric acid, petroleum, or mineral oil is added. After thorough mixing the compound is moulded into blocks or briquettes by means of pressure.—D. A. S.

A Composition Suitable for Use in the Manufacture of Candles, Night Lights, and the like. T. S. K. Hawkhurst, New York, U.S.A. Eng. Pat. 2590, February 6, 1893.

The composition is a wax-like compound and consists of paraffin wax, sperm oil, and paraffin oils of the flash-points 150° and 300° F.—J. L.

Improvements relating to the Manufacture of Gas and to Apparatus therefor. J. Askins, Lima, U.S.A. Eng. Pat. 2716, February 7, 1893.

Hydrocarbon vapours or gases are led into a water-gas generator or furnace, in the upper part of which the gases are combined and "fixed," taken off by a pipe opposite the hydrocarbon vapour inlet to a scrubber or receiver, or directly for consumption. The furnace has a valved outlet in the roof for the exit of the gases while the coke is being raised to incandescence. This is closed when water-gas is produced by admission of steam into the body of the burning coke, and the hydrocarbon vapour or gas is then admitted immediately below the roof. Tiles arranged to meet centrally, are built vertically into the walls of the upper part of the furnace, with spaces between of about three inches. The tiles are cut away in front of the inlet and outlet pipes, and are perforated for the horizontal passage of the vapours or gases, which thus encounter and mingle with transverse currents of water-gas rising between the highly-heated tiles. The vapours and gases thus become fixed before passing out through the opposite outlet pipe. The fixing apparatus is also shown in a modified form, the tiles being replaced by refractory checker brickwork.—E. S.

Improvements relating to the Generation of Gas from Water, Steam, and the like, and to Apparatus therefor. W. G. Bedford, Philadelphia, U.S.A. Eng. Pat. 4225, February 25, 1893.

The apparatus described, is a cylindrical vessel having an upper "receiver" wide at the top and converging to a reduced diameter at the bottom. Placed opposite is a similar conical receiver admitting the liquid or vapour to be electrolysed at its base, and with an apex cut off so as to leave space for the entrance of a bolt, screwed into the bottom of the upper receiver, but entering the lower "cap" or receiver without contact. A series of cylindrical plates, are secured to supports from the upper cap in electrical contact therewith, and also to insulated supports connected to the lower cap. Alternating with these are other similar plates, in contact with the lower cap, but making no contact at top. The two series of plates form electrodes, the electricity being "brought from without"; or the apparatus produces "its own electricity." Steam water with or without an acid, "anything containing sodium, magnesium, potassium, or zinc," or potassium iodide may be treated in the apparatus, hot water being used. When water or steam is electrolysed, both oxygen and hydrogen pass into the upper cap through openings, and are taken from the dome. It is stated that "with care" the gases "may be kept separated in this generator."—E. S.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

PATENTS.

Improvements in Apparatus for Distilling Mineral or other Tars, Hydrocarbons, or other analogous Liquids. J. A. Yeadon and W. Adgie, both of Leeds, Yorkshire. Eng Pat. 5238, March 16, 1892.

In Specification 19,183, 1889 (this Journal, 1890, 797), the same inventors describe a "revolving retort working with fixed and closed or gas-tight end-plates or mouthpieces for feeding and discharging," &c. The present invention adapts the before-described apparatus to the distillation of tar, or of tar and coal, or of other liquids capable of replacing tar so as to obtain gases for heating or illuminating.

In distilling tar and coal, according to the former specification, the coal is delivered into a hopper, from the bottom of which it is taken by blades or worms into the interior of the retort. A pipe fitted with a tap is now added, and delivers the tar from an elevated reservoir to the worm-box through which the coal travels, with which it passes into the retort. When tar or other analogous liquid is to be distilled, the shaft and blades are replaced by an internal pipe, connected through a gland and stuffing-box to a pipe fitted with a valve, leading from the reservoir, projecting some distance into the retort, and provided with orifices or jets. The retorts are preferably made of metal, with internal ribs, and when tar or oils are to be distilled, cross-ribs are cast with them. An ascension pipe for the gases produced, arrangements for discharging the cinders through a tapering outlet, and other arrangements are shown. For liquid tailings or refuse a discharge shaft is dispensed with, the outlet being fitted to a pipe dipping into water in a tank, making a water-sealed joint.—E. S.

Improvements in Purifying Anthracene and Anthraquinone. B. Willcox, London. From the "Farbenfabriken vormals Friedrich Baeyer and Co.," Elberfeld, Germany. Eng. Pat. 5539, March 21, 1892.

Crude anthracene is treated in closed or open vessels, preferably the former, with liquid sulphur dioxide, which only attacks the anthracene slightly, whilst it dissolves away the impurities. 30 per cent. anthracene treated with an equal weight of sulphur dioxide leaves a residue containing about 50 per cent. of crude anthracene; almost 60 per cent. of the material is dissolved, the dissolved portion containing only about 2 per cent. of anthracene. By employing a greater proportion of sulphur dioxide the percentage of anthracene in the purified material is considerably increased and but little more anthracene itself goes into solution. With four times its weight of liquid sulphur dioxide 30 per cent. anthracene can be brought up to 70—80 per cent. Impure anthraquinone can be similarly purified by sulphur dioxide, in which anthraquinone itself is practically insoluble, whilst the impurities are readily dissolved. This process is cheaper than the purification by means of hydrocarbons or other organic solvents, yields a purer product. can be employed at low temperatures, and allows of the ready recovery of the solvent.—C. A. K.

Improvements in Apparatus for the Manufacture of Gas for Illuminating or Heating Purposes, applicable also for the Distillation of Liquid Hydrocarbons. P. Dvorkovitz, London. Eng. Pat. 7983, April 27, 1892.

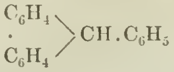
See under II., *page* 438.

IV.—COLOURING MATTERS AND DYES.

Contributions to our Knowledge of the Fluoresceïn Group. R. Meyer and E. Saul. Ber. **25**, 3586—3590.

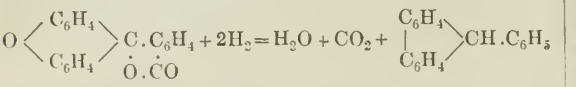
The authors allude to a previous paper on the subject (R. Meyer and H. Hoffmeyer, Ber. **25**, 2118) describing a substance crystallising in colourless needles melting at 145° which was obtained by distilling hydrofluoranic acid with baryta or soda-lime or fluorane with soda-lime and zinc-dust. The reaction in the case of fluorane has been further investigated, and they have obtained about 12 grms. of a yellowish-red crystalline distillate by distilling 50 grms. of fluorane with six times its weight of zinc dust and of soda-lime, using about 20 grms. of fluorane at a time.

Repeated crystallisation of the distillate from alcohol and addition of animal charcoal gave a substance with a constant melting-point of 145°, which analysis and an examination of its properties showed to be *Diphenylene-phenylmethane*—



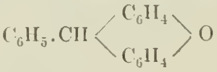
$$\begin{matrix}C_6H_4\\ \cdot\\ C_6H_4\end{matrix}>CH.C_6H_5$$

When dissolved in fuming nitric acid and water is added, a nitro compound separates as a yellow flocculent precipitate. If this is dissolved in alcohol and ammonia is added a greenish-blue colouration is produced. By oxidising the diphenylene-phenylmethane with bichromate and sulphuric acid it yields *o*-benzoylbenzoic acid which crystallises from water in long needles melting at 92°—94° C. or anhydrous at 126°—128°. The formation of diphenylene-phenylmethane by distillation of fluorane with zinc-dust and soda-lime takes place according to the following equation—



$$O<\begin{matrix}C_6H_4\\ C_6H_4\end{matrix}>\underset{O.CO}{C.C_6H_4}+2H_2=H_2O+CO_2+\begin{matrix}C_6H_4\\ |\\ C_6H_4\end{matrix}>CH.C_6H_5$$

This reaction gives a direct proof of the relation of the fluoresceïn group to the triphenylmethanes, which hitherto had only been proved directly in the case of phenolphthaleïn. By distilling fluorane with zinc-dust only, a mixture of at least three substances is obtained. The best characterised of these is *Diphenylene-phenylmethane oxide*—



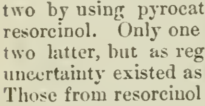
$$C_6H_5.CH<\begin{matrix}C_6H_4\\ C_6H_4\end{matrix}>O$$

which crystallises from boiling alcohol in needles melting at 135°—137°. It is very easily soluble in ether and benzene with a yellow colour and no fluorescence. It is scarcely soluble in cold concentrated sulphuric acid, but on warming, a yellow solution with a green fluorescence is produced. The second substance was purified by crystallisation from methyl alcohol, forming golden-yellow plates melting at 150°—152° C., very easily soluble in ether, with a strong yellowish-green fluorescence. Cold concentrated sulphuric acid dissolves it to a cherry-red solution. If the substance be sublimed it forms a green fluorescent vapour, a phenomenon which is also observed during the distillation of the fluorane with zinc-dust. The third substance crystallised in needles, but was obtained in such a small quantity that it had not been investigated. At the conclusion of the paper mention is made of crystalline phenylhydrazine compounds which have been obtained from fluorane and diphenylphthalide; these are to be described later.—T. A. L.

The Constitution of the Mono-oxyxanthones. E. Dreher and St. v. Kostanecki. Ber. 26, 71—78.

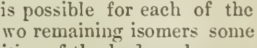
The analogy, pointed out by one of the authors, subsisting between the oxy-xanthones and certain yellow colouring matters of vegetable origin, led the authors to a close investigation of the hydroxy derivatives of xanthone.

Of the four possible hydroxy-xanthones, two are obtained by condensing salicylic acid with resorcinol, and the other two by using pyrocatechol and hydroquinone in place of resorcinol. Only one formula is possible for each of the two latter, but as regards the two remaining isomers some uncertainty existed as to the position of the hydroxyl group. Those from resorcinol have the constitutional formulæ—



I.

and



II.

and have hitherto been known as α- and β-hydroxy-xanthone. They possess very different properties, and by comparing these properties with those of a substance obtained from salicylic acid and such a homologue of resorcinol that only one hydroxy-xanthone could be formed, it would be possible to discriminate between the two formulæ. The homologue employed was *m*-xylorcinol (1.3.4.6).$C_6H_2(CH_3)_2(OH)_2$, which was distilled with salicylic acid and acetic anhydride in small quantities from a retort. Yellow needles collected in the neck of the retort, which were dissolved in alcohol and a deep yellow sodium salt insoluble in boiling water precipitated by adding soda-lye to this solution. The hydroxy-dimethyl-xanthone which is formed crystallises in long shining yellow needles, melts at about 160° C., is more difficultly soluble in alcohol than xanthone, and in its properties closely resembles α-hydroxy-xanthone. In the preparation of 4-hydroxy-xanthone a by-product is obtained which has been recognised as a di-xanthone. It crystallises from glacial acetic acid in long white needles melting at 317° C., and dissolves in concentrated sulphuric acid with a yellow colour and greenish fluorescence. Experiments have also been made in methylating the hydroxy-xanthones, and it has been discovered that 1-hydroxy-xanthone does not yield a methyl ether, whilst the other three isomerides do.

The iso-euxanthone, which is 1·3-dihydroxy-xanthone, was also methylated, but only gave iso-euxanthone monomethyl ether $C_{13}H_6O_2(OCH_3)(OH)$, a substance crystallising from glacial acetic acid in needles melting at 145° C. The paper also contains speculations as to the influence of the relative positions of the hydroxyl and carbonyl groups on the colours of the hydroxy-xanthones and of their sodium salts, and also as to the conclusions which may be drawn from the non-methylation of some of the hydroxyl groups.—T. A. L.

PATENTS.

Manufacture of Azo Colouring Matters derived from Paraphenylenediamine. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 8270, May 2, 1892.

These colouring matters, which are dyestuffs for wool, giving shades ranging from violet to blue, are derivatives of *p*-nitraniline and its homologues. The latter substances, after diazotisation, are combined with certain naphthol or dihydroxynaphthalene sulphonic acids and the resulting nitro azo colouring matters reduced by means of alkaline reducing agents. In the place of *p*-nitraniline the monoacetyl derivative of *p*-phenylene diamine may be employed. In this case the colouring matter obtained instead of being subjected to alkaline reduction is saponified preferably by means of caustic soda. The colouring matters obtained according to either of these two methods contain a free amido group and are strongly basic in character; moreover, they can be diazotised and yield tetrazo dyestuffs. By combining *p*-nitrodiazobenzene with a dihydroxynaphthalene disulphonic acid there results the compound—

$$O_2N.C_6H_4.N:N.C_{10}H_3(OH)_2(SO_3Na)_2$$

which on alkaline reduction, preferably with sodium sulphide, yields $H_2N.C_6H_4.N:N.C_{10}H_3(OH)_2(SO_3Na)_2$. The same compound after saponification is obtained by combining *p*-diazo-acetanilide with dihydroxynaphthalene disulphonic acid, which gives first—

$$CH_3CO.HN.C_6H_4.N:N.C_{10}H_3(OH)_2(SO_3Na)_2$$

and on boiling with caustic soda the compound mentioned above. The homologues of *p*-nitraniline, which are described as being suitable for the purposes of this invention, are: nitro-*o*-toluidine melting at 134° C., nitro-*p*-xylidine melting at 143° C., and the monoacetyl derivatives of *p*-phenylene diamine, of toluylene diamine melting at 64° C., and of xylylene diamine melting at 104° C. These compounds after diazotisation are combined with (1) dihydroxynaphthalene sulphonic acid obtained from the α-naphthol disulphonic acid S of Ger. Pat. 40,571 by fusion with potash; (2) dihydroxynaphthalene disulphonic acid obtained from α-naphthol trisulphonic acid of Ger. Pat. 56,058 by fusion with potash; (3) dihydroxynaphthalene disulphonic acid obtained by fusing with potash the α-naphthol trisulphonic acid S, which is formed by sulphonating the α-naphthol disulphonic acid S of Ger. Pat. 40,571; (4) amido-naphthol disulphonic acid obtained by fusing with potash the naphthylamine trisulphonic acid of Ger. Pat. 56,058.—T. A. L.

Manufacture of Dialkylised Meta-methoxy-, meta-ethoxy- and Meta-benzyloxy-para-amido-benzophenones. O. Imray, London. From the "Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 8269, May 2, 1892.

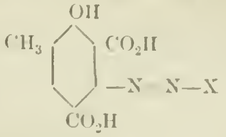
The substances mentioned in the title are prepared by condensing the benzanilides of *m*-methoxy-, *m*-ethoxy-, or *m*-benzyloxy-benzoic acid with phosphorus oxychloride and a tertiary amine, such as dimethylaniline, and decomposing the phenylated auramine thus obtained by boiling it with dilute acids. The benzanilides are prepared by heating *m*-methoxy-, ethoxy-, or benzyloxy-benzoic acid with aniline, or by methylating, ethylating, or benzylating *m*-hydroxybenzanilide. The following compounds are then obtained:—*m*-methoxybenzanilide, white needles melting at 120° C., easily soluble in alcohol and hot benzene, sparingly soluble in cold benzene; *m*-ethoxybenzanilide, white needles melting at 104° C., easily soluble in alcohol, sparingly soluble in benzene; *m*-benzyloxybenzanilide, white needles melting at 112° C., easily soluble in alcohol, sparingly soluble in benzene. When these compounds are treated and decomposed in the manner described above they form the following compounds:—*m*-methoxy-*p*-dimethylamidobenzophenone, yellowish-white needles melting at 67° C., easily soluble in water and very easily soluble in benzene. This compound is a very weak base soluble in strong hydrochloric acid, but entirely precipitated by water; *m*-methoxy-*p*-diethylamidobenzophenone, white needles melting at 121° C., scarcely soluble in hydrochloric acid, very easily soluble in alcohol, and moderately soluble in benzene; *m*-ethoxy-*p*-dimethylamidobenzophenone, greenish-white needles melting at 90° C., very easily soluble in benzene, moderately soluble in alcohol, and soluble in strong hydrochloric acid, but reprecipitated by water; *m*-ethoxy-*p*-diethylamidobenzophenone, greenish-white needles melting at 104° C., is a non-basic substance easily soluble in alcohol and very easily soluble in benzene; *m*-benzyloxy-*p*-dimethylamidobenzophenone, greenish-white needles or plates melting at 86° C., very easily soluble in benzene, less so in alcohol, soluble in strong hydrochloric acid, but reprecipitated on the addition of water.—T. A. L.

Improvements in the Manufacture of Alpha-Oxyuvitic Acid. J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Dresden, Saxony. Eng. Pat. 8455, May 4, 1892.

Dry potassium *o*-cresolate is heated under pressure to about 220° C. and dry carbonic acid passed in until the melt is saturated. It is then allowed to cool, dissolved in water, and the α-hydroxyuvitic acid, which melts at about 290° C., is precipitated by means of hydrochloric acid. It has the formula [1.2.3.5]$C_6H_2.CH_3.OH(CO_2H)_2$, and is the sole product of the reaction at temperatures above 210° C. At temperatures below 160° C. *o*-cresol carboxylic acid [1.2.3]$C_6H_3.CH_3.OH.CO_2H$ is formed. Other alkaline salts of *o*-cresol may be employed in place of the above-mentioned potassium salt, and the reaction will also proceed at atmospheric pressure, but in this case the yield is small.—T. A. L.

Improvements in the Manufacture of Colouring Matter from Alpha-Oxyuvitic Acid. J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Dresden, Saxony. Eng. Pat. 8456, May 4, 1892.

In the case of phenols when the para and both ortho positions to the hydroxyl are occupied, it has generally been assumed that these bodies are incapable of reacting with diazo compounds. Alpha-hydroxyuvitic acid (see preceding abstract) appears to form an exception, as it is said to react with diazo compounds as easily as phenols, salicylic acid, and such like bodies do, and these compounds are described as being the first representatives of a new group of *m*-oxyazo compounds having the constitution—



where X designates the radicle of a primary amine. By combining tetrazodiphenyl with α-hydroxyuvitic acid a colouring matter is obtained which dyes unmordanted cotton yellow. The combinations may be varied in the well-known manner.—T. A. L.

The Manufacture and Production of New Basic Dyestuffs. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 9633, May 20, 1892.

These dyestuffs are prepared by further alkylation of the dialkyl rhodamines either by passing dry hydrochloric acid gas through a solution of the rhodamine in ethyl or methyl alcohol, or by heating the rhodamine hydrochloride with alcohol under pressure, or else by using the rhodamine base and heating it under pressure with methyl or ethyl alcohol and methyl or ethyl chloride. The new dyestuffs so obtained are said to be stronger colours, to have more affinity for the fibre, and to be more soluble in water than the original rhodamines.—T. A. L.

The Manufacture of New Basic Colouring Matters of the Auramine Class, and of New Materials for Use therein. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,465, June 1, 1892.

By condensing two molecules of methyl-*o*-toluidine with formaldehyde, dimethyl-diamido-di-*o*-tolylmethane is obtained, which is to be employed for producing an auramine dyeing greener shades of yellow than that hitherto known (Eng. Pat. 5512 of 1884; this Journal, 1885, 279). The condensation is performed by means of hydrochloric acid, and the new base is purified by recrystallisation from alcohol or petroleum spirit and melts at 87° C. In order to prepare the auramine, about 25·5 kilos. of the dimethyl-diamido-di-*o*-tolylmethane, 6·5 kilos. of sulphur, 240 kilos. of salt, and 14 kilos. of ammonium chloride are heated in a closed vessel, provided with an agitator, to about 175° C., ammonia gas being passed in under a slight pressure for about 7—8 hours. The melt is then extracted with cold water, and the residue dissolved in water at about 80° C., the solutions filtered, and the colouring matter precipitated with salt, after which it is filter-pressed and dried. It dyes cotton mordanted with tannin and tartar emetic a pure greenish-yellow shade.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Preparation and Properties of Fibroïn. L. Vignon. Comptes rend. **115**, 17, 613—615.

The average amount of fibroïn contained in the silk of *Bombyx mori* has been variously given by different experimenters. Mülder, who prepared it by treating the raw silk with boiling acetic acid, considered it to represent 53—54 per cent. of the whole. Städler found 42—50 per cent. by acting on the silk with a 5 per cent. solution of caustic soda at the ordinary temperature. Cramer, heating the silk with water at 133°, obtained 66 per cent.; and Francezau, by boiling twice with soap and then treating with acetic acid, 75 per cent. In view of these discordant results it has been deemed desirable to again investigate the matter.

The method of preparation adopted by the author was as follows:—A skein of raw, white silk weighing about 10 grms. was boiled in a solution of 15 grms. of neutral soap in 1,500 cc. of water for 30 minutes. Then it was rinsed successively in hot and tepid water to remove the soap, hydro-extracted, and submitted to a repetition of this treatment, a fresh bath of soap being used, in which the silk was immersed for 20 minutes, and after the subsequent rinsing in water, the skein being passed through dilute hydrochloric acid, then again rinsed in water, and finally washed twice with 90 per cent. alcohol. Thus purified, the fibre contains about 0·01 per cent. of mineral matters (the raw silk contains an average of 0·8 per cent.). It is very brilliant, white, and soft, and is considered to be fibroïn. It amounts on an average to 75 per cent. of the raw silk.

The percentage composition of fibroïn is: C, 48·3; H, 6·5; N, 19·2; and O, 26·0. Its density is about 1·34. It dissolves in concentrated hydrochloric acid, forming a strongly lævo-rotatory solution. On adding more fibroïn to this solution a viscid, transparent mass, resembling the contents of the silk-gland of the worm, is obtained. From the solution alcohol precipitates a coagulum of fibroïn, which, when dried, appears like dry, coagulated albumen. In this condition it is without lustre, but it retains unchanged its composition, density, action on polarised light, and dyeing properties.—E. B.

PATENTS.

A Process for the Manufacture of Cellulose Wadding. J. Feirabend, Niedernhausen, Prussia. Eng. Pat. 3061, February 19, 1891.

Wood-pulp is beaten up with water into an attenuated condition. The turbid liquid is run on to a wire-cloth strainer, and the wet tissue taken from this on to a drying cylinder. The dry cobweb-like mass is wrapped round a revolving drum until a sufficient thickness is attained. It is then removed and cut into slabs as desired.—R. B. B.

Improvements in Machinery employed in the Manufacture of Wood-Wool. J. H. C. Martin, Kent. Eng. Pat. 8230, May 13, 1891.

The main feature in this invention is a feed-trough fixed with an inclined bottom, and having an outlet suitably inclined from the bottom of the trough, say at an angle of 45°. The wood is placed in the trough on its edge, with its length across the same; the cutting knives work against the inclined face of the feed-trough, and move to and fro in the direction of the grain of the wood, but cut only on the downward stroke. The trough is filled with the wood, and is provided with a number of teeth or scoring knives so as to slightly enter the wood. By this and other devices the wood is held close up to the cutter. The feeding arrangement is also part of the claim. By this process wood is stated to be cut almost entirely into wool.—Ed. T.

Improvements in Apparatus for Drying Mungo and the like, and for Facilitating the Removal of Vegetable Materials contained therein. H. Schirp, Barmen, Germany. Eng. Pat. 5301, March 17, 1892.

The wet shoddy, mungo, &c., is passed through a series of chambers, in an opposite direction to a current of hot air, and transferred from one chamber to the next by means of rakes or by carrier bands. On coming out from the last chamber the material almost dry is received on a perforated table, through which hot air passes from beneath, and the drying is thus completed. The dry material is put through rollers in order to crush any vegetable substance remaining in it, which can then be separated by shaking.—R. B. B.

Improvements in the Method of and Apparatus for Washing Fibrous Materials. J. Reddihough and J. W. Clough, Bradford, Yorks. Eng. Pat. 9572, May 20, 1892.

The pressers for squeezing the fibre in the washing trough are each connected to a crank by a rod provided with a spiral spring. This allows the presser to yield and the pressure on the material is thus suited to its varying quantity or thickness. A motion is also imparted to the pressers whereby the fibre is caused to pass forward in the direction of the flow of the washing liquid, thus avoiding choking of the fibre and consequent stoppage of the machine.—R. B. B.

Improvements in Treating Bast and Wood for obtaining therefrom Fibre suitable for being Spun or Woven. A. Törngren, Tammerfors, Finland. Eng. Pat. 2989, February 10, 1893.

By successive treatment with various solutions the bast is deprived of its phosphoric acid, sulphates, and siliceous compounds.

The phosphoric acid constituents are dissolved out by dilute sulphuric acid at 30°—40° C. Sulphates, chiefly calcium sulphate, are removed by immersing in a bath containing common salt, with or without the addition of ammonium chloride. The silicates are rendered soluble and removed by a solution of bleaching powder. Between each stage of the treatment the bast is rinsed with water, and after the chlorine bath a final washing takes place with the addition of a small quantity of caustic alkali or soap. This is succeeded by breaking and heckling as in the treatment of flax.—R. B. B.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

Dyeing and Printing by Means of the Salts of Gold. E. Odernheimer. With report on same by R. Lussy. Bull. Soc. Ind. Mulhouse, 1892, 529—539.

Two papers on the subject are given and a report by M. Lussy on the author's experiments. The author's results are set forth in the first paper as follows:—

(1.) *Grey Colours.*—These form the basis for the subsequent production of "Golden purple" on the fibre. The textile fabric is steeped in, or printed with an aqueous solution of a salt of gold, preferably a double salt such as the chloride of gold and sodium. After drying, it is passed through a reducing bath, and there is instantly precipitated upon the fibre finely-divided metallic gold possessing a pearl-grey colour which is very fast, and remains unaltered by acids and alkalis. The fibre itself, by virtue of its reducing power, tends to cause separation of the gold, but the precipitation with reducing agents is more certain and complete. The reaction takes place in the cold, but is accelerated by warming and by the action of sunlight. By varying the concentration of the gold solution the depth of colour is modified.

Reducing Agents.—Pyrogallic acid and hydroquinone yield bluish-greys, oxalic acid a grey of a more violet-red tone. Other reducing agents, *e.g.*, ferrous sulphate, may be employed.

The extremely fine state of division of the gold and its considerable colouring power allow of a beautiful shade of grey being obtained with very small quantities of gold. Thus, for dyeing 200 grms. of half-silk the following amounts are sufficient.

(*i.*) *Gold Bath.*—0·2 grm. double chloride of gold and sodium in ½ litre water.

(*ii.*) *Reducing Bath.*—0·5 grm. of oxalic acid in ½ litre of water. Silk is easily dyed in the cold; for wool, cotton, linen, &c., the bath must be heated. Previous mordanting with metallic salts modifies the shade, with copper sulphate greenish-greys are produced, with tin salts darker and browner shades.

(2.) *Fixing of "Golden Purple," "Golden Pink," and of Gold with Metallic Reflection on the Fibre.*—When the fabrics dyed grey as described above are pressed with a hot iron, a beautiful red with a metallic lustre is developed at the points of contact, the darker greys change to dark purple-red, and the pale shades to pink. Designs in two or three shades of red, and red designs on a white or grey ground, can be thus formed, the hot metal being applied to those parts which are to form the design.

Another Method.—Fabrics impregnated with a gold solution are heated with a solution of oxalic acid or an oxalate. Reds and violet-reds are thus produced.

All the colours, greys and reds alike, when once fixed, are absolutely fast to light and to soap, and are not affected by acids nor alkalis.

The second paper consists partly of a historical notice or brief summary of the previous attempts made to fix gold upon the fibre, by von Schüle, Kastner, Elsner, and others. It appears that processes for precipitating metallic gold upon the fibre by reduction of solutions of its salts were known and carried out previous to the French Revolution.

Besides a repetition of much in the first paper the author makes several further statements.

The red is obtained on silk without subsequently applying heat, the precipitate forming at 100°—110° C.

The application of these methods by hand-printing is difficult because the gold solution is reduced by the thickening, even in the cold. The best result is with a mixture of Senegal gum, glycerin, and gold solution.

Another Method of Dyeing.—The gold solution is reduced by the addition of gum, and the fibre is dyed in this solution. The gold is deposited very evenly, but the affinity of the separated gold for the fibre is very feeble, and is increased by the addition of oxalic acid.

By applying a hot iron for a considerable time to the purple-dyed fabric, the purple is transformed into lustrous metallic gold.

Several other methods of producing the purple are reviewed. Müller reduced the gold solution with glucose, Vitalis produced a lilac on cotton with gold chloride and stannous chloride, and Lapouraille dyed silk lilac by treating with a dilute gold solution and exposing to sunlight (Elsner, Chem. Tech. Mittheil, 1861—1862, 51). It is therefore not only stannous chloride which is capable of forming the purple precipitate with salts of gold. The grey colour obtained as described in the first paper is immediately destroyed by chlorine. This reaction can be made use of to produce a white pattern on a grey ground, it being sufficient for this purpose to print on the grey fabric, MnO_2 and gum solution, afterwards passing through dilute hydrochloric acid.

M. Lussy in his report states that he has verified the correctness of the above results as regards silk, but that the shades obtained on wool and cotton are not so pure, while cotton requires a gold solution four times as concentrated as for silk. The printing results are not so good because the thickening acts upon the colour. A very pure gum is necessary to obtain a red or pink on the fibre. The reduction of the gold solution is accomplished most readily by phosphoretted hydrogen; with hydrogen the action proceeds much more slowly. The printed or dyed fabrics must be passed into phosphoretted hydrogen while still wet.

The purple colour can only be transformed into metallic gold at a temperature of 240°—260° C.—R. B. B.

The Tendering of Fibres in the Production of White Discharges on Vat Indigo-Blue. A. Scheurer. Bull. Soc. Ind. Mulhouse, 1892, 540—541.

In a previous paper (Bull. Soc. Ind. Mulhouse, 1892, 278) the author stated that the addition of glycerin to the acid-bath, employed in the production of the discharge, lessened the tendering effect of the acid upon cotton. The accuracy of this statement having been questioned (Färb. Zeit. June 15, 1892; this Journal, 1892, 904), he has made further trials and finds it necessary to modify the previous conclusions. The following experiment was made:—Two pieces of cotton A. and B. were dyed a vat indigo-blue and printed with the following mixtures:—

A. { 40 parts potassium bichromate.
160 parts neutral potassium chromate.
800 parts gum solution.

B. { 50 parts potassium bichromate.
300 parts neutral potassium chromate.
650 parts gum solution.

The blue ground on A. was just discharged on subsequently passing through a bath containing 50 grms. oxalic acid and 50 grms. sulphuric acid, and made up to 1 litre with water Pattern B. was passed, after printing, through a similar bath to which 60 grms. glycerin was added. Both patterns were boiled with sodium carbonate, and tested with the dynamometer.

Results:—

	Resistance.
All blue fabric	100
Pattern A.	65
Pattern B.	64

The conclusion is that when the printing mixture is only just sufficiently concentrated to discharge the blue, the addition of glycerin does not prevent tendering of the fibre. In the previous experiments it was found that when the mixture is more concentrated than this, the tendering effect is lessened by introducing a certain proportion of glycerin or of a similar substance. The same effect is not produced by making the acid-bath more dilute.

It is impossible to regulate the printing mixture, on the large scale, so as just to furnish the required amount of chromic acid; it is therefore necessary to employ a mixture a little too strong. The chief objection to this is a slight tendency of the colour to "run" in the acid-bath, but the presence of glycerin obviates this defect.—R. B. B.

Production of Colours on Textile Fibres by means of Uranium Salts. Report by P. Werner on an essay sent for competition for the Society's prize. Bull. Soc. Ind. Mulhouse, 1892, 542—544.

The author of the essay, after reviewing the present industrial applications of uranium compounds, proposes to produce on fibres by means of these compounds yellow and brown colours. The yellow is obtained by steeping in uranium nitrate solution, and converting this into the hydrate by contact with a hot surface. The shade may vary from light yellow to orange-yellow. For the brown shade the fibre, after steeping in uranium nitrate, is worked in a hot solution of pyrogallic acid or of potassium ferrocyanide.

M. Werner states that a bright, full yellow is obtained only on the silk fibre. The colours leave much to be desired in the way of fastness. The high price of uranium compounds would also prevent the process from finding an extended practical application.—R. B. B.

The Action of Copper upon Colouring Matters exposed to Light. Camille Schoen. Bull. Soc. Ind. de Mulhouse, 1892, 590.

It has been known for several years that precipitated metallic copper and the oxide, sulphide, sulphate, acetate, and chlorate of copper, if applied to colouring matters, greatly increase their resistance to light, while the ferrocyanide of copper proved quite inert in this respect. It was further found that those compounds convert the white parts of the fabrics into oxycellulose. Further experiments have shown that this formation of oxycellulose occurs only if together with the copper compounds ammonium salts are present, and a mixture of copper and ammonium salts printed on a white fabric, which is then exposed to light, has a very strong action on the fibre, which is converted into oxycellulose. By treating a dyed cloth with the same mixture the colour is protected from light, but no formation of oxycellulose is noticeable, so that the protective action of the copper seems to be due to reoxidation of the colouring matter. The salts of iron, tin, and manganese with or without ammonium salts possess no such protective action.—C. O. W.

The Dissociation of Chrome Alum. H. Bautigny and E. Péchard. Comptes rend. **115,** 17, 604.

See under VII., *page* 445.

PATENTS.

Improved Apparatus for Dyeing or Chemically Treating and Drying Paper, Felt, or other Fabrics. W. Searle and W. H. Elliot, London. Eng. Pat. 2096, February 3, 1892.

See under I., *page* 435.

A Method of and Process for Printing Celluloid. W. Hazelberg, Berlin. Eng. Pat. 4167, March 2, 1892.

A method of printing letters, pictures, &c., indelibly on celluloid plates, the colours retaining their brightness and the celluloid its gloss. The celluloid plate is highly polished, and then pressed by means of a metal plate having a rough surface produced, preferably, by a sand blast. This imparts to the celluloid plate a finely-granulated dead surface, suitable for the reception of colours. It is then printed on a lithographic press with printing colours, to which has been added a solvent of celluloid such as ethyl acetate. The celluloid is then pressed with a metal plate, of which the whole of the face has been highly polished, or on which parts of the face have been left "flat" or "dead."—Ed. T.

Improvements in or relating to the Bleaching of Vegetable and Animal Fibres or other Organic Substances. C. J. E. de Haën, List, near Hanover, Prussia. Eng. Pat. 4823, March 11, 1892.

Sodium peroxide, recently introduced as a bleaching agent, is usually applied by introducing it into a slightly acid solution, and thus producing hydrogen peroxide. This method has the defect that the bleached fibres lose their lustre and are hard to the touch. This patent describes a method of liberating the oxygen of the sodium peroxide by gradually adding the peroxide to a solution containing a magnesium or other salt. When magnesium sulphate or chloride is used magnesium hydrate is precipitated and the oxygen set free. By adopting this process the defects mentioned are avoided.—R. B. B.

Process for Dyeing Loose Cotton, Cotton Thread, and Woven Fabrics. G. Jagenburg, Rydboholm, Sweden. Eng. Pat. 5408, March 18, 1892.

This patent relates to an improved process for producing aniline-black. When a concentrated solution of an aniline salt is mixed with a solution of a metallic acetate, *e.g.*, copper acetate, a precipitate is formed which varies in colour from dull yellow to dark olive, according to the relative proportions of aniline and acetate present. This precipitate is dissolved by acids, and such a solution in acetic acid is here employed as the dye-bath. Such a bath may be made up as follows:—

	Grms.
Water	1750
Aniline salt	250
Acetate of copper	300
Acetate of alumina	100
Acetic acid, 8° B.	15·3

The goods impregnated with this solution are dried at 25°—30° C., whereby they assume an olive-green tint. By continuing to expose them to this temperature a "half-oxidation" takes place and the fibre becomes grass-green. The oxidation is completed by working in a bath containing potassium bichromate and sulphuric acid. The goods are then hung up in a cool place for several hours, or exposed to a temperature of 36°—40° C. for half an hour, and finally washed. It is claimed that the black so produced does not turn green, and that the goods are in no way injured.

—R. B. B.

Improvements in the Process of Producing and Fixing Coloured Figures in Cotton Material in Conjunction with Grounds of Contrasting Colour. A. G. Brookes, London. From the Arnold Print Works, North Adams, Massachusetts, U.S.A. Eng. Pat. 3186, February 13, 1893.

A design is produced by basic aniline colours upon an alizarin ground by the following series of operations:—The cotton is first mordanted with tannic acid. The tannin is fixed as usual with an antimony salt. A metallic mordant for the alizarin is next applied, *e.g.*, acetate of alumina.

The basic colour is then printed on the cotton together with a discharge for the metallic mordant, the discharge consisting of an organic acid or a salt of such an acid. After steaming and "dunging" the cotton is dyed with alizarin and finished in the usual manner.

Or the order of the above operations may be somewhat modified.—R. B. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Formation of Alkaline Carbonates in Nature. E. W. Hilgard. Ber. **25,** 3624.

The formation of alkaline carbonates found in nature such as "Trona," "Szekso," "Kara," "Reh," has never been thoroughly studied, and practically nothing has so far been published on this matter.

The author on evaporating certain mineral waters, observed crystals of calcium sulphate separating out, although the mother-liquor showed an alkaline reaction, owing to the presence of alkaline carbonates. An analogous process takes place in nature between calcium carbonate and sodium salts in presence of an excess of carbonic acid. In this way sodium sulphate and calcium carbonate by mutual reaction form gypsum and sodium carbonates.

All neutral alkaline carbonates take up carbonic acid from the air; alkaline bicarbonates, on the other hand, are decomposed and it is only alkaline sesquicarbonates which are stable. On passing carbonic acid through a solution of sodium sulphate (or sodium chloride) in which calcium carbonate is suspended, sodium carbonates are formed.

This process was followed up quantitatively by the author, who employed solutions of alkaline sulphates of varying concentration, with a view to finding out whether it could be used for manufacturing soda on a large scale.

When the reaction had come to an end at the ordinary temperature, the solution was filtered and the calcium sulphate and carbonate precipitated with strong alcohol. The filtrate contained only a trace of lime. The amount of alkaline carbonate formed was ascertained by titration. A part of the liquid immediately after saturation with carbonic acid was also titrated and another part evaporated in order to determine to what extent the reverse reaction would take place under such circumstances.

The results in the following table show that in the case of the potassium salt the reaction is complete only up to 1 grm. per litre, in the case of the sodium salt only to 0·8 grm. per litre.

REACTION BETWEEN K_2SO_4, $CaCO_3$, AND H_2CO_3

Grms. K_2SO_4 per litre		0·25	0·50	0·75	1·00	1·10	1·25	1·50	1·75	2·00	4·00	8·00
Cc. normal acid neutralised after saturation with carbonic acid before treatment with alcohol.		2·9	5·8	8·6	11·5	11·8	13·1	15·0	17·4	17·8	23·2	24·7
$KHCO_3$ formed.	Per cent. of possible maximum....	100·0	100·0	100·0	100·0	93·3	91·1	86·9	86·4	77·4	50·4	26·9
	Absolute weight before evaporation	0·89	0·59	0·88	1·17	1·20	1·39	1·53	1·76	2·82	2·37	2·52
	„ „ after „	0·06	0·10	0·12	0·14	0·16	0·19	0·20	0·21	0·24	0·25	0·26

REACTION BETWEEN Na_2SO_4, $CaCO_3$, AND H_2CO_3

Grms. Na_2SO_4 per litre		0·27	0·50	0·75	0·80	1·00	1·25	1·50	1·75	2·00	4·00	8·00
Cc. normal acid neutralised after saturation and before treatment with alcohol.		3·5	7·1	10·6	10·6	12·6	15·5	18·0	18·6	19·3	24·1	25·2
$NaHCO_3$ formed.	Per cent. of possible maximum....	100·0	100·0	100·0	99·5	89·2	88·4	85·3	75·3	68·4	12·7	22·4
	Absolute weight before evaporation	0·30	0·60	0·89	0·89	1·06	1·29	1·52	1·56	1·62	2·02	2·12
	„ „ after „	0·04	0·05	0·08	0·11	0·11	0·13	0·17	0·18	0·22	0·25	0·26

It is further shown that on evaporation about nine-tenths of the alkaline carbonates formed are reconverted into sulphates. This reconversion undoubtedly would not take place if the solutions were evaporated at the ordinary temperatures.

Evaporations of this kind take place in nature, viz., in Arabia, Egypt, the Desert of Sahara, the Aralo-Caspian Depression, the Desert of Gobi, Nevada, and Utah in North America. This formation exercises a most deleterious effect on the cultivation of artificially-watered land, as is found to be the case in the North-West of India and n North America from the Rocky Mountains to the Pacific Coast.

The quantity of alkaline carbonates formed will greatly vary according to the intensity of the evolution of carbonic acid, as well as to the concentration of the solutions. This explains the great variation in the composition of the "Trona" or "Szekso" of commerce, the alkaline carbonates in these substances sometimes reaching 80 per cent., although generally not over 25—35 per cent.

The efflorescence of alkaline carbonates makes large tracts of land all but incapable of cultivation, and watering only increases the evil. Such land may be cultivated by incorporating gypsum with the land. The efflorescences in the valley of San Joaquim, California, have the following composition :—

K_2SO_4	3·25	12·53
Na_2SO_4	20·91	..
NaCl	12·21	2·48
$NaHPO_4$	1·87	5·19
$NaNO_3$	16·40	..
Na_2CO_3	27·02	40·40
$(NH_4)_2CO_3$	1·27	..
$MgSO_4$	..	1·01
Organic substances and water	17·07	38·09
	100·00	100·00

The most important vegetable alimentary substances are here concentrated, making it most desirable that such land should be cultivated by addition of gypsum before these valuable salts are lixiviated away by rain floods.

The reaction which produces alkaline carbonates plays, no doubt, an important part in the formation and in the decomposition of minerals and rocks. Amorphous silica is soluble in solutions of alkaline carbonates, and the author has often observed the presence of alkaline silicates in waters in the dry regions as well as the formation of *agate-geodes* and *zeolites* under their influence.—K. E. M.

The Production of Calcium Sulphate from the Waste Liquors of the Ammonia-Soda Process. H. Schreib. Chem. Zeit. **16**, 1836.

THE author describes the manufacture of calcium sulphate ("Annaline" "Pearl-hardening") for which he uses a piece of apparatus figured in the original.

A lead-lined wooden vessel serves for storing the precipitant, viz., sulphuric acid or acid sodium sulphate. An adjoining wooden vessel is filled with the waste liquor of the ammonia-soda manufacture. The calcium chloride contained in this liquor is precipitated as calcium sulphate by addition of the necessary quantity of liquor. After several hours standing the clear solution is drawn off by means of a skimmer or swivel-siphon made of corrugated rubber. A fresh quantity of waste liquor is now treated in the wooden vessel in the same way, and the process repeated until a considerable quantity of calcium sulphate is obtained. After washing several times with water, the whole precipitate is flushed on to the filter shown, where it is thoroughly drained. If the precipitate is well beaten down during the process of draining, the resulting sulphate will not contain over 25 per cent. of water. A vacuum-filter is not applicable here, since the extremely fine precipitate would block up the interstices of the filtering-material too rapidly. The fineness of the sulphate is increased by agitating the liquor well during precipitation and adding the acid rapidly.—K. E. M.

The Dissociation of Chrome Alum. H. Baubigny and E. Péchard. Comptes rend. **115**, 17, 604—605.

GRAHAM proved the dissociation of potash alum by experiments based on the different rates of diffusion of its constituent salts. He showed that when a solution of potash alum was placed at the bottom of a vessel full of water, the supernatant liquid after the lapse of some time contained aluminium and potassium sulphates in different proportions from that in which they exist in the double salt. Eventually, however, a state of equilibrium again obtains between the salts.

The authors consider they have been able to demonstrate the dissociation of chrome alum in a more simple manner. Having observed that this salt after repeated precipitation from an aqueous solution by alcohol presented an acid reaction, they added 0·3 grm. of gaseous ammonia to 20 cc. of a saturated solution of it, thus rendering it neutral to methyl-orange. After standing some time the solution, which had turned from violet to green on adding the ammonia, gave a deposit of violet crystals of an acid reaction, and again became acid to methyl-orange. The phenomenon is exhibited by a solution of chromium sulphate, but not by those of ordinary alum and aluminium sulphate.—E. B.

The Inertness of Quicklime. V. H. Veley. Proc. Chem. Soc. 1893 [123], 114.

The conditions under which calcium carbonate is formed from lime and carbon dioxide have been to some extent investigated by Debay, Raoult, and Birnbaum, with Mahn.

The experiments recorded in the paper were conducted on a much larger scale than heretofore, and the amount of combination between the lime and carbon dioxide as dependent on the conditions (1) of moisture, (2) of temperature, is investigated. It is shown that the combination is incomplete, not only with lime to which 11 per cent. of water are added, but even with the hydrate; the presence of 10 per cent. of free water in the hydrate increases the absorptive power nearly fourfold. Dry carbon dioxide combines with lime to a slight extent at 300°, to a greater degree at 350°, and fairly completely at 420° (melting-point of zinc; *cf.* Birnbaum and Mahn).

The conditions of the formation of calcium sulphite from lime and sulphur dioxide have been studied by Birnbaum and Wittich, who do not, however, give any quantitative results.

It is here shown that lime and sulphur dioxide, when dry, begin to combine at about 300°, and more completely at 352°; but at a higher temperature the resulting sulphite is decomposed into sulphate and sulphide, and by the interaction of the latter and the sulphur, dioxide sulphur is formed.

There is a great similarity in the behaviour of dry carbon and sulphur dioxides as regards the amounts of them absorbed by lime under the same conditions of temperature. Incidentally it is noted that quicklime does not absorb nitrous fumes at ordinary temperatures.

PATENT.

A Process and Apparatus for the Manufacture of Per Salts of Iron. E. Hermite and A. Dubosc, Paris, France. Eng. Pat. 10,281, May 30, 1892.

See under XI., *page* 452.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Results obtained in the Baccarat Glass Works by Introducing Metastannic Acid into the Putty Powder. L. Guéroult. Comptes rend. 1892, **115**, 757—759.

Putty powder is a stannate of lead obtained by oxidising a mixture of three parts of lead and one part of tin in a special furnace, and has till recently been exclusively employed for polishing crystal glass. The author instances many cases of injurious results to the workmen owing to the use of this substance, in part due to lead poisoning and in part to the chipping off of small particles of the putty during the working with the polishing wheel, which is coated with it. Such small particles get into the air and thence into the mouth and respiratory organs. To avoid these injurious results a mixture of one part of putty powder to two parts of metastannic acid has been substituted for the putty alone at the Baccarat works, and with most successful results, no cases of lead poisoning or of accidents having arisen since its introduction.—C. A. K.

PATENTS.

Improvements in the Manufacture of Glass. V. B. Lewes, Greenwich. Eng. Pat. 8865, May 10, 1892.

The fusion of the frit or refractory material of which glass is made proceeds but slowly when the heat is applied from the exterior of the melting vessel or from the surface, as in a tank furnace, owing to the non-conducting nature of the material. In this invention the material is heated rapidly throughout its mass by mixing with the frit some carbonaceous substance, which is burnt by air or, preferably, oxygen, which may be introduced into the vessel or tank by passages or by tubes of refractory material. The oxygen for the combustion may also be obtained by adding a nitrate to the frit, which yields up the oxygen required when the vessel has been sufficiently heated from outside. —V. C.

Improvements in Joints for Earthenware Pipes. H. L. Doulton and C. E. Morris, London. Eng. Pat. 9462, May 18, 1892.

In former inventions for obtaining tight joints the socket has been lined with cement, and the spigot end has been tipped with cement, the lining of the socket being cylindrical and the tip of the spigot rounded or spherical. In the present invention, the lining of the socket is made of an elastic material, preferably plaited cotton, like a lamp-wick, treated with bituminous material. The joint is made by the fitting of the rounded tip of the spigot end into the cylindrical ring of elastic lining, the width of the strip of elastic material being such as to admit of a true fit with the rounded or spherical end in every position which the amount of freedom allowed to the pipes permits them to take up.—V. C.

Manufacture of Composition for the Production of Ceramic Fancy Ware. C. Werfel, Prague. Eng. Pat. 24,002, December 29, 1892.

A material composed of the following ingredients is termed "Elfenite" by the inventor:—

"1 kilogramme glue dissolved in water."
"5 dekagrammes colophonium."
"5 ,, linseed oil-varnish."
"1 ,, weak acetic acid."
"1 ,, chromate of potassium."
"7 ,, cellulose or rag-stuff boiled and mixed into a paste with—
"5 kilogrammes chalk."
"20 dekagrammes slaked lime."

The material can be fashioned into articles, which attain great hardness by simply drying, and do not need to be fired as do majolica goods. The articles can be kept without harm in damp places.—V. C.

Improvements in the Method of Manufacturing Glass Bars, Rods, or Sticks. P. Sievert, Döhlen, nr. Dresden. Eng. Pat. 1289, January 20, 1893.

These articles have hitherto been produced by stretching a mass of hot glass, a process which requires skilled operators and leads to loss of material as well as suffering under the disadvantage that only limited lengths can be produced at one stretching.

In the present invention the articles are formed by bringing the molten glass between a suitably grooved table and a grooved roller, or between two suitably grooved rollers rotating in opposite directions. The rollers may be so adjusted as either to completely sever the glass or so as to leave the bars, &c. in a continuous sheet, which can afterwards be severed by a diamond.—V. C.

Process or Mode of Making Glass having an Orange-Yellow Colour when the Light passes through it, and a Greenish Colour when the Light falls upon it. F. Welz, Klostergrab, Bohemia. Eng. Pat. 2033, January 30, 1893.

The process consists in adding selenium and oxide of uranium to the glass metal while it is still in the melting pot. The proportions are approximately 15 parts of selenium to 25 parts of oxide of uranium.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

The Testing of Natural Stones and the Determination of their Mechanical Strength, Specific Gravity, Absorption of Water, and Resistance to Abrasion. Böhm. Mitt. Königl. tech. Versuchs. 1892, **5**, 188—229.

The following are the chief points of importance in the methods of testing used :—

(1.) The compression tests are made on cubes the sides of which are 4, 5, or 6 cm. in length, thus giving a surface of 16, 25, 36 sq. cm. to which the load is applied.

(2.) The determination of the compressive strength is usually made by the application of the load at right angles to the natural bedding plane of the stone as occurring in the quarry.

(3.) The determination of the compressive strength of the frozen stone is performed on test-cubes saturated by immersion for 12 hours in water ; half the number taken are exposed to a temperature of – 12° to – 15° C. in the air for 24 hours, and the remainder to the same temperature for the same time under water.

(4.) The method of determining the power of the stone to resist abrasion consists in grinding a cube of the stone, the face of which has an area of 50 sq. cm., and is cut parallel to the bedding plane by means of an iron disc fed with emery. The load is 30 kilos., 450 revolutions are made, the effective radius being 22 cm., the disc making 22 revolutions per minute. 20 grms. of Naxos emery No. 3 are used during each 22 revolutions. Four observations at equal intervals are taken, so that the progressive loss of weight of the stone is determined and its degree of uniformity of structure ascertained. The weight ground off is then calculated into cubic centimetres by dividing it by the specific gravity of the stone.

(5.) When the influence of high temperatures on the compressive strength of the stone is to be determined, the test-pieces are first dried for an hour in a drying oven, then heated to bright redness, half of the number taken allowed to cool in the air, the remainder quenched in water, and the crushing tests carried out as usual.

The remainder of the paper consists of tables giving the results of tests made at the testing station, which are too voluminous for abstraction.—B. B.

Roofing Tiles from Sawdust and Cement. Hauenschild. Thonind. Zeit. 1892, **16**, 852.

A dry mixture is made of two measures of sawdust and one of Portland cement ; this is worked up to a stiff paste with water and rolled into plates. The resulting material shows a satisfactory resistance to frost, but otherwise does not appear to have been tested for durability.—C. F. C.

Improvements in Drainage Pipes. Thonind. Zeit. 1892, **16**, 990.

A composite structure is recommended, viz., the lower section to be of earthenware whilst the upper is of a mixture of cement and any suitable material for securing penetrability by water.—C. F. C.

PATENTS.

Oil-Cloth as an Improved Substitute for Wall-Paper and for Ceiling, Panel, Railway Carriage, and other Decorative Purposes. F. Pugh, Swindon, Wilts. Eng. Pat. 11,577, July 8, 1891.

The basis is a cloth of a strong, pliable, and even texture, which is well sized on the back, and smooth-faced in front. For ordinary use " ¾ white " damask is recommended. It is saturated in a warm solution of glue, glycerin, and French chalk or whiting, and then stretched on drying frames or passed over steam-heated cylinders. Various methods of ornamentation are given. The inventor claims the sole right to call the said varieties of oil-cloth by the name of "Walloilum."—Ed. T.

A Composition Material forming Boards, Slabs, Linings, and the like, in Substitution for Wood or other Material. C. F. Baker, J. H. Randall, and G. S. Mayhew, Minneapolis, U.S.A. Eng. Pat. 2033, February 2, 1892.

The inventors prepare a material capable of general use in the arts, as a substitute for wood and other materials. A central layer of wooden strips or slats, placed edge to edge, is faced on both sides by sheets of paper-board, and the slats secured together by an adhesive cement, composed, for ordinary purposes, of glue and whiting or plaster of Paris. Other cements are recommended for water- and fire-proof boards. The parts are then forced together by heavy pressure. The compo-board thus formed is rigid, light (about the density of wood), strong, and durable, and may readily be made to assume any required shape. In addition to ordinary uses it is stated to be applicable to electric conduits, the roofs of rail-cars, ceilings, floors, refrigerators, also as a non-conducting covering for pipes, boilers, &c.
—Ed. T.

A Machine for Mixing, Working, Amalgamating, or Agglomerating and Compressing Plastic Materials. A. Desgoffe, Lille, France. Eng. Pat. 5723, March 23, 1892.

The machine consists of a helix *a* arranged so as to be placed axially in a cylindrical casing *d*, the periphery of which is provided with a screw-thread *h* of opposite hand to that of the helix. The interior of the helix is occupied by a shaft or cylinder *k*, having a screw-thread of an opposite hand to the helix on its outer periphery. The helix can be rotated in the cylindrical casing, with the casing and internal shaft fixed, or as an alternative it may be fixed and the casing and shaft themselves rotate. The action of the machine is identical whichever arrangement is adopted. The material to be treated is introduced at one end through a hopper *r*,

Fig. 1.

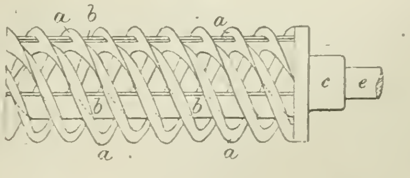
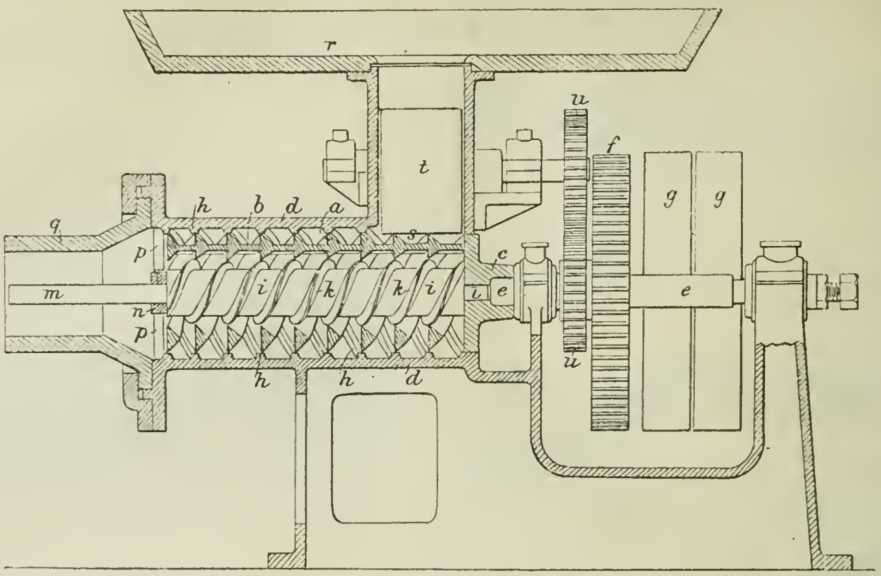


Fig. 2.



with rollers *t*, and being caused to travel to the other end, emerges through a die *q*, as in an ordinary pug mill. Multiple threads may be used and the internal shaft and the casing may be heated by steam when materials such as pitch are being worked.—B. B.

Improvements in Machines for Treating Clay or other Substances required to be Reduced to a Plastic State in the Manufacture of Bricks and other Articles. B. Joberus, Kenilworth, and E. Joberus, Aldridge. Eng. Pat. 7085, April 12, 1892.

The machine consists of a pair of rolls, the surfaces of which are provided with spiral ribs and grooves contained in a box having a hopper at one end and a die at the other. The ribs on the rolls are right- and left-handed respectively, and may increase in pitch towards the delivery end so as to pug or grind the clay more thoroughly as it approaches the die. The inner surface of the box containing the rolls may be plain or ribbed, and the ribs may be of coarser pitch than those on the rolls, or disposed in the reverse direction when the clay is to be passed very slowly through the machine. One of the rolls may be driven and itself serve to drive the other, or they may be connected by spur wheels.—B. B.

Improvements in the Manufacture of Artificial Bituminous Stone. R. Huppertsberg, Berlin, Germany. Eng. Pat. 7270, April 16, 1892.

Asphalt or similar bituminous material is powdered and mixed with "a suitable mineral binding material, such as oxide of lime and oxide of magnesia, or cement or plaster, or roasted dolomite, or siliciferous carbonate of magnesia." Magnesium chloride and water "or other fluid" are then added to form a paste, and sand may also be incorporated. No heat other than that evolved by the hydration of the magnesium chloride is applied. It is claimed that the product, which is named "Bitumelith," is superior to mixture made by fusing bituminous material and adding mineral matter.—B. B.

Improvements in Apparatus for Grinding Cement and other Substances. T. W. Brittain, Chesterton, and H. J. R. Pamphilon, Coughton. Eng. Pat. 8777, May 9, 1892.

The grinding apparatus is of the centrifugal type and consists of a cylinder in which is an axial shaft upon which are mounted boxes or slides carrying movable grinders set radially at varying angles. The revolution of the shaft causes these grinders to bear against the interior surface of the cylinder, and thus grind the material to be treated. (*Cf.* Eng. Pat. 9205, 1891.)—B. B.

X.—METALLURGY.

On the Liquation of Metals of the Platinum Group, Edward Matthey. Proc. Roy. Soc. **51**, 447—448.

The author has continued a previous investigation of his own, which was published in the "Proceedings of the Royal Society" (Proc. Roy. Soc. 1890, **47**, 180—186; this Journal, 1890, 644).

In the present paper he discusses, in detail, the effects of the cooling of large masses of the alloys gold-platinum, gold-palladium, platinum-palladium, platinum-rhodium, and gold-aluminium.

The details of manipulation are set forth. They involved melting masses of metal with high melting-points.

The author regrets that time has not enabled him to examine *more* members of each particular series of alloys, so as to present results in fuller detail; in fact, the silver-copper series is the only one upon which anything like exhaustive work has been done.

No doubt, in every series of alloys there is one definite alloy which would yield a uniform mass on cooling, and it is known that in the silver-copper series this alloy (Levol's) contains 718 parts of silver per thousand. It is not certain, however, that this is the eutectic alloy of the series—that is, the one with the lowest melting-point—but it is well known that when silver-copper alloys which contain more silver than 718 parts per thousand are cooled, the centre of the solidified mass is richer than the exterior. This is the case with standard silver, for instance, which contains 925 parts of silver per thousand, and it is safe to conclude that an alloy rich in copper is the first to fall out from the mass, and that this alloy sets round the inner surface of the mould, driving a still fluid alloy, rich in silver, to the centre. The general rule in the present result seems to be that, *in the cooling of a fluid mass of two united metals an alloy rich in the more fusible constituents of the mass falls out* *first, driving the less fusible constituent to the centre.* The gold-platinum alloys (A, B, C, D, and E) seem to be always rich in gold externally.

It is remarkable that the metals of the platinum group do not show much liquation among themselves, but, on the other hand, when gold is united to members of the platinum group, there is evidence of liquation.

The gold-palladium one (F) follows the above rule.

There is evidence that the alloy E, containing 750 parts of platinum and 250 of gold, is near the composition of a true compound, as it shows but little sign of liquation, and is, moreover, hard and brittle, differing materially from the rest of the series. The purple alloy of gold and aluminium M, $AuAl_2$, is almost certainly a true chemical compound, the solidified mass being as nearly uniform in composition as may be. The uniformity of the alloy (J) of platinum with 10 per cent. of rhodium is of much interest, in view of the important part which the alloy is playing in pyrometric work.

Conducting the experiments, the results of which are embodied in the present paper, has been very laborious, and although, as already stated, no complete series of the alloys of any two metals has been examined, quite sufficient data have been collected to afford valuable guidance to the metallurgist, who will now know what behaviour may be expected from the other members of the groups of the alloys in question. The gold-platinum series of alloys are of industrial importance, as native gold is so often associated with platinum, and it is somewhat surprising to find that assays made on pieces of metal cut from the exterior of an ingot cannot be trusted to represent the composition of the mass. The aim of the investigation has been to show, that notwithstanding the great difficulty which attends the preparation of alloys of metals with very high melting-points, it is possible to elicit from them the same kind of information which has proved to be so useful in the case of the more ordinary and tractable alloys.

The Products of the Interaction of Tin and Nitric Acid. C. H. H. Walker. Proc. Chem. Soc. 1893 [123], 114—115.

This investigation is a continuation of the investigations of Veley, on the conditions of the interactions of metals and nitric acid.

Since the work was commenced, a paper by Clemente Montemartini on the same subject has appeared.

It is generally stated in manuals on chemistry that metallic tin dissolves in nitric acid, forming both a stannous and stannic salt, according to the conditions of temperature and concentration of acid, but it does not appear that this statement is based on quantitative investigations.

In the paper, determinations are given of the amounts of stannous salt formed according to the conditions of (1) mass of metallic tin; (2) temperature; and (3) concentration of acid. It is shown that the proportion of stannous salt formed is but little affected by the mass of tin, and in the case of dilute acids by increase of temperature, but with more concentrated acids the effect is more marked, so that an alteration of a few degrees reduces the amount of stannous salt to *nil*. Increase of concentration of acid, other conditions remaining the same, decreases the proportion of stannous salt. The white, or yellowish-white, substance deposited from fairly concentrated solutions is a hydrated stannic nitrate of rather indefinite composition (*cf.* Clemente Montemartini). The average value of a number of analyses corresponded most nearly with a formula $Sn(NO_3)(OH)_3$. The substance appears to slowly decompose on exposure, so that the composition varies not only with the time elapsing between its production and analysis, but also according to the method of purification adopted to eliminate nitric acid.

On certain Ternary Alloys. Part VII. C. R. Alder Wright. Proc. Roy. Soc. 57, 530.

In this further instalment of researches on ternary metallic mixtures, the author describes the results obtained with alloys where *lead* (or *bismuth*) and *zinc* are the two metals not miscible together in all proportions, whilst *cadmium* (or *antimony*) is the "solvent" metal, miscible indefinitely with either of the other two. The experiments were made in precisely the same way as in the case of the previously investigated analogous mixtures (this Journal, 1890, 914; 1892, 245 and 693); simultaneously, corresponding experiments were commenced with similar mixtures in which aluminium was employed instead of zinc; but it was found that the close analogy between aluminium and zinc hitherto found to subsist as regards their functions in ternary alloys of the kind now undergoing investigation, breaks down when cadmium is the solvent metal. Whereas molten zinc and cadmium are miscible in all proportions; this is not the case with aluminium and cadmium, these two metals behaving like aluminium and lead, or aluminium and bismuth; *i.e.*, when mixed together in a molten condition and allowed to stand a light alloy floats up, consisting of aluminium containing 2 to 3 per cent. of the heavier metal, whilst a more dense alloy subsides, consisting almost entirely of the heavier metal, with, at most, a few tenths per cent. of aluminium. Accordingly, alloys containing aluminium, cadmium and lead, or aluminium, cadmium and bismuth, belong to a class different from that including the ternary alloys previously described; these contain *but one pair* of constituents not mutually miscible in all proportions, whereas aluminium-cadmium-lead and aluminium-cadmium-bismuth alloys contain *two* such pairs, viz., aluminium-cadmium and aluminium-lead in the one case, and aluminium-cadmium and aluminium-bismuth in the other. The effect of this is to bring about a deep-seated modification of the "critical curve" deduced in these cases, the full discussion of which is postponed to a future paper; as similarly are the parallel results obtained with the combinations aluminium-lead-zinc, aluminium-bismuth-zinc, bismuth-zinc-lead, and bismuth-aluminium-lead, which possess analogous characters.

With antimony as "solvent" metal, this difference in behaviour between aluminium and zinc disappears so far as miscibility with the "solvent" is concerned; but another difference becomes manifest, viz., that antimony and aluminium tend to combine together, forming a definite compound, AlSb (this Journal, 1892, 492), of greatly raised melting-point, whereas antimony and zinc do not exhibit such behaviour. The fusing-point, or, more exactly, the solidifying point, of this compound, AlSb, has been determined by Professor Roberts-Austen by means of observations with the Le Chatelier pyrometer, and found to be sensibly identical with that of pure gold, viz., 1045° C.; so that the compound exhibits the remarkable peculiarity that *its fusing-point is higher by 340° C. and upwards than that of the least fusible of its constituents.* One result of this is that certain ternary mixtures of fused antimony, aluminium, and lead, or bismuth, or other metals, become more or less pasty or semi-solid on standing, owing to the formation and separation of this compound; a circumstance which tends to limit the range of the experiments from which critical curves can be deduced of the kind previously described.

The critical curves deduced with the mixtures lead-zinc-cadmium and bismuth-zinc-cadmium exhibit mutual relations mostly of the same kind as those previously observed with other ternary alloys containing lead and bismuth respectively, but otherwise identical; thus, the bismuth-containing alloys always furnish a critical curve lying *inside* that obtained at the same temperature with the corresponding lead-containing alloy. In one respect, however, a marked difference is traceable; with silver as solvent metal, the ties slope downwards *to the left* in all cases, whether lead or bismuth be the heavier immiscible metal, and whether zinc or aluminium be the lighter immiscible one (the figures being plotted with the heavier metal at the left and the lighter one at right of the base of the triangle). With tin as solvent metal, the opposite is the case, the ties always sloping downwards *to the right*, excepting in the case of the lower ties with the combinations lead-zinc-tin, lead-aluminium-tin, where the irregularity is apparently due to the influence exerted by the tendency towards the formation of a definite compound, Pb_3Sn. With cadmium as solvent metal, however, the ties uniformly slope downwards to the *right* in the case of bismuth-zinc-cadmium alloys, and to the *left* in the case of lead-zinc-cadmium alloys. In the latter case the ties over a considerable range visibly converge towards a point on the left-hand branch of the critical curve, at which the proportion between cadmium and lead is sensibly close to that indicated by the formula $CdPb_2$, thus strongly suggesting the existence of a definite atomic compound of that composition. No corresponding peculiarity is noticeable with bismuth-zinc-cadmium alloys. With both sets of alloys the effect of alteration of temperature in modifying the precise position of the critical curve inside the triangle is somewhat marked, more especially towards the highest part of the curve.

The critical curves deduced with the mixtures lead-zinc-antimony and bismuth-zinc-antimony exhibit certain peculiar features. As in all other cases as yet examined, the curve with bismuth-containing alloys lies *inside* the corresponding curve with lead-containing alloys. Like the curves just described with cadmium as solvent metal, the ties slope uniformly to the left when lead is the heavier immiscible metal, and *vice versâ* when bismuth is substituted for lead. The lead alloy curve exhibits no marked peculiarity of any kind, and, in particular, no indication of bulges, either inwards or outwards; the bismuth alloy curve, on the other hand, exhibits a well-marked notch, or inward bulge, in the right-hand branch, the maximum depression of which corresponds with a mixture of metals containing bismuth and antimony in proportions near those corresponding with the formula Sb_2Bi_3; whilst a similar but wider depression is also observable in the left hand branch, at the deepest point of which practically the same ratio is also found. Since, moreover, experiments in progress with aluminium-antimony-bismuth alloys seem to indicate an analogous state of things with these alloys also, it would seem tolerably evident that a definite atomic compound of antimony and bismuth exists, indicated by this formula, and in its general relations analogous to the compound Ag_4Zn_5, previously indicated by similar irregularities in the contour of the critical curves deduced with alloys of lead-zinc-silver and bismuth-zinc-silver.

As far as comparisons can be made (the temperatures at which the various series of observations were made being necessarily not the same in all cases) the critical curves deduced with a given pair of immiscible metals (*e.g.*, lead and zinc, or aluminium and bismuth) and the various solvents, tin, silver, cadmium, and antimony, are so related that, *cæteris paribus*, the antimony curve always lies *inside*, and the cadmium and silver curves always *outside*, the tin curve; whilst if the cadmium and silver curves could be compared for the same temperature, probably the former would be somewhat inside the latter. Direct comparison is, however, impracticable, because the high fusing-points of some of the silver-containing alloys render it impossible to trace out the curve completely at temperatures much below 800°—900°, whereas the volatility of cadmium renders it impossible to work safely with mixtures containing that metal at temperatures much exceeding 600°—650°.—C. R. A. W.

The Disintegration of a White-metal Aluminium Alloy. E. Hjelt. Chem. Zeit. **16**, 1835—1836.

The author gives analytical data to prove that the disintegration of a white-metal aluminium alloy is due to the greater part of the aluminium being oxidised, and not (as H. Hoeveler believed, Chem. Zeit. **16**, 1339), to a molecular disintegration such as is observed to take place in the case of block-tin.—K. E. M.

Aluminium Apparatus for the Laboratory. G. Bornemann. Ber. **25**, 3637—3642.

See under XXIII., *page* 465.

PATENTS.

Improvements in the Treatment or Refining of Copper. J. C. Bull, Erith, Kent. Eng. Pat. 6399, April 2, 1892.

In refining copper, when the oxidising part of the process is completed, oxides are reduced, and dissolved oxygen is removed, by forcing through the mass of the molten metal, liquids or solids easily decomposed into reducing gases or vapours. Paraffin, petroleum, and the lighter hydrocarbon oils are named as suitable substances for the purpose. The addition of such may be continued after the elimination of the oxygen is complete, in order to remove as volatile compounds with hydrogen, arsenic, antimony, and phosphorus. If desired, a known percentage of oxides may be added to the oxygen-freed metal, or by interrupting the process at intervals, and assaying samples, the reduction may be partially carried out. The process is preferably conducted in a Bessemer converter of "a modified form," and is applicable to "many metallurgical operations."—E. S.

Improvements in Furnaces for Heating and Melting Metals. A. E. Butler, B. F. Butler, and H. M. Butler, Leeds. Eng. Pat. 7067, April 12, 1892.

The object of this invention is to economise heat in furnaces used for iron and steel. Instead of the ordinary fireplace a closed combustion chamber without bars is provided, with stoking mechanism for automatically feeding fuel from a hopper regularly in small quantities on to the top of the incandescent coal, so that the opening of fire-doors is avoided. An air-blast supply-pipe is connected with the chamber by a number of nozzles of a diameter varying according to position. The blast may be heated by previously passing under the furnace bed or round the sides.—A. W.

Improvements in the Manufacture of Iron and Steel. A. Turner, Greenock, and M. B. Baird, Glasgow. Eng. Pat. 7302, April 16, 1892.

Crude metal such as pig iron is melted and pure metal in the form of a rod is suspended over it and melted by passing through it a current of electricity, when it drops into the crude material and thus mixes with it. The current may preferably be passed through the molten crude metal, a rod of pure metal forming each of the two terminals which dip into it. A blast is used, and the air, in consequence of the electricity passing through the metal, is stated to become ozonized, by which the metal is rendered better and purer. —A. W.

Improvements in Refining Iron. H. Höfer, Hagen, Germany. Eng. Pat. 7758, April 25, 1892.

Ordinary "pig iron" as produced in a blast furnace, is run direct into the upper part of a vertical "furnace" or tower in which are set, alternately from opposite sides, slightly inclined steps, over and down which the molten iron flows in broad thin streams, falling over the edge of each step in a "cataract" on to the step next below, till it reaches a concave bottom, whence it flows by narrow channels into a hearth below having a horizontal outlet-way. One or more openings are made in the sides of the tower, with suitable doors, through which a flux may be introduced. A gas generator is shown, having a mixing chamber and an inlet through which air may be introduced so that the gas may be rendered oxidising or retained in a condition to effect reduction. By means of suitable valves, the mixing chamber communicates with the hearth into which the molten iron flows from the tower. The gases ascend into the tower, partly through a vertical channel leading into the upper part or edge of the conical depression at the bottom of the tower, and partly through the channels down which the iron flows. Within the tower the gases pass upwards through the ways formed by the baffle plates or steps, in a direction opposite to the flow of the iron, and leave the tower or furnace at the top, where the fluid iron coming from the blast or other smelting

furnace enters the refining furnace. It is preferred that the generator producing the required reducing and oxidising gases and hot air should be of the regenerator type.
—E. S.

Manufacture of Plates, Slabs, Sheets, and similar Objects of Combined Metals. C. D. Abel, London. From F. C. Glaser, Berlin, Germany. Eng. Pat. 11,030, June 11, 1892.

The invention consists, as expressed in the claims, of "1. A manufacture of slabs, plates, sheets, and similar objects of two different kinds of metal wherein a bar of the harder metal having an oblong cross section and constituting a core has a coating of the softer, more ductile metal cast round it in such manner that at the edges or narrow sides of the core the said coating is of considerably less thickness than on the broad sides, in order that by the subsequent rolling process a flat plate or other object composed of two metals with dense surface may be produced with a minimum waste of the covering metal." 2. A modified process whereby such objects "are produced with a coating of the softer metal only on the one side, by forming the harder metal core of oblong cross section with projections on the edges or narrow sides, which are formed either dovetailed or with grooves, or by otherwise forming projections or recesses on the said edges, and then casting the softer metal only upon the one side of the core, the edges of such covering being confined by or keyed into the projections or recesses" in order that such objects may when rolled out have a coating of softer metal on one side only, with a minimum of waste of the soft metal at the edges.—E. S.

Improvements in or relating to Obtaining and Separating Sulphide of Nickel in the Treatment of Mattes containing Copper, Nickel, Iron, and other Metals. W. P. Thompson, Liverpool. From J. L. Thompson, Bayonne, U.S.A. Eng. Pat. 498, January 10, 1893.

Matte, or ore, containing nickel, copper, and iron is melted with an alkaline sulphide, preferably that of sodium. The copper and iron sulphides separate to a considerable extent from the nickel sulphide and combine with the sodium sulphide, forming a kind of slag on the enriched matte. On tapping and treating the lower layer repeatedly with fresh portions of sodium sulphide nearly all the iron and copper can be removed and the nickel sulphide obtained in a state of commercial purity ready for conversion into metal or for other treatment.—A. W.

Improvements in or relating to Obtaining and Separating Sulphide of Nickel for Use in Metallurgical Operations in the Treatment of Mattes of Copper, Nickel, Iron, and other Metals. W. P. Thompson, Liverpool. From R. M. Thompson, New York, U.S.A. Eng. Pat. 499, January 10, 1893.

The matte is first melted with caustic alkali, which combines with the sulphur and produces a certain quantity of metallic nickel together with the other metals of the matte. Since, however, the nickel is the most readily separated from sulphur this metallic portion contains a larger ratio of nickel to iron and copper than did the matte. It is separated by gravity and melted with sodium sulphide, which combines with and removes the copper and iron as sulphides, leaving nickel sulphide still less contaminated with these metals. If necessary greater purity is obtained by repeated treatment with sodium sulphide. Instead of the last-named material salt-cake and carbon can be used as being cheaper, or the sulphide produced in the first operation can be employed with economy.—A. W.

Improvements in Soldering Aluminium and Alloys of Aluminium. George Wegner and Paul Gührs, Berlin, Germany. Eng. Pat. 512, January 10, 1893.

The articles to be soldered are cleaned, and damped with a flux composed of zinc chloride, "chloride of tin," and stearin in stated proportions. The soldering composition then applied contains about four parts tin to one of zinc. The flux is also applicable to soldering together aluminium with other metals.—E. S.

Improvements in the Manufacture of Iron and Steel, and in Apparatus for the Purpose. T. M. While, Barrow-in-Furness, Lancaster. Eng. Pat. 563, January 10, 1893.

The metal mixer, into which charges of molten iron are drawn from smelting furnaces, is heated preparatorily to receiving such charges by burning in it suitable fuel by means of an air-blast, and the same blast is also applied when the mixer is charged with the molten metal, to maintain its fluidity during the mixing, and approximately to secure uniformity in its quality.

The mixer is constructed of metal with a refractory lining, and is provided with a hopper, spout, and manholes, through one of which the tuyère enters. This tuyère is a metal tube protected by a series of short tubular firebricks strung upon it and set in fireclay, and the upper end of the tube has a telescopic joint to permit the tuyère to be lifted when needful. The mixer is mounted on trunnions in the usual way.—E. S.

Improvements in Furnaces. J. A. Fletcher and S. Fletcher, Ashton-under-Lyne. Eng. Pat. 2399, February 3, 1893.

This relates to furnaces used by brass founders for melting metal in crucibles. The lower half of the furnace is supplied with an extra outer casing so as to form an annular space between it and the wall. Air is forced in at the top of this space, and, in its passage round and downwards through it, becomes heated previous to its introduction to the fuel. The casing has apertures covered with hinged doors so set and weighted that they remain open when using induced draught and closed when using forced draught, while acting in the latter case as safety-valves against excessive air pressure.—A. W.

Improvements in Regenerative Furnaces. R. Dietrich, Bendorf, Germany. Eng. Pat. 2665, February 7, 1893.

The furnace head or part of the furnace in which the flues are located is formed of fire-resisting material, preferably a mixture of finely-ground chrome ore, magnesite, and a small proportion of furnace slag, with tar enough to enable it to be stamped or rammed down to make a jointless piece. The flues entering the furnace head may be formed of lining pieces or pipes, circular or elliptical in cross section. Instead of four regenerators, two only for gas are used, air regenerators being dispensed with; and the exchangeable fireclay pipe through which gas enters the head is of less diameter than the flue into which it is inserted, so that cold air may pass in around the pipe from a vertical passage, admission to which is regulated by a flap. The gas-supply pipe is thus cooled. The admission of gas is regulated by a plug or valve arrangement.—E. S.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

The Manufacture of White Lead by Electrolysis. Electrotech. Zeits. 1892, **13**, 442. Chem. Zeit. **16**, 323.

See under XIII., *page* 455.

PATENTS.

Improvements in the Manufacture of Metallic Articles by Electro-deposition. J. W. Davis and J. O. Evans, Wolverhampton. Eng. Pat. 8108, April 29, 1892.

This invention relates more especially to the production of metallic hollow-ware articles by the electro deposition of a metal or metallic alloy upon or within suitable cores, moulds, or matrices, but is applicable also to the manufacture of solid articles. The core, mould, or matrix is revolved in a horizontal, vertical, or inclined position in the bath; and a special feature of the invention consists in causing a periodic reversal of the direction of rotation, such as that of a meat-jack, and in moving the core, mould, or matrix also to and fro endways, thereby producing a very smooth surface of the deposited metal or alloy. The speed may be accelerated as the process nears completion. The anode or anodes may be either stationary within the bath or revolved therein, and may be divided from the cathode by an earthenware or other porous partition, through which the liquid may be circulated by means of a pump or other suitable appliance.—G. H. R.

A Process and Apparatus for the Manufacture of the Per-Salts of Iron. E. Hermite and A. Dubosc, Paris, France. Eng. Pat. 10,281, May 30, 1892.

When a solution of ferrous sulphate, to which a weak solution of the proto-chloride of iron, sodium, potassium, calcium, vanadium, or more especially magnesium has been added, is electrolysed, a basic sulphate of the peroxide is formed according to the equation—

$$2(FeOSO_3 7H_2O) + O = Fe_2O_3 2SO_3 + 14H_2O$$

and the addition of an equivalent of sulphuric acid either before or after electrolysis causes the formation of the trisulphate of peroxide of iron, which is a most energetic agent for coagulating blood, and can be used in slaughter-houses for the preparation of dried blood manure. By causing the sulphate of iron solution to circulate through apparatus arranged to maintain a maximum proportion of the salt in solution, a completely saturated solution of the sulphate of the peroxide can be obtained, and by varying the current density, and its duration, a greater or less quantity of this body may be formed, constituting the various dyeing mordants known as rust, sulpho-nitrate, and persulphate of iron. A convenient form of apparatus for conducting the process consists of a tank of enamelled iron with an outlet at the bottom for running off the contents when required, a perforated pipe in the lower part of the tank for supplying the solution to be acted on, and an overflow outlet at the upper part. The electrodes are plates of iron alternating with platinum sheets.—G. H. R.

An Improvement in Electrical Insulating Sheet. R. Wood, Manchester. From C. W. Jefferson and R. R. St. John, Schenectady, New York, U.S.A. Eng. Pat. 10,430, June 1, 1892.

Mica, although one of the best insulators, cannot be used in many cases because of its tendency to fracture on bending, pressing, &c. To overcome the difficulty is the chief object of this invention. Sheets are made of one or more layers of overlapping scales or laminæ of mica cemented together by means of shellac or other similar substance, and faced on one or both sides or between the layers with a fibrous material, in order to impart strength to the whole. For thin sheets the best tissue paper may be used, or if thickness is not of importance a stronger material, such as cotton gauze, India lawn, &c., may be employed. Thick sheets may be formed by increasing the number of layers of mica or fibrous material according to requirements. The sheets thus produced are said to be water- and acid-proof, incombustible, and to possess good insulating properties.
—H. T. P.

Improvements in the Manufacture of Electrodes for Ozonisers. E. Andreoli, Brixton, Surrey. Eng. Pat. 21,794, November 29, 1892.

This invention refers to the construction of certain point-bearing metallic plates, or their equivalents, not described in the author's previous specifications, Eng. Pat. 17,426, 1891, and 9631, 1892, but which have been described by the author in various foreign patents. According to it electrodes for open or closed ozonisers are constructed of plates of tin or other metals cast, cut, or stamped so as to form sharp edges, tongues, or angles protruding from one or both sides, which act as points to facilitate the electric discharge; or fretsaws or serrated wires, or their equivalents, supported on a frame or on cross-bars, and from the many points of which the silent discharge can take place, may be employed.—G. H. R.

An Improved Galvanic Dry Battery or Cell, and a Composition for use in such Cells. R. Haddan, London. From R. Gabarro, Barcelona, Spain. Eng. Pat. 22,950, December 13, 1892.

The cell consists of an outer vessel of zinc, a layer of wax or equivalent insulating material in the base thereof, a central hollow or solid electrode of carbon, a composition or combination of two compositions between the carbon and zinc, and a sealing of resin or equivalent insulating material. The exciting material is composed as follows:—

	Parts.
Sal ammoniac	175
Chloride of zinc	100
Oxide of zinc	150
Water	125
Sulphate of magnesia	100
Clay	225
Ivory-black	25

To these may be added if desired—

Hydrochloric acid	100
Mercuric sulphate	100

—G. H. R.

A New or Improved Method of Plating or Coating Aluminium or Aluminium Alloys. G. Wegner and P. Gührs, Berlin, Germany. Eng. Pat. 24,061, December 30, 1892.

The object of this invention is to produce an adherent deposit so that the articles coated may be hammered, cut, or bent without the coating coming off. The method consists in first steeping the aluminium article to be operated on in a bath composed of acetic verdigris dissolved in vinegar, oxide of iron, sulphur, and ammonium chloride, then brushing it with a soft brass-wire brush, thereafter rinsing it in water, and finally subjecting it to treatment in an electrolytic bath.—G. H. R.

An Improved Depolarising Material for Galvanic Elements. F. Szymanski, Posen, Germany. Eng. Pat. 2361, February 2, 1893.

According to this invention the depolarising material is manufactured by mixing a solution of manganic chloride or fluoride with air-dry chemically indifferent solid substances such as cellulose, pulverised graphite, powdered carbon, pulverised peroxide of manganese, or the like, but preferably an air-dry mixture of powdered carbon and peroxide of manganese. A suitable quantity of these substances is added to produce a pasty mass, which is then compressed round a carbon electrode. When zinc is used for the other electrode it is amalgamated, and the electrolyte is preferably a solution of zinc chloride which has been neutralised by the addition of zinc carbonate.—G. H. R.

An Improved Insulating Material for Electrical Purposes, and Method of Preparing same. A. Gentzsch, J. Goldschmidt, and E. R. von Scanavi, Vienna, Austria. Eng. Pat. 3398, February 15, 1893.

Shellac is treated with water to remove any soluble matter and the same process is used for the preparation of resin for the purposes of the patent. Birch-tar oil and aniline-oil are extracted in similar manner by boiling with water. The shellac and resin are drained from water and heated together to 150°—180° C. until the mass swells and decomposes, after which the temperature is raised to 400° C. or more, when a brown-black brittle substance is obtained. The birch-tar oil and aniline-oil are also freed from water by heat, and the composition is finally incorporated by melting together the resins and oils with anthracene, the proportions being about 38·5 parts of shellac, 38·5 of resin, 3·8 of birch-tar oil, 3·8 of aniline-oil, and 15·4 of anthracene. The resulting material is said to be useful as an insulator for electrical purposes.—B. B.

Improved Process for the Production of Electrolytic Copper. M. Perreur-Lloyd, Paris, France. Eng. Pat. 3747, February 20, 1893.

According to this process, which consists in agitating either the bath or the electrodes, a working rate of, say, 50 or even 100 ampères per square decimetre may be adopted so as to deposit per decimetre and per hour from 60 to 100 grms., or more, of metal instead of using only from one to two ampères per square decimetre, yielding a deposit of from 1 to 2·30 grms. only per decimetre, as by processes at present employed.—G. H. R.

Improvements relating to the Generation of Gas from Water, Steam, and the like, and to Apparatus therefor. W. G. Bedford, Philadelphia, U.S.A. Eng. Pat. 4225, February 25, 1893.

See under II., *page* 439.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Manufacture of Washing-Powders, &c. H. Schreib. Chem. Zeit. 16, 1858.

The washing-powders or soap-powders, which have latterly become important articles of commerce, always contain besides powdered dried soap a large percentage of sodium carbonate, generally in the form of dried soda crystals. These powders may be prepared in either of the following ways:—

(1.) Anhydrous sodium carbonate or soda-ash is added to a "clear-boiled" soap-paste, and after thoroughly mixing, the somewhat stiff material is drawn off into cooling frames. The cold and hard soap thus obtained is then finely ground.

(2.) Soda crystals and soap are melted together and then treated in the above manner. This method of manufacture, however, is only advantageous where soap-scraps are to be had.

A suitable apparatus consists of a wrought-iron vessel with a strong agitator contained in an interior cast-iron vessel, which can be cooled by water circulated in the outer vessel. The liquid soap is cooled whilst the soda-ash is slowly added and completely dissolved. During the grinding process care has to be taken not to overheat and thus soften the product.

The composition of soap-powders varies considerably. Only a small proportion of resin-soap can be used, as such soap is sticky and cannot be powdered. Oleïn soap may be used with advantage, and the oleïn may be saponified with sodium carbonate instead of the more expensive caustic leys.

As a small quantity of free chlorine is not objectionable in soap-powder, dark-coloured materials such as bone-fat, fish-oils, &c., may be used for making the soap, with an addition of a small quantity of bleaching-powder.

To some soap-powders 2 to 5 per cent. of sodium silicate is added.

A good washing-powder should contain—

30—35 per cent. of fatty acid;

30—35 per cent. of sodium carbonate; and

30—40 per cent. of water.

The inferior powders containing only 5—10 per cent. of fatty acid should not be used for the laundry; they are only serviceable for scrubbing purposes.

There is a soap-powder in the market containing a soap prepared by treating linseed with caustic soda directly. This soap contains certain impurities derived from the seed, which lather freely, and thus when the powder is used, give the impression of more genuine soap being contained in the powder than is actually the case. For washing printers' cliches and types a powder is recommended containing only a small quantity of combined fatty acid, but 10—15 per cent. of caustic soda.

The so-called "bleaching soda" consists of 80 parts of soda crystals and 20 parts of silicate of soda.—K. E. M.

Vegetable Oils. De Negri and Fabris. Annali del Laboratorio Chim. Centr. delli Gabelli, 1891—92, 220—256.

Oil of Pistachio can be extracted from the seeds by pressure as also by ether or carbon disulphide; it is of a golden-yellow colour and possesses a faint odour. When cooled below 0° it remains liquid even at − 8° to − 10°, when it suddenly solidifies, but liquefies again at + 5°. It is sparingly soluble in alcohol, but readily in ether, chloroform, and benzene.

The following data are given for the oil extracted by various methods:—

Specific gravity at 15°	0·9185
Point of solidification	−8° to −10°
Fatty acids:—	
Melting-point	17°—20°
Point of solidification	13°
Iodine number	86·9
Saponification number	191—191·6

The oil gives with Heydenreich's and Brullé's reagents an orange coloration, and Hauchecorne's reagent a green coloration changing to yellow when heated. Bechi's, Milliau's, and Baudouin's reagents produce no alteration.

Oil of Walnut can readily be extracted by pressure from not over-ripe nuts, as also from the kernels by ether or carbon disulphide; it is of a yellowish colour, and is used in some countries, especially Piedmont, as a good substitute for olive-oil.

The following data are given:—

Specific gravity at 15°	0·9265
Melting-point of fatty acids	16°—18°
Temperature rise	96°
Iodine number	144·5—145·1
„ of fatty acids	150·05
Saponification number	193·8—197·3

Its specific gravity, rise of temperature, and high iodine-number distinguish it from other oils obtained from nuts.

It gives a brown coloration with Heydenreich's, reddish-brown with Hauchecorne's, and an intense orange coloration with Brullé's reagent.

Oil of Hemp.—Hemp seeds contain 30—35 per cent. of oil, which can be extracted either by pressure or solvents; when freshly prepared the oil is of a greenish-yellow colour, but blackens after some time. It is siccative and does not solidify even at − 27°. It is used to admix with colza-oil and in the preparation of varnishes. It is composed of the glycerides of linoleïc, oleïc, palmitic, and stearic acids.

The following data are given, which are for the most part in accord with those of previous observers:—

Specific gravity at 15°	0·928
Fatty acids:—	
Melting-point	17°—19°
Point of solidification	14°—15°
Iodine number	140·5
„ of fatty acids	141
Saponification number	192·78

The oil gives greenish-brown colorations with Heydenreich's and Hauchecorne's reagents, and reddish-brown with those of Brullé and Bechi.

Oil of Jatropha Curcas (East India Nut). — The *Jatropha Curcas* is a species of the *Euphorbiaceæ* family, indigenous to the Cape Verde Islands, as also to Cuba, New Granada; it grows to a height of about 4 metres.

The seeds contain 30—40 per cent. of an oil extracted by pressure, of yellowish colour, and without distinct odour. It contains ricinoleïc, stearic, palmitic, and myristic acids; it is used in soap manufacture, for the adulteration of olive-oil. It possesses cathartic properties; it is completely saponified only after prolonged boiling with potash, and not readily, as stated by Horn (Zeits. Anal. Chem. 1888, 164; this Journal 1888, 142). The oil dissolves in 100 parts of alcohol, and is soluble in all proportions in chloroform, ether, and benzene. A white crystalline solid is deposited from the oil, when kept at 10°, which Maillot identified as palmitin.

The following data are given:—

Specific gravity at 15°	0·92
Point of fusion of fatty acids	24°—26°
Saponification number	210·15
Iodine number	100·91
„ of fatty acids	105·05

The oil gives a brown coloration with Heydenreich's reagent, and a reddish coloration with Hauchecorne's and Brullé's reagent. It can be distinguished from castor and croton oils by its different solubility in absolute alcohol, petroleum, and glacial acetic acid.

Oil of Soja Hispida (*Soja Bean*).—The *Soja Hispida* is a herbaceous plant of the *Leguminoseæ*, indigenous to China and Japan, where the seeds are highly valued as a comestible.

The seeds contain a large quantity of a fermentable sugar, as also a ferment similar in its properties to diastase; the oil, present in the proportion of 14 to 18 per cent., can be extracted by pressure or by means of ether; it possesses laxative properties, a yellowish-brown colour and a slight aromatic odour. It readily solidifies, and is intermediate between the siccative and non-siccative oils.

The following properties are given, which are confirmatory of those obtained by Stingl and Morawski (Chem. Zeit. 1886, 140):—

Specific gravity at 15°	0·924
Point of solidification	8°—15°
Fatty acids:—	
Point of fusion	27°—29°
„ solidification	23°—25°
Temperature rise	59°
Iodine number	121·3
„ of fatty acids	122
Saponification number	192·5

The oil gives, with Hauchecorne's reagent, a dirty white coloration in the cold, but deep orange when heated; with Brullé's reagent a deep orange, but no coloration with Bechi's reagent.

Oil of Coffee Berries.—The fatty oil of coffee can be extracted from the powdered berries by means of ether; traces of caffeïne are removed from the solution by agitation with water slightly acidulated with sulphuric acid, and then the ether is completely eliminated by prolonged warming on a water-bath under reduced pressure. The oil thus obtained is of greenish-brown colour, and possesses a slight odour of coffee; it is sparingly soluble in cold alcohol, but completely soluble in twice its volume of boiling alcohol, insoluble in cold, more readily in hot acetic acid.

It is partially carbonised by Maumené's test, with considerable evolution of sulphur di-oxide; it is readily saponified by alcoholic potash, and the soap formed can be completely salted out from an aqueous solution, from which cholesterin can also be obtained by agitation with ether. The fatty acids from the oil are of a bright yellow colour and without odour.

The following constants are given of the oil obtained from various specimens:—

Specific gravity	0·951
Point of solidification	2°—6°
Fatty acids:—	
Point of fusion	37°—41°
„ solidification	33°—37°
Temperature rise	53·5°—55°
Iodine number	78·6—86·48
„ of fatty acids	81·8—90·35
Saponification number	165·1—173·37
„ of fatty acids	172—178

The oil gives with Heydenreich's reagent a reddish-brown colouration and an olive-green, changing to brown, with Hauchecorne's reagent, as also with hydrochloric acid.

Oil of Laurus Nobilis (*Bay Tree*).—This fatty oil is extracted from the ripe berries of the *Laurus Nobilis*, in which it is present in the proportion of about 20 per cent.; it is imported into Venice and Trieste, principally from Spain, Greece, and Crete.

The oil is of a buttery consistency at ordinary temperatures, of a greenish-yellow colour, has a slightly bitter taste and peculiar aromatic odour; it is composed principally of laurostearin, the glyceride of lauric acid, myristin, resin, camphor, chlorophyll, and an ethereal oil, which imparts to it the peculiar odour it possesses. The oil is used in pharmacy, in veterinary practice, and as an article of food by the Lapps.

The following constants are given:—

Point of fusion	32°—34°
„ solidification	25°
Iodine number	67·8
Saponification number	197·48

The oil gives a brown coloration with Heydenreich's reagent, a dirty green changing to an orange yellow coloration when heated with Hauchecorne's reagent, and a violent reaction with Brullé's reagent. The oil is frequently adulterated with soap, lard, and with colouring matters such as indigo, turmeric, and copper salts.—V. H. V.

The Analysis of Steam Lard. A. Goske. Chem. Zeit. 1892, 1560 and 1592.

See under XXIII., *page* 469.

The Detection of Fatty Oils in Mineral Oils. Ruhemann, Mitt. aus. d. kgl. techn. Versuchsanst. 1892, 306.

See under XXIII., *page* 470.

Note on Hübl's Method of Wax Examination. G. Buchner. Chem. Zeit. 1892, **16**, 1922.

See under XXIII., *page* 471.

Determination of Sulphides, Thiosulphates, and Sulphites in Crude Glycerin. C. Ferrier. Chem. Zeit. **16**, 1840.

See under XXIII., *page* 471.

The Analysis of Beeswax. H. Röttger. Chem. Zeit. **16**, 1837—1839.

See under XXIII., *page* 471.

PATENT.

An Improved Washing and Cleansing Composition. S. S. Pearce, London. Eng. Pat. 22,533, December 8, 1892.

The improved composition consists of water, ammonia, soap, and salt.—J. L.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

The Manufacture of White Lead by Electrolysis. Electrotech. Zeits. 1892, **13**, 442; Chem. Zeit. **16**, 323.

By this method lead anodes 3 mm. in thickness are employed for the electrolysis of a solution containing 300 cc. of nitric acid in 2,000 cc. of water, and the lead-salt formed is precipitated as white lead by means of a stream of carbonic acid gas. Any silver contained in the lead is deposited on the cathodes and can be recovered.—G. H. R.

The Poisonous Character of certain India-rubber Articles. A. Bulowsky. Arch. Hyg. 1892, **15**, 125.

The author has investigated india-rubber articles used as toys by children. Such articles may be considered as generally free from poisonous matters (1) when they float on water; (2) are elastic; and (3) of soft consistency.

Black dolls are often coloured "in the mass" with lead pigment, and are therefore dangerous; red articles are also usually coloured in the mass, but the pigment used is antimony sulphide, which being unattacked by the saliva may be considered innocuous.

Grey rubber goods almost invariably contain zinc oxide, and are therefore not used without danger for such articles as are introduced into the mouths of children.

For superficial colouring, poisonous pigments are frequently used, but no general classification of such articles in this respect is possible.—C. F. C.

The Analysis of India-rubber Articles. D. Holde. Mitt. aus. d. kgl. techn. Versuchsanst. 1892, 306.

See under XXIII., *page* 469.

Contributions to the Analysis of India-rubber Articles. R. Henriques. Chem. Zeit. 1892, **16**, 1595, 1623, and 1644.

See under XXIII., *page* 467.

PATENTS.

An Improved Process and Apparatus for the Manufacture of White Lead and other Lead Pigments. G. D. Coleman, Chicago, U.S.A. Eng. Pat. 14,794, August 16, 1892 (Amended March 4, 1893) (this Journal, 1893, 53).

The essential amendments consist in an alteration of the arrangement of the air and water pipes communicating with the cylinder in which the corrosion of the lead for the purposes described is effected, the insertion of the weight of lead (500 lb.) used for a charge, and the interpolation of a statement that the temperature of the cylinder with its contents may under the prescribed conditions rise from 65° to 150° F. in a three hours' run, and the provision of means for regulating the temperature by a flow of water through the apparatus, and of controlling the pressure in the cylinder by the use of an external supply of air or other gas.—B. B.

Improvements in and relating to the Manufacture of Whiting. H. C. Higginson, Newburgh, U.S.A. Eng. Pat. 2705, February 7, 1893.

The process described is intended to supplant the ordinary system of levigation for grading whiting. The whiting is ground with water by an edge-runner working in a tank. A second tank receives the ground whiting suspended in water; a pump transmits the whiting through an overhead tank to a grading screen set at an incline and provided with wire sieves differing in fineness, so that the finest part of the whiting falls through the sieve at the upper part of the screen, and coarser grades through successive sieves below the first, the products being collected in different tanks. The final liquors containing only a little whiting greatly sub-divided are pumped through a filter-press into a tank, and are returned to the edge-runner tank by another pump. A saving of ground space is one of the advantages claimed.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

An Improved Substitute for Leather. E. Drew, London. Eng. Pat. 2172, February 1, 1893.

This consists of alternate layers of canvas, and thin sheets of wood, which are cemented together, and the whole pressed and dried. The outer layer of canvas is of waterproof material.—R. B. B.

XV.—MANURES, Etc.

The Solubility of the Phosphoric Acid of Bone-Meal. H. Otto. Chem. Zeit. 1892, **16**, 1128.

Owing to the cheapness of superphosphate, basic slag, &c., the use of bone-meal as a manure has decreased, and although this has also brought about a fall in its price, yet it is not used owing to the belief that the phosphates in it are not readily assimilated in the soil.

The author has proved that about 40 per cent. of the total phosphates contained in bone-meal free from fatty matter, are soluble in Wagner's citrate solution, and since bone-meal also contains a considerable quantity of nitrogen, it is to be considered a highly-valuable manure.—A. L. S.

The Analysis of Thomas Slags. O. Foerster. Chem. Zeit. 1892, 1596.

See under XXIII., *page* 466.

XVI.—SUGAR, STARCH, GUM, Etc.

The Saccharification of Wood-Gum by Hydrochloric Acid. C. Councler. Chem. Zeit. 1892, **16**, 1719–1720.

For the saccharification of wood-gum, previous observers using dilute sulphuric acid have not obtained a greater yield of xylose than one-third the weight of the wood-gum.

The author has employed hydrochloric acid and at first he used silver carbonate to remove the acid after saccharification, but found ultimately that lead carbonate could be used with equal convenience, as lead chloride is but slightly soluble in dilute alcohol and quite insoluble in strong alcohol.

In one experiment 15·5 grms. of partially-dried wood-gum from beech wood was boiled with 200 cc. of water and 10 cc. of hydrochloric acid of sp. gr. 1·19 for from 2½ to 3 hours. Half a grm. of humous substance was formed, and after removal of the hydrochloric acid and crystallisation 14·7 grms. of crude xylose were obtained, which, on recrystallisation gave 9·63 grms. of pure xylose. When more dilute acid is used for the saccharification and this process is not carried too far, dextrin-like bodies are formed which appear to consist of products intermediate between wood-gum and xylose. The purification of these bodies presents considerable difficulty.—A. L. S.

The Relation between the Percentage of Fat in Beet Seeds and the Percentage of Sugar in the Plants grown from the Seeds. N. Laskovsky, Landw. Versuchsstat. 1892, **40**, 335. Chem. Zeit. **16** (1892), 308.

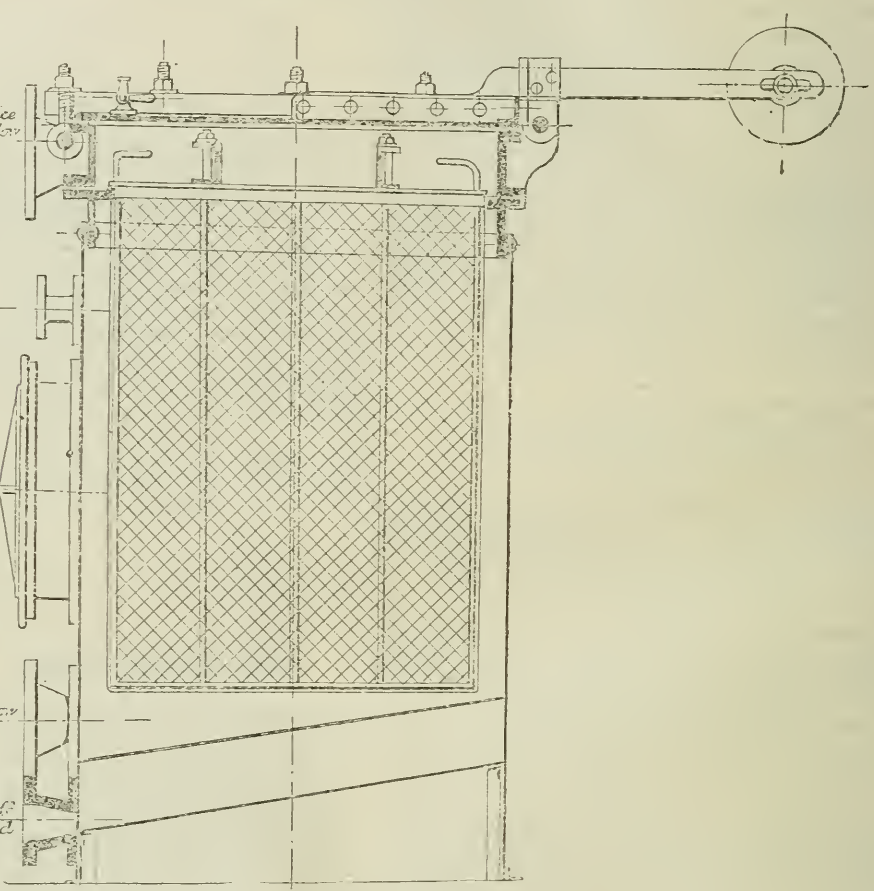
The author has shown that those beets which are known to be rich in sugar produce seeds rich in fat, and that the large roots of one and the same kind of beet contain less fat than the small roots. He has now attempted to ascertain whether there is any connection between the proportion of fat in the seed and the proportion of sugar in the plant, and whether the plants produced from the large roots are poorer in sugar than those produced from the small roots of the same kind of beet.

His results are given in a table; they show that the seeds most rich in fat do actually give beets most rich in sugar, and also that the large roots produce beets poor in sugar; the number of experiments is, however, too small to allow of any final conclusion being drawn.

The fat in beet seeds must be estimated as rapidly as possible because it readily decomposes, and the seeds should not be dried at a temperature above 100°; the ethereal extract of the fat must be evaporated on the water-bath, and should only be dried for a short time at 100°.—F. S. K.

Braunbeck's Albumen Retainer. Zeit. Zucker-ind. Böhmen, 1893, **27**, 232—233.

The diffusion juice, after it has been freed by suitable means from pulp and the like, is heated to 75° C., at which temperature beetroot proteïds coagulate. It is then filtered at a pressure of 600 mm. by means of the albumen retainer shown below, the linen filter-cloths of which are rough or coarse on their surfaces.



Braunbeck's Albumen Retainer.

—A. R. L.

Ritter's Pulp Retainer. Zeit. Zucker-ind. Böhmen, 1893, **27**, 190—193.

The main feature of this invention is a drum-shaped filter of extremely small mesh, which rotates about its axis and dips partially into a receptacle containing the diffusion juice. The upper portion of the drum comes into contact as it rotates with a set of brushes, and the gauze is thereby cleansed from particles of pulp, &c.; the process of filtration is therefore continuous.—A. R. L.

Application of Calcium Acid Sulphite in the Manufacture of Sugar. L. Lachaux. Bull. de l'assoc. des Chim. **10**, 501.

Labarre and Fontaine in 1884, when the use of animal charcoal in beetroot sugar manufacture was being discontinued, devised a process whereby the juice and syrups were treated with acid calcium sulphite. As, however, the juices (after the first saturation) contained lime and the syrups sodium and potassium carbonate, the acid calcium sulphate was simply converted into the normal salt and precipitated as such, but little decolorisation and even a harmful effect (see Battut, Neue Zeit. **25**), being produced. It can, indeed, be shown by passing a current of sulphurous anhydride through the first saturation juice that decolourisation takes place suddenly at a point when the liquid is nearly neutral. It follows, therefore, that the application of calcium acid sulphite is only successful in neutral or faintly acid juices. The most satisfactory application of calcium acid sulphite is in conjunction with the diffusion process, and Vivien's failure (Neue Zeit. **7**, 241) is to be ascribed to his having made use of a bad method.

In order to obtain a good result, a solution containing 44 grms. of calcium acid sulphite in 1 litre of water is diluted to 10 litres and poured upon a charge of 1 ton of freshly-cut root chips at the moment it is being transferred to the diffusion cell; in this way too rapid decolourisation (local action) and chemical changes (inversion) are avoided.

The diffused juice is of a greyish-white instead of a blackish-brown, and analysis showed a great fall in the amount of organic non-sugar, and a purity quotient of 90·27 as compared with 88·68 as obtained without the use of sulphite. The pressed chips retain the same amount of sugar as in the ordinary process. The increased purity of the juice renders it possible to employ less lime (for the first saturation, thereby minimising the loss of sugar occurring in the precipitate, which is of a pale colour. The massecuite obtained by evaporating the juice also showed a less relative quantity of organic non-sugar than that from the ordinary process. No increase of invert sugar was observed.—A. R. L.

Estimation of Small Quantities of Invert Sugar in presence of Sucrose by means of Fehling's Solution. T. Baumann. Zeit. Ver. Rubenz.-Ind. 1892, 824.

In Herzfeld's method 10 grms. of the substance containing invert sugar are used, but, under these circumstances, in the case of certain kinds of molasses, green precipitates are produced. A smaller weight has therefore to be used. This being so, the author has, from his experiments, constructed a table to be employed when 5 grms. of the sample are weighed out, dissolved in 50 cc. of water, and boiled with 50 cc. of Fehling's solution for two minutes under exactly the conditions directed by Herzfeld.

The following is a table for ascertaining the percentage of small quantities of invert sugar in the presence of sucrose, using 5 grms. of the sample :—

Mgrms. Cu.	Invert Sugar.	Mgrms. Cu.	Invert Sugar.
	Per Cent.		Per Cent.
35	0·04	60	0·30
40	0·09	65	0·35
45	0·14	70	0·40
50	0·19	75	0·45
55	0·25	80	0·51
85	0·56	205	1·87
90	0·61	210	1·93
95	0·66	215	1·98
100	0·72	220	2·04
105	0·77	225	2·10
110	0·83	230	2·16
115	0·88	235	2·21
120	0·93	240	2·27
125	0·99	245	2·33
130	1·04	250	2·39
135	1·10	255	2·44
140	1·15	260	2·50
145	1·21	265	2·56
150	1·26	270	2·62
155	1·31	275	2·68
160	1·37	280	2·74
165	1·42	285	2·79
170	1·48	290	2·85
175	1·54	295	2·91
180	1·59	300	2·97
185	1·65	395	3·03
190	1·70	310	3·09
195	1·76	315	3·15
200	1·82	320	3·21

—A. R. L.

Composition of the Ash of Hungarian Molasses. J. Szilágyi. Chem. Zeit. 1892, **16**, 1922.

The results of analyses of molasses ash from various sources are given below :—

Source.	Insoluble in Water.	K_2CO_3	Na_2CO_3	KCl	K_2SO_4	Total K_2O
Hungary	13, 48	48·65	27·15	3·01	6·05	38·34
Bohemia	5, 09	69·92	14·92	4·65	4·39	52·98
Moravia..................	11, 61	60·82	13·63	6·89	5·44	48·78

When utilised for the production of alcohol, it is customary to neutralise the molasses (generally with sulphuric acid). The consequent change in the composition of the ash is shown in the following table :—

Source.	Insoluble in Water.	K_2CO_3	Na_2CO_3	KCl	K_2SO_4	H_2O	Total K_2O
Hungary (Dioszeg, Hatvan, Nagy-Surany, Z.F.).	20·9	28·4	15·4	8·94	26·08	..	40·28
Hungary (Tapolcsany, Bück Nagy-Szombat, Z.F.).	26·6	34·68	11·8	7·22	19·44	..	38·72
Moravia..........................	18·12	42·06	10·41	8·89	20·42	..	45·33
Bohemia	19·44	51·5	11·07	11·32	12·46	2·45	48·99

—H. T. P.

PATENTS.

Improvements in and relating to the Manufacture of Refined Sugar from Raw Sugar. T. Drost, Breslau, Germany. Eng. Pat. 5719, March 23, 1892.

The following series of operations characterise the continuous system described :—

(*a*.) A special centrifugating of the mash and "green syrup" with a simultaneous warming, so as to produce a perfect separation and easy deposition of the same, thus avoiding any mixing with the subsequent clarifying.

(*b*.) Clarifying with a raw sugar or sugar solution or "masse cinte" solution, or thick syrup arising in the process, at sp. gr. 1·325, or with the specified equivalent, for the purpose of producing crystal sugar of at least 99·2 to 99·8 polarisation.

(*c*.) Returning the refuse liquor resulting from (*b*) into the process, *e.g.* into the vacuum pan, for further treatment of the same with raw sugar.

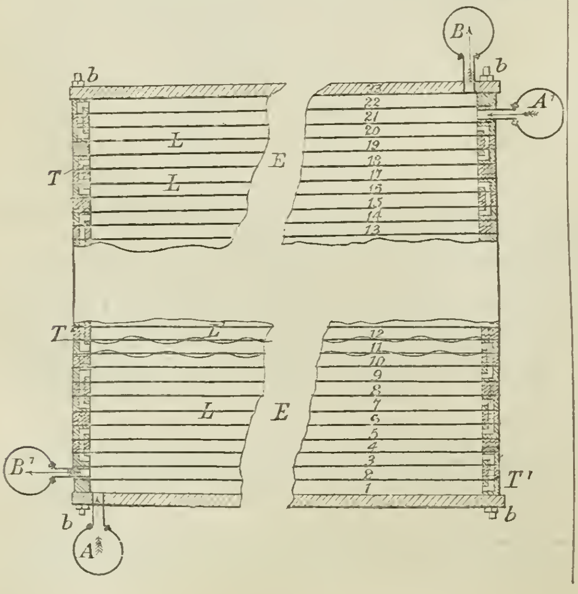
Steam may also be suitably applied after operations *a* and *b*, for producing marketable sugar, for drying the same, and also in dealing with the refuse liquor.

An Improved Composition for Use as Size or an Adhesive Cement. H. J. Sedway, London. Eng. Pat. 560, January 10, 1893.

Equal proportions of gum tragacanth and tapioca are ground together and heated with water at about 70° F., after which there are added about 50 per cent. of gum hog and an equal amount of starch, and the whole mixture heated at from 70°—120° F. The cement thus produced is said to be superior to any hitherto known for the requirement of silk and cotton manufacturers, calico printers, book-binders, hat and boot makers, &c.—A. R. L.

Improvements in Apparatus suitable for Cooling Cane Juice and other Substances. W. L. Wise, London. From C. D'Abbadie de Barrau, Mauritius. Eng. Pat. 1858, January 30, 1892.

The apparatus consists of a cistern or bac E. having a number of metallic plates or partitions L, arranged so as to form a series of adjacent spaces 1, 2, 3, &c. The ends of these spaces are connected by junction pieces T, having passages T^1 through them so that two channels of considerable length are formed running parallel with one another in a sinuous manner from end to end of the cistern or bac. The channel represented by the uneven numbers is provided with an inlet pipe A and an outlet pipe B, whilst that represented by the even numbers has inlet and outlet pipes A^1 and B^1, the latter two being arranged oppositely to the others. The hot juice enters the apparatus through A, and after circulating through the channel, escapes at B, whilst the cooling water enters at A^1 and escapes at B^1. The depth of the channels is conveniently about 4—5 cm. —A. R. L.



XVII.—BREWING, WINES, SPIRITS, Etc.

Chinese Yeast. Calmette. Ann. de l'Inst. Pasteur 1892, **6**, 604.

In the preparation of wines and certain spirits in China a peculiar ferment is used, sold in cakes about the size of a crown piece. In the preparation of this material a complicated recipe is worked, in which figure about 40 aromatic drugs, *e.g.*, ginger, pepper, cardamoms, &c. These are ground fine, sieved, and the mixture incorporated with an equal weight of rice meal, and sufficient water for moulding into cakes. The cakes are spread on mats and kept in the dark at 30° C., a quantity of moistened rice being also strewn on the mats. After 48 hours the cakes become covered with a mould and are then sun-dried. The product is used to ferment rice in the proportion of 1·5 per cent., the yield of alcohol (pure) being about 14 per cent. of the rice.

The product may be regarded as a symbiosis of several varieties of yeast with a special diastatic amylomyces which the author terms A. Rouxii. The function of the drugs is obviously merely that of qualifying the flavour of the alcoholic product.—C. F. C.

The Influence of the Concentration of the Alcohol on the Extraction of Hops. H. Strassmann and M. Levy. Chem. Zeit. 1892, **16**, 1123.

See under XXIII., *page* 472.

PATENTS.

Improvements in the Manufacture of Malt and in the Apparatus employed therein. J. Y. Johnson, London.—From J. A. Saladin, Nancy, France. Eng. Pat. 7534, April 21, 1892.

There is attached to the spade, which is used for turning the malt on the floors, a nozzle or spray producer. This is connected by a tube passing along the handle of the spade and by a length of flexible tubing to a reservoir of air, water, or both ; so that as the spade is used for turning the malt, it will be possible to moisten or aërate the malt as required. The same arrangement may be applied to the mechanical turners used in pneumatic malting.—A. L. S.

An Improved Wort and Yeast Aërator. O. Ritter, J. H. A. Meyer, and L. Hofman, St. Louis, Missouri, U.S.A. Eng. Pat. 7547, April 21, 1892.

The aërator is based on the principle of the injector used in filling steam boilers with water. The apparatus consists of a tube to the upper portion of which is fitted a cotton-wool air filter ; the lower portion of the tube is immersed in the fermenting wort and is fitted to a perforated bulb-shaped expansion containing two concentric conical nozzles. Air being pumped through the tube passes throug the first conical nozzle and impinges into the second, through openings in the tube, the wort is drawn by the air current, and the mixture passes through the second nozzle and into the body of the fermenting wort. The whole quantity of wort is thus quickly aërated.—A. L. S.

An Improvement in the Drying and Curing of Malt. T. Haynes, Radcliffe-on-Trent, Nottinghamshire. Eng. Pat. 8623, May 6, 1892.

Green malt is to be first dried in thin layers and finally cured in thick layers.—A. L. S.

Improvements in Distilling and Rectifying Brandy, Whisky, and other Spirits and Oils, Essences, and the like, and in Machinery and Apparatus therefor. R. H. Leaker, Bristol. Eng. Pat. 20,903, November 18, 1892.

The wash is conducted from the wash-receiver on to an apparatus which separates the yeast, &c., partly by subsidence and partly by filtration. Thence the wash passes into a heater, in which it is heated by the vapours from the still which pass through coils of piping contained in the heater. Here the wash becomes sufficiently heated to volatilise the aldehydes contained in it. The aldehyde vapours collect in the upper part of the still and are drawn off by a vacuum pump to a condenser.

The heated wash is led partly into the upper part of the analyser and partly direct into the still, where it is delivered in a finely-divided state. A jet of heated air is led into the still at the same time.

The vapours from the still are drawn by vacuum pumps through the analyser to the rectifier, and thence to the wash heater and condenser.

The vacuum pumps produce a low pressure within the apparatus, and consequently distillation takes place at a low temperature.—A. L. S.

Improved Process for the Manufacture of Yeast without Alcohol. M. Krouchkoll, Paris, France. Eng. Pat. 23,894, December 27, 1892.

Green malt is crushed in a mill, an equal weight of flour or suitable starchy material mixed with it at 54°—56° C., and subsequently about three-quarters the weight of water stirred in. The mash is left for 1½—3½ hours to settle, after which a sufficient quantity of water at a temperature of 95° C. is added that the temperature of the entire mixture, which is kept stirred for 2—3 minutes, is 62°—64° C. A cover is then placed upon the vessel containing the mash, which latter is allowed to remain for about 1¼ hours, after which the cover is removed and the contents of the vessel allowed to slowly cool to 32° C. A quantity of yeast, equivalent to about 10 per cent. of the solid matter, is mixed into a paste with water and added to the mash, together with about 2 parts per 1,000 (on the yeast) of tartaric acid in aqueous solution. At the expiration of two hours, bicarbonate of soda ($NaHCO_3$) or carbonate of potash (K_2CO_3), in the proportion of 2 parts per 1,000, is stirred into the mixture.

About five hours after the preparation of this mash another is made with half the weight of materials employed in the first; in the place of tartaric acid, however, there is added to the second mash in admixture with yeast a like proportion of "hydrochlorate" or carbonate of ammonia. The two mashes are united at a temperature of 32° and the mixture left for 12 hours, when the yeast will be found as a layer at the bottom of the containing vessel, together with pellicules of barley. The product is strained through a sieve, when the yeast passes through and the pellicules are retained. The yeast is now allowed to settle, and is finally washed by decantation with water, intervals of 5—6 hours being allowed for it to settle.—A. R. L.

Improvements in the Treatment of Beer and other Liquids, and in Apparatus for the same. A. Werner, New York, U.S.A. Eng. Pat. 1591, January 24, 1893.

The carbonic acid evolved during the fermentation of the wort is collected by gravity, purified and compressed into cylinders.

The finished beer is collected in a vessel or vessels on the upper floor of the brewery and conducted by a closed pipe to the basement, a filter is placed in a convenient spot on the pipe, in the basement the beer passes successively through the following apparatus:—A charger, by means of which carbonic acid is injected into it; a heater, in which it is pasteurised, and a cooler, in which it is cooled to its initial temperature. After passing through these vessels the beer is led by a tube, shaped like an inverted cone, back to its starting place, and there collected in casks or bottles as required.—A. L. S.

New or Improved Corn Product and Process for Manufacturing the same. W. P. Thompson, Manchester. From B. G. Hudnut, Terre Haute, Indiana, U.S.A. Eng. Pat. 2683, February 7, 1893.

The corn product described in this specification is named *maizeline* and is recommended as a substitute for malt in brewing.

Raw corn is ground in a hominy mill, and subsequently passes to a reel or grader in order to separate the hominy from the offal; from thence it passes to a dryer, after which it is treated, in a specially constructed cleaning or scouring machine (out of which it is discharged at the bottom) with steam at a temperature sufficiently high to burst the starch granules. The material passes next between rollers, and is thereby flattened into flakes, after which it enters a dryer and from thence passes again through rollers, whereby the flakes are broken up into light particles which are subsequently graded. The finished maizeline has the appearance of granulated sugar.

It is urged that inasmuch as "the starch of the corn has been converted by the above process into soluble starch," *maizeline* is much more readily transformed by diastase than any other malt substitute heretofore proposed. It is said to be almost, if not altogether, free from "dextrine."
—A. R. L.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

Analysis of Butter. Schmidt, Chem. Zeit. 1892, **16**, 1275.

See under XXIII., *page* 467.

Detection of Wheaten Flour in Rye Flour. A. Kleeberg. Chem. Zeit. **16**, 1071.

See under XXIII., *page* 466.

PATENTS.

Improvements in the Manufacture of a Light-coloured Albumen from Blood. C. Cosineru, Berlin, Germany. Eng. Pat. 3105, February 17, 1892.

Defibrinised blood is mixed with slightly acidulated ethyl alcohol, methyl alcohol, or acetone, or a mixture of these. The albumin and globulin contained in the blood are precipitated, whilst the colouring matter remains in solution. The quantity of reagent added depends on the quantity of water contained in the blood; to obtain good results, the mixture of the reagent and the blood should not contain more than 20 per cent. of water. The reagent may either be acidified with 1 per cent. of sulphuric or phosphoric acid, or the acid added to the mixture of blood and solvent. The albumin precipitates in almost colourless flakes, which are separated by filtration and washed with alcohol and water successively. It may be further bleached, if necessary, by treatment with hydrogen peroxide or other oxidising agent. The product is of value for industrial purposes and as an alimentary substance.—C. A. K.

Improvements relating to the Treatment of Tea. H. Carus-Wilson, London. Eng. Pat. 8651, May 6, 1892.

This invention consists in treating tea with a solution of borax in the form of spray, or with the dry powdered compound and a jet of steam, in apparatus suitable for the purpose. The product is spread on open-mesh trays, and subsequently dried in a kiln at 150° F. It is urged that high qualities of tea can in this way be manufactured at less cost than heretofore, and the deterioration arising from the loss of volatile oils which, in certain kinds of tea, is considerable, is prevented.—A. R. L.

Improvements in the Treatment of Animal Fats. W. Shepperson, South Hampstead, Middlesex. Eng. Pat. 15,482, August 29, 1892.

Animal fats are mixed with sugar and eggs according to this invention.—J. L.

A Process and Apparatus for Sterilising Water. V. and A. Babes, Bucharest, Roumania. Eng. Pat. 24,080, December 30, 1892.

The water is sterilised without filtration by the addition of alum in the proportion of 1—2 parts per 10,000, thoroughly mixing the whole, and allowing it to settle for 10 to 12 hours. In this time "the alum separates from the water," carrying with it to the bottom all the existing germs. A convenient form of settling vessel is shaped like a truncated cone and is provided with a removable agitator, and a pipe of not more than 4 to 5 mm. bore to draw off the sterilised product; together with a jacket for holding ice.
—F. H. L.

(*B.*)—SANITARY CHEMISTRY.

The Poisonous Character of certain India-rubber Articles. A. Bulowsky. Arch. Hyg. 1892, **15**, 125.

See under XIII., *page* 455.

Results obtained in the Baccarat Glass Works by introducing Metastannic Acid into Putty Powder. L. Guéroult. Comptes rend. 1892, **115**, 757.

See under VIII., *page* 446.

PATENTS.

Improved Means and Apparatus for Separating Solid or Semi-solid Substances from Sludge or other Fluid or Semi-fluid Matters. W. Birch, Lower Broughton, Manchester. Eng. Pat. 6535, April 5, 1892.

An endless band of porous woven cloth travels round a revolving drum and then over a small roller which is weighted in such a way as to keep the edges of the belt tight against the drum, while the centre is somewhat slack. Into this space—between the adjacent surfaces of the drum and belt—is introduced the semi-solid substance, the liquid immediately passing through, and the solid remaining on the drum as a crust or paste is subsequently removed by travelling scrapers.—F. H. L.

(*C.*)—DISINFECTANTS.

PATENTS.

Improvements in the Manufacture of Periodides of Phenols and of Phenol Carboxylic Acids. B. Willcox, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 7782, April 25, 1892.

The periodides of the phenols and of phenol carboxylic acids obtained as described in previous patents 5079, 1889; 18,021, 1890; and 7026, 1891 (this Journal 1892, 370) can also be obtained by subjecting mixtures of the solutions of alkaline salts of phenols and of alkaline iodides to electrolysis. The electrodes separated by a suitable diaphragm are placed in a solution of the alkaline iodide and an alkaline solution of the phenol gradually added whilst the electrolosis is in progress. The strength of the electric current is preferably two ampères per square decimetre of electrode surface. The degree of concentration of the solutions employed can be varied considerably; the quantity of iodide employed is regulated according to the nature of the resulting product. The phenol is completely converted into the periodide after the current has passed for several hours; the latter separates out in the solid form and can be filtered off and dried. In this manner all the periodides described in the previous specifications can be prepared.—C. A. K.

An Improved Antiseptic, Disinfecting and Deodorizing Compound. J. M. Raymond, Paris. Eng. Pat. 11,275, June 15, 1892.

This compound consists of—

	Parts by Weight.
Water	1,000
Zinc sulphate	300—500
„ acetate	10—30
Sodium "hyposulphite"	30—50
Aluminium sulphate	30—45
Boric acid	4—7
Mercuric iodide	0·10—0·25

The latter being only employed when a very powerful disinfecting action is required. Various other formulæ are given, varying somewhat in the proportions of the ingredients, according to the purpose for which the disinfectant is to be used.—F. H. L.

XIX.—PAPER, PASTEBOARD, Etc.

Treatment of Waste Liquors from the Bisulphite Process of Wood Boiling. E. Bruck, Chem. Zeit. **95**, 1892, 1782.

The author proposes to treat these liquors with gelatin and alum for the removal of the soluble lignone derivatives, and subsequently with chalk to neutralise. This treatment is found to remove one-fourth of the dissolved organic matter and a large proportion of the uncombined sulphite, and to give an effluent which remains unchanged for months. [*Cf.* Eng. Pat. 1549, 1883.]—C. F. C.

Normal Papers. W. Herzberg. Mitth. Königl. Techn. Versuchs, 1892, 108—114.

This paper contains statistical tables tending to show how far the conditions of tender have been fulfilled by manufacturers. It is curious to note that the paper supplied to the German Government does not attain the required standard so well as the paper made for private customers.
—J. L.

PATENTS.

Improvements in Apparatus for Boiling Esparto Grass and the like. G. W. Hawksley, Sheffield. Eng. Pat. 9303, June 2, 1891.

Reference is made to a previous patent (this Journal, 1890, 1145), the chief feature of the invention being the removal of the circulator, or cylinder of steam tubes, from the inside to the outside of the boiler, and being so constructed as to be fixed to an existing or new boiler.—Ed. T.

Improvements in or connected with Paper-Making. J. Jardine, Penicuik, N.B. Eng. Pat. 10,437, June 19, 1891

The object is to save paper-making fibre ordinarily lost, and to purify the water employed. Instead of the usual methods, trays are arranged to catch, uncontaminated, all the water which would otherwise go into the drains, and this water, with the fibres, is led into tanks, whence it is pumped into filter-presses. Or the water and suspended matter may be allowed to settle, precipitation being assisted by the addition of alumino-ferric sulphate, and after the supernatant water has been run off, the residue may be pumped into filter-presses. The fibre is incorporated with the main body of the pulp and the water may be used over again.—Ed. T.

Improvements in the Treatment of Short Fibres, particularly Paper Pulp, for the Purpose of Forming therefrom Rovings which are Applicable for Spinning into Yarn, the Manufacture of Wax Matches, and other Purposes. C. Kollner, Vienna. Eng. Pat. 20,225, November 20, 1891.

The process consists in subjecting fibrous materials to violent motion in large quantities of water, for the purpose of separating and extending the same. The quantities of water are considerably greater than in paper-making, and may vary between 300—500 parts of water to 1 part of dry fibrous material. The liquid containing the fibre in suspension is then placed upon a moving sieve, so as to form strips of fibre-felt which are rolled together by suitable devices, and constitute in this thread-like condition a roving for further treatment. In this way paper-pulp, either alone or mixed with longer fibres, hair, cotton, flax, &c., can be converted into rovings suitable for being spun into fine yarns. Woven fabrics thus made are soft, elastic, capable of being cleaned and successfully printed upon with bright colours. When the roving is to be further treated by spinning and weaving, there may with advantage be added to the fibrous material resinate, oleate or stearate of soda, which is converted by the addition of sulphate of alumina into alumina resinates, &c. Additions of this kind impart to the roving a very desirable tenacity and facilitates its stretching in the semi-moistened condition.—Ed. T.

An Improved Method of Purifying the Liquid which has been used in the Manufacture of Cellulose, and the Production of Useful Products therefrom. V. B. Drewsen, Bohnsdalen, Norway. Eng. Pat. 2629, February 10, 1892.

The waste liquors obtained in the manufacture of "sulphite cellulose" are treated with caustic lime, preferably at 90 lb. steam pressure, in a closed vessel. The organic sulphur compounds are thus separated, together with calcium sulphite. The innocuous solution, separated by a filter-press, may be discharged into any water-course, and the calcium sulphite and lime compounds used for the production of calcium bisulphite, instead of limestone or caustic lime, by treatment with sulphurous acid.—Ed. T.

Improvements in Straining Apparatus for Straining Paper Pulp and other Similar Materials. F. L. Roeckner, Boxmoor, Herts., and R. L. Roeckner, London. Eng. Pat. 9126, May 13, 1892.

This invention relates to the cylindrical oscillating pulp strainers described in a previous patent (Eng. Pat. 7932, 1885). It has been found that the washer forming the watertight connection between the vat outlet and the open end of the cylinder, rapidly wears out owing to the vibratory motion of the latter. In the improved apparatus the cylinder is fitted with a conical end-piece connected to the vat outlet by a short length of stout rubber tube, which readily accommodates itself to the oscillatory movement of the cylinder. Further claims are :—

An improved pulp outlet arrangement consisting of an opening in the circumference of the straining cylinder, and a corresponding opening in the vat joined together by a flexible rubber tube or bellows.

Providing the vat with an opening at one end and a cover-plate, so that the cylinder and shaft may be bodily removed for cleaning purposes.

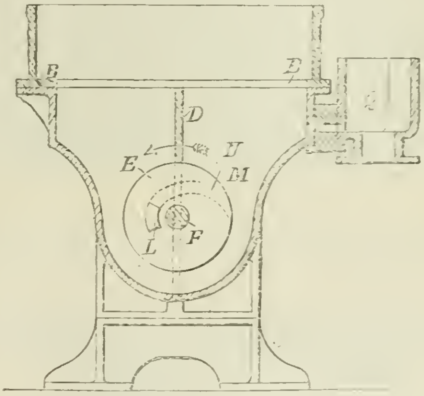
A watertight stuffing arrangement, consisting of a rubber sleeve, fitting closely on the oscillating cylinder shaft and attached also to the end of the bearing. By this means friction is considerably reduced and the use of lubricants avoided.

Lastly, a means of drawing off strained pulp from the cylinder, consisting of a wide open tube projecting above the surface of the pulp in the vat, and attached to one end of the cylinder with which it oscillates. The pulp is drawn from this tube by a siphon or suction pipe.

—H. T. P.

Improvements in Paper Pulp Strainers or Knotters. W. Umpherston, Leith. From E. W. Goodrich, Appleton, Wisconsin, U.S.A. Eng. Pat. 13,024, July 15, 1892.

A vat having a curved bottom and lateral wings is divided into several compartments of equal size by partitions, each compartment being further divided by a central partition D. A series of rotary discs E on a horizontal shaft F are placed within, the central partition being cut away to fit the shaft and discs closely. The discs are provided with curved internal passages N, one end L, commencing nearer the axis than the periphery, the other, M, at the periphery, as shown in the drawing, so that the receiving and the discharging openings are in opposite compartments. The discs are so arranged that half discharge on one side and half on the other of the central partition. When the shaft revolves the fluid is set in active motion, which serves to keep the strainer B clear and prevents clogging. The liquor is run off at Q.—J. C. C.



Paper Pulp Strainer or Knotter.

Improvements in or Relating to the Manufacture of Paper Pulp. H. J. Bird, Hoboken, New Jersey, U.S.A. Eng. Pat. 16,375, September 13, 1892.

According to this invention it is intended to utilise the contents—consisting of partially digested grass, hay, &c.—of the paunches of slaughtered animals for the manufacture of paper pulp. For this purpose it is only necessary to heat the mass in the ordinary way with lime under pressure, and subsequently pass it through a "pulping" or "beating" engine in order to separate the fibres and remove soluble matters. With the finer portions of the raw material even the lime treatment may be dispensed with, the "beating" process being sufficient to convert it into pulp. It is claimed that comparatively little lime is required in the above process, owing the presence of gastric juice, in fact, in some cases the solvent action of the latter may be utilised to soften an additional quantity of some other vegetable material.—H. T. P.

Improvements in Paper Pulp Digesters. H. H. Lake. From C. Curtis, county of Middlesex, Massachusetts. N. M. Jones, county of Penobscot, and T. B. Draper, county of Massachusetts, U.S.A. Eng. Pat. 20,145. November 8, 1892.

The improvements consist in applying to digesters, preferably of cylindrical form, made of iron, steel, phosphor-bronze, &c., a lining made of blocks of Portland cement and ground glass or quartz, with or without the addition of soluble glass. The blocks are subjected to pressure and are then carbonated by exposure to carbonic acid gas. In addition to this lining there is an intermediate lining composed of asbestos and cement to protect the metal in case of cracking of the carbonated lining. The latter, having the same co-efficient of expansion as the metal of which the digester is composed is not liable to be removed from the metal. It moreover prevents loss of heat by radiation.—E. J. B.

Improvements in the Method of Producing Thin Films of Metal and Manufacturing Metal Surfaced Paper therewith. C. Endruiveit, Berlin, Germany. Eng. Pat. 2724. February 7, 1893.

The improved process is as follows:—A well polished yellow brass or nickeled sheet of metal is wetted by means of a paint brush or sponge with a solution of higher alkaline sulphide or hydrosulphide; for instance, a solution containing 5 parts by weight of potassium trisulphide or hydrosulphide to 100 parts of water, and in addition, 1 per cent. of spirit which is added to remove any greasy particles which may be present. The plate is then immersed for a short time in a neutral solution of copper sulphate (1 to 5) and transferred to an acid copper bath in which copper is deposited on it. It is immersed in a zinc bath in which it receives a deposit of that metal, and is subsequently treated with a solution of hydro-sulphate of ammonia, mercaptan, or similar compound or allylesulphide previous to pasting the paper thereon or causing the paper to adhere by paste in which the said substances are mixed. The metallic surface of the paper so produced is rubbed over, when dry, with a mixture of gold or silver cyanate with carbonate of potash in order to produce a real gold or silver paper.
—G. H. R.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Chemical and Physiological Properties of a Crystalline Dihydrochloride derived from Eucalyptus Oil. Anthoine. Journ. Pharm. Chim. 1892, [5], **26**, 391; Chem. Zeit. **16**, (1892), 363.

When eucalyptus oil (100 parts) is treated with hydrochloric acid it yields a crystalline product (about 25 parts), and a black liquid, which consists for the most part of a liquid dihydrochloro-derivative.

The solid product, after repeated crystallisation, is obtained in colourless mica-like plates, melting at 50° and boiling at 115° with decomposition; it has a slight smell and a somewhat bitter taste, which, however, does not develop at once. It is optically inactive and dissolves freely in most ordinary organic solvents, but is almost insoluble in water, by which, as well as by alcohol, it is slowly decomposed. Analyses of the compound point to its being a *dihydrochloro-eucalyptene*; in chemical behaviour it resembles dihydrochloroterebenthene.

This crystalline dihydrochloro-eucalyptene, or *eucalypteol* as it is named by the author, has no apparent effect on the diastatic fermentation of starch, solution and conversion into sugar taking place in the normal manner even in presence of large quantities of eucalypteol; it has, nevertheless, the property of preventing the subsequent growth of bacteria in the resulting sugar solutions. The peptic fermentation of albumin is somewhat retarded in presence of eucalypteol, but peptonisation is always complete, and, as before, the resulting solutions do not subsequently undergo putrefaction; the effect of eucalypteol on the pancreatic fermentation of albumin is the same as in the case just mentioned.

Urine, to which a few centigrams of eucalypteol have been added, remains clear and free from micro-organisms even after a month's time.

The action of yeast is somewhat retarded in presence of eucalypteol, but is not otherwise modified.

The above results show that eucalypteol, a substance easily prepared, hinders the development of micro-organisms without influencing the normal and necessary fermentations which take place in the alimentary canal.—F. S. K.

Some Double Salts of Quinine. E. Grimaux. Comptes rend. **115**, 17, 608—610.

The author in a previous note has sought to establish that in the basic salts of quinine the acid is united, not to the nitrogen of the quinoline residue, but to that of the other, probably piperidine, group. If such be the case, the nitrogen of the quinoline group should also be capable of uniting with acids, rendering it possible to prepare salts of the base with two dissimilar acids. This view has been confirmed by the preparation of several examples of such double salts, namely the haloid-sulphates and -phosphates. The hydrobromide-sulphate—

$$(C_{20}H_{21}N_2O_2)_2.2HBr.H_2SO_4.3H_2O$$

for instance, is formed by adding 30 grms. of basic quinine sulphate (1 mol.) to 21 c.c. of hydrobromic acid of sp. gr. 1·180 (2 mols.). The quinine salt dissolves at once and the double salt soon separates as a mass of microscopic white needles. It loses its water of crystallisation at 100° (one sample experienced a loss corresponding to $4H_2O$). It is less soluble in water than the hydrochloride-sulphate, but more so than the hydriodide-sulphate, which requires 19·6 parts at 22°. The phosphate-hydrochloride—

$$(C_{20}H_{24}N_2O_2)_2.2HCl.H_3PO_4$$

crystallises in colourless needles with $9H_2O$, the -hydrobromide with $7H_2O$, and the -hydriodide in yellow crystals containing $6H_2O$.—E. B.

Contributions to our Knowledge of Sparteïne. F. B. Ahrens, Ber. **25**, 3607—3612.

The paper describes several derivatives of oxysparteïne $C_{15}H_{24}N_2O$, a compound obtained from sparteïne (Ber. **24**, 1095; this Journal 1891, 568), by oxidation and its physiological properties have also been investigated. They are shortly summarised as follows: "In doses which cause no visible change in the general condition in the case of dogs, and of frogs, oxyspartein acts on the circulatory system, this consists in an increased activity of the heart in which the work done by single pulsations is augmented, and notwithstanding a decrease in the number of pulsations in most cases the total work done by the heart is even increased." By the action of hydrogen peroxide on spartein and on oxysparteïne the author obtains the substances dioxysparteïne $C_{15}H_{26}N_2O_2$ and trioxyspartein $C_{15}H_{24}N_2O_3$ respectively, and several of the derivatives of these bodies are described.—T. A. L.

Note on the Pyrazoline Reaction. L. Knorr. Ber. **26**, 100—103.

See under XXIII., *page* 466.

Estimation of Quinine in Cinchona Bark. J. H. Schmidt. Pharm. Central-H. N.F. 1892, **13**, 594.

See under XXIII., *page* 467.

New Colour Reactions of Mixtures of Phenacetin, Methacetin, and Hydracetin with a Quinine Salt. T. Gigli. Selmi. 1893 [3], **6**. Chem. Zeit. **16**, 368.

See under XXIII., *page* 466.

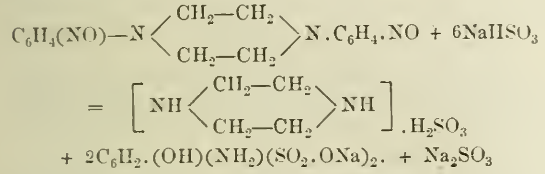
PATENTS.

Improvements in the Manufacture of Oxygen Gas. G. Webb and G. H. Rayner, London. Eng. Pat. 13,036, July 31, 1891.

A reprint of the original patent (this Journal, 1892, 773). The claims in the former are in this specification condensed into one.—C. A. K.

Improvements in the Manufacture of Piperazine and its Salts. B. Willcox, London. From "The Farbenfabriken vormals Friedrich Bayer and Co.," Elberfeld, Germany. Eng. Pat. 4497, March 7, 1892.

Dinitroso-diphenyl-piperazine is converted into piperazine by means of acid sulphites according to the equation—



$$C_6H_4(NO)-N\left\langle\begin{array}{c}CH_2-CH_2\\ CH_2-CH_2\end{array}\right\rangle N.C_6H_4.NO + 6NaHSO_3$$

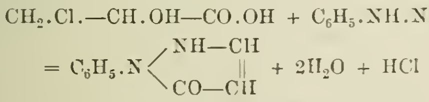
$$= \left[NH\left\langle\begin{array}{c}CH_2-CH_2\\ CH_2-CH_2\end{array}\right\rangle NH\right].H_2SO_3$$

$$+ 2C_6H_2.(OH)(NH_2)(SO_2.ONa)_2. + Na_2SO_3$$

The dinitroso-diphenyl-piperazine is treated with a 40 per cent. aqueous solution of the acid sulphite and the mixture heated to the boiling-point when a violent reaction occurs, the dinitroso-compound being completely dissolved with the formation of a yellow liquid. When the reaction is ended the solution is acidified with hydrochloric or with sulphuric acid, when a portion of the amido-phenol sulphonic acid separates, which is filtered off. The filtrate is then made alkaline and the piperazine distilled over with steam. It is purified by conversion into the hydrochloride and subsequent decomposition of the latter (compare this Journal, 1892, 773).—C. A. K.

An Improved Process for the Production of Oxygenated Pyrazol Derivatives. J. Pfleger and W. Krauth, Frankfort-on-Main, Germany. March 23, 1892.

Oxygenated pyrazol derivatives are obtained by the condensation of β-chlor-lactic acid, glyceric acid, or chloracrylic acid, either in the form of their salts or esters with primary or with secondary symmetrical hydrazines. β-chlor-lactic acid is acted upon by phenyl hydrazine according to the following equation :—



$$CH_2.Cl.-CH.OH-CO.OH + C_6H_5.NH.NH_2$$

$$= C_6H_5.N\left\langle\begin{array}{c}NH-CH\\ \qquad\ \|\\ CO-CH\end{array}\right. + 2H_2O + HCl$$

Phenyl-oxy-pyrazol.

The condensation is best effected between the ethyl ester of β-chlor-lactic acid and phenyl hydrazine in presence of sodium acetate. The reaction is started at 100° C. and completed at 125°—130° C. The resulting product is treated with ether, which dissolves certain impurities, leaving the phenyl-oxy-pyrazol behind in the form of glittering white plates, readily soluble in water and in alcohol. They give an intense reddish-blue colouration with ferric chloride. Chlor-acrylic acid yields the same compound. Such oxy-pyrazol derivatives are of value therapeutically.—C. A. K.

Manufacture of Derivatives of Amido-Crotonic Acid. C. D. Abel, London. From C. F. Boehringer, J. Sohne, Waldhof, near Mannheim, Germany. Eng. Pat. 5811, March 24, 1892.

Acetylacetic anilide, when treated with aqueous or with alcoholic ammonia in slight excess and the mixture allowed to stand for 24 to 30 hours at the ordinary temperature, is converted into amidocrotonylanilide :—

$$\underset{\textit{Acetylacetic anilide.}}{C_{10}H_{11}NO_2} + NH_3 = \underset{\textit{Amido-crotonyl anilide.}}{C_{10}H_{10}(NH_2)NO} + H_2O$$

The product is purified by recrystallisation from alcohol, and forms colourless needles, melting at 146°—147° C. When treated with acetic anhydride it is converted into the acetyl compound which consists of colourless crystals melting at 98° C., and which are very soluble in water, alcohol, and chloroform. These products are of value for therapeutic purposes.—C. A. K.

Improvements in the Manufacture of Periodides of Phenols and Phenol Carboxylic Acids. B. Willcox, London. From The "Farbenfabriken vormals F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 7782, April 25, 1892.

See under XVIII., *page* 460.

Improvements relating to the Production of Narceïne-sodium-sodium-Salicylicum. E. Kauder and L. Merck, Darmstadt, Germany. Eng. Pat. 7979, April 27, 1892.

Narceïne sodium salicylicum is prepared by dissolving narceïne in dilute caustic soda, and adding to the solution sodium salicylate either alone or in aqueous solution. The mixture is evaporated quickly at a moderate heat, when a greyish-white slightly hygroscopic residue remains containing 50 per cent. of narceïne. The preparation is readily soluble in cold water and without decomposition, no free base or basic salt being precipitated, as is the case with other narceïne preparations. Physiological experiments show that the preparation is free from injurious secondary effects, and that it is of special value as a narcotic in the treatment of children's diseases and as a sedative in bronchitis and other similiar diseases.—C. A. K.

New Method of Securing in Holders Menthol Cones and similar Substances. T. D. Vint, Hastings. Eng. Pat. 7925, April 27, 1892.

The object of the invention is to prevent menthol cones and the like from breaking off at the base by which they are fixed to the holder. The stick is secured to the holder by means of feather tips, down, badger hair, india-rubber, silk, wool, or other threads or filaments which ramify through the mass of the menthol cone or stick, and the ends of which are tightly wedged or otherwise secured in the holder. Feather tips are the best for the purpose. They admit of the cone being applied by rubbing in the usual way, without injury to the skin, as the feathers wear away along with the menthol.—C. A. K.

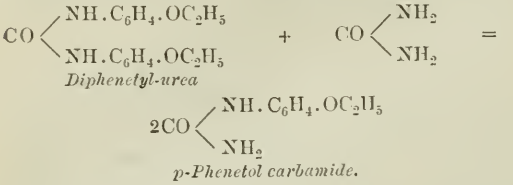
Improvements in Nitrating Cellulose and other Vegetable Fibrous Substances. C. F. Cross, E. J. Bevan, and C. Beadle, London. Eng. Pat. 9284, May 16, 1892.

Instead of treating the fibre directly with nitric and sulphuric acids according to the usual process, it is first reduced to the form of powder. This may be effected by subjecting the fibre to the action of hydrochloric acid gas for some hours. The least mechanical pressure will then reduce the substance to powder. This powder is washed free from acid, dried, and treated with concentrated nitric acid. A gummy solution of nitrated substance is thus formed. The nitrated products are obtained by precipitating such solutions with water for the lower nitrates, or with sulphuric acid for the higher and highest nitrates.

—R. B. B.

Process for Obtaining p-Phenetol-carbamide. H. Thoms, Berlin, Germany. Eng. Pat. 19,878, November 4, 1892.

By the action of carbonyl chloride on para-phenetidine, di-para-phenetylurea is obtained, which is converted into para-phenetol carbamide by heating with urea to 150°—160° C., according to the following equation:—



$$CO\begin{cases}NH.C_6H_4.OC_2H_5\\NH.C_6H_4.OC_2H_5\end{cases} + CO\begin{cases}NH_2\\NH_2\end{cases} = 2CO\begin{cases}NH.C_6H_4.OC_2H_5\\NH_2\end{cases}$$

Para-phenetol carbamide is a crystalline body, melting at about 170° C. and has an intense sweet taste. It is therefore suitable for industrial application as a sweetening substance. According to physiological experiments the new body, for which the name "*Dulcin*" is proposed, is quite harmless. In addition to the above method of preparation it is also obtained by the action of ammonium carbamate or of commercial ammonium carbonate on diphenetylurea or by heating para-phenetidine hydrochloride with urea or with ammonium carbonate or carbamate to 160° C.—C. A. K.

A New Process of Preparing Methyl-Ether, Ethyl-Ether, and their Homologues by the Action of Alcohols on Benzene Sulphonic Acid and other Sulphonic Acids or their Esters. F. Krafft and A. Roos, Heidelberg, Germany. Eng. Pat. 21,938, November 30, 1892.

The patentees have shown that by the action of methyl-alcohol and its homologues on benzene sulphonic acid, benzene disulphonic acid, paratoluene sulphonic acid, β-naphthalene sulphonic acids, &c., esters of the sulphonic acids are readily formed, which are decomposed by an excess of the alcohol with the formation of ethers and regeneration of the sulphonic acids. (Ber. 1892, **25**, 2255.) The reaction is employed for the preparation of simple and of mixed ethers, the alcohol being gradually added to the sulphonic acid and the mixture kept boiling at a temperature of 135°—145° C., when the ether, water, and undecomposed alcohol distil over. The process possesses a great advantage over the usual method for the preparation of ether, because the sulphonic acid itself undergoes practically no change, it having been shown that benzene sulphonic acid is capable of converting 100 times its weight of ethyl-alcohol into ethyl-ether. The decomposition in this case is represented by the following equations—

I.

$$C_6H_5.SO_2.OH. + C_2H_5.OH = C_6H_5.SO_2OC_2H_5 + H_2O$$

II.

$$C_6H_5.SO_2.OC_2H_5 + C_2H_5.OH = C_6H_5.SO_2OH + (C_2H_5)_2O$$

It is not necessary to isolate the ester of the sulphonic acid except in the case of alcohols of high molecular height. —C. A. K.

A New or Improved Process for Separating Solid or Fluid Substances, Dissolved in Alcohol, Ether, or Chloroform without Evaporation of the Solvent. C. Weitenkampf, Berlin, Germany. Eng. Pat. 23,398, December 19, 1892.

The solution is cooled to a temperature of 20°—25° C., saturated with carbonic acid and filtered. The temperature and pressure must be kept constant throughout the operation.—A. L. S.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photography in Colours. G. Lippmann. Comptes rend., **115**, 17, 575

The colours of the spectrum are correctly photographed on gelatin or albumin films, sensitised with potassium bichromate, when the latter are exposed in the camera in contact with a mercury mirror. The albumin films must be treated with a solution of mercuric chloride, either before sensitising or previous to washing, after exposure. This coagulates the albumin and so prevents its dissolution in the parts unaffected by the light. The images are seen in their natural colours while the films are moist, but on drying the colours vanish, reappearing, however, when the films are moistened. Albumin films require to be completely moistened to render the colours visible, but those of gelatin exhibit them on being slightly moistened, for instance by breathing upon them. (Compare this Journal, 1891, 485). —E. B.

PATENT.

Improvements in or relating to Photographic Films or the like. A. J. Boult, London.—From G. Eastman, Rochester, U.S.A. Eng. Pat. 7501, April 20, 1892.

Celluloid films are very liable to show on development fog or markings caused by electrical discharges occurring during the manufacture or employment of the material. This objectionable property of the film is removed by incorporating in the nitro-cellulose a small amount (10 grains to the pound) of ammonium or other alkaline nitrate. In preparing the improved film described in Eng. Pat. 19,658, 1890, where the celluloid is coated on both sides with a gelatin film, the ammonium nitrate may be added in the proportion of 50 grains to the pound to the non-sensitised gelatin film.—F. H. L.

XXII.—EXPLOSIVES, MATCHES, Etc.

Determination of Nitroglycerin in Dynamite. M. Liebschutz. Monit. Scient. **41**, 14—16.

See under XXIII., *page* 470.

PATENTS.

An Improved Explosive Projectile. O. M. Thowless, Newark, New Jersey, U.S.A. Eng. Pat. 6341, April 1, 1892.

The inventor charges a shell or explosive projectile, either with sodium alone, and provides openings so that when the shell falls into water, the latter rushes in and coming in contact with the sodium causes an explosion, or, the shell, in addition to the sodium, contains water in a glass receptacle which is broken by the impact and thus gives it access to the sodium. Arrangements are also described for charging the shell with nitroglycerin, dynamite, gunpowder, or guncotton and sodium and water.—W. M.

A New or Improved Manufacture of Gunpowder. J. G. Lorrain, London. From G. Schnebelin, Paris, France. Eng. Pat. 9359, May 17, 1892.

This invention describes a powder made by adding to a solution of 600 grms. of potassium chlorate, 18 grms. of elder pith, or other form of cellulose, and 150 grms. of starch and drying the pasty mass so produced.

When it is desired to make a smokeless powder the starch is omitted.—W. M.

Improvements in and relating to Matches. P. Lorenz, Berlin, and R. Wuppermann, Barmen, Germany. Eng. Pat. 10,493, June 2, 1892.

"The matches forming the present invention are formed of a tough and strong pasteboard preferably made from wood pulp and are stamped from one piece, after the manner of a fringe being narrowed at the point so as to prevent the heads rubbing against each other. Such leaf contains preferably about 10 or 12 matches and several of these leaves are fixed together to form a block and attached in a wrapper of strong paper, the ends of which fold over each other and are closed in the style of an envelope. The inside of the over-lapping end of the wrapper and the outside of that part covered by the said overlap are provided with igniting surfaces, so that to ignite a match the head is placed between the two igniting surfaces, the latter lightly pressed together and the match drawn sharply out when the same will be ignited."—W. M.

Improvements in and Relating to Matches and the Manufacture thereof. C. M. Bowman, Lebanon, Pa., U.S.A. Eng. Pat. 2704, February 7, 1893.

The splints of these matches are notched at one end, so that after dipping the "fulminate" is keyed into the splint as well as encasing the end. Further in the method of making, cards of splints are formed in the shape of double combs, by means of circular saws properly assembled. These cards are then placed in a suitable way, and secured in a separated position by a holder which bears upon the uncut portion of the card, and are ready for dipping.—J. C. C.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS.

Aluminium Apparatus for the Laboratory. G. Bornemann. Ber. **25**, 3637—3642.

The low specific gravity, the high specific heat, and the stability towards atmospheric influences, give aluminium certain advantages over other metals for a variety of laboratory utensils. It is a suitable material for light weights, certain portions of balances, weighing-tubes, air-baths, clips, metal parts and adjuncts in apparatus used in cases where hydrogen sulphide is evolved, water-baths, heating apparatus, &c. It is further important on account of its malleability, fusibility, tensile strength, elasticity, and chemical stability. It is not, however, suitable where a temperature of above 400—500° C. is employed, or where it repeatedly comes in contact with caustic alkalis or strong acids. The author compares air-baths of copper with those of aluminium and shows as the result of a number of experiments that the same flame is capable of heating an aluminium bath more rapidly than a copper bath, and can maintain the bath at a higher temperature. The difference of temperature in different parts of the bath are more uniform in the aluminium than in the copper bath. Two aluminium baths in daily use for 10 months showed at the end of this period no deterioration of the metal. No scaling was noticeable, as is always the case with copper. Aluminium water-baths also possess other advantages over copper baths. After a bath had been in use for three weeks the metal inside remained practically untouched by the water while the outside metal was only slightly attacked by the sulphurous products of combustion contained in the gas. Rings and clips have the advantage of preserving their metallic lustre and do not require to be lacquered. An aluminium sand bath did not show any diminution in weight after considerable use, but could not be heated to a temperature approaching a dark-red heat. An aluminium crucible was destroyed by heating cupric oxide in it to a dark red heat. Aluminium melts between 580° and 628° C., but becomes granular and brittle before reaching this temperature.—K. E. M.

PATENTS.

An Improved Blow Pipe. F. H. Beirne, Wrexham. Eng. Pat. 10,614, June 3, 1892.

For the purpose of facilitating the production of a continuous blast, the inventor inserts an india-rubber bag in the stem of a blow pipe between the mouth-piece and the nozzle. A valve opening inwards prevents the return of the air from the bag to the mouth-piece during expiration. —B.

A New Instrument for the Measurement of the Refractive Index of Light in Liquids. C. Féry, London. Eng Pat. 5281, March 17, 1892.

This instrument has a collimator and telescope furnished with cross-wires, the axes of which coincide, rigidly attached to a stage, on this is a hollow prism which can be moved backwards and forwards between the collimator and telescope by a rack and pinion, a vernier and scale being attached. The hollow prism is the essential feature of the invention, its two sides being formed of similar slips of glass cut out of a plain convex lens, so that a liquid poured into the trough forms a prism of constant angle, two opposite sides being bounded by solid prisms of glass of varying angle, and the refraction of the light caused by this liquid, is, in a certain position annulled by the refraction of the prisms of glass. The instrument is standardised by noting the position of the trough, by means of the vernier and scale for two liquids having known indices of refraction.—J. C. C.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Note on Eschka's Method of Estimating Sulphur. F. Hundeshagen. Chem. Zeit. **16**, 1070—1071.

The author points out that Eschka's method may lead to errors, amounting up to 6 per cent. of the sulphur present, owing to volatilisation of sulphur, a fact which can be proved by the blackening of lead paper held over the crucible. This source of error can be avoided by adopting the author's proposal, viz., to use two parts of magnesia and one part of calcined potassium carbonate (thus replacing Eschka's sodium carbonate by potassium carbonate). Several lignites, rich in sulphur, were examined both by Eschka's and by the author's modified method, and the superiority of the latter is demonstrated in the subjoined table:—

Lig-nite.	A. Magnesium Sodium Carbonate (Eschka's) Mixture.		B. Magnesium Potassium Carbonate Mixture.		Loss of sulphur in A.
	Reaction on Lead Paper.	Sulphur found.	Reaction on Lead Paper.	Sulphur found.	
No.		Per Cent.		Per Cent.	Per Cent.
I.	Blackening	1·97	No coloration.	2·10	0·13
II.	"	2·43	"	2·58	0·15
III.	"	2·77	Very slightly brown.	3·06	0·29

It was further found that good results were obtained if only half of the sodium carbonate was replaced by the corresponding potassium salt.

These experiments prove that potassium carbonate is better able to bind sulphuretted hydrogen than sodium carbonate, as the latter becomes anhydrous at a lower temperature than the former, and does not absorb the gas so readily. Besides, the sodium sulphide is more easily decomposed by carbonic anhydride.—J. L.

The Analysis of Thomas Slag. O. Foerster. Chem. Zeit. 1892, 1596.

The Union of Agricultural Laboratories of Germany adopted the use of sulphuric acid for the decomposition of Thomas slag, the phosphoric acid being estimated by means of the citrate method. In the meantime it has been shown that, even with this modification, the citrate method in its present form is not satisfactory for the estimation of the phosphoric acid in Thomas slag, and under these circumstances the molybdenum method has been reverted to, retaining, however, the sulphuric acid for the decomposition of the slag. It must, however, be pointed out that hot concentrated sulphuric acid is capable of oxidising into phosphoric acid the phosphorus contained in iron phosphide, which may occur in such slags. If, therefore, sulphuric acid is to be employed for the decomposition, it is preferably employed in a dilute form. Considering, however, that tetra-calcium phosphate is completely soluble in dilute citric acid, and that slags so treated sometimes leave a residue containing phosphoric acid, the employment of stronger acids appears objectionable, as the value of these slags depends entirely upon the phosphoric acid of the tetra-calcium phosphate contained in them.—C. O. W.

Borax the Basis of Alkalimetry. E. Rimbach. Ber. **26**, 171.

It is customary to use sodium carbonate for standardising normal acids. This substance, generally prepared by ignition of sodium bicarbonate, is difficult to obtain chemically pure. If heated to too high a temperature it is apt to contain caustic soda; if not sufficiently heated, undecomposed bicarbonate will remain. This fact, coupled with that of its great hygroscopicity, leads the author to propose the use of borax instead of sodium carbonate. The facility with which borax may be obtained quite pure, and its high molecular weight, make it specially adapted for the purpose. It is obtained sufficiently pure by recrystallising the pure borax of commerce twice, and drying the fine powder by exposure for several days.

One grm. of borax corresponds to 5·2391 cc. of normal acid; 1 litre of normal acid corresponds to 190,872 grms. of borax.—K. E. M.

Determination of the Hardness of Water. Schmidt. Chem. Zeit. 1892, **16**, 1275.

In Wilson's method for the determination of the hardness of water, the determination has to be very quickly made, owing to combined calcium, &c. being partially precipitated on the addition of sodium carbonate. It is therefore recommended that potassium bicarbonate be substituted for the sodium carbonate, the former not producing any turbidity, and therefore not preventing the whole of the bases from being acted upon.—C. A. K.

ORGANIC CHEMISTRY.—QUALITATIVE.

Note on the Pyrazoline Reaction. L. Knorr. Ber. **26**, 100—103.

By oxidising pyrazoline bases in an acid solution they are converted into red or blue colouring matters. The test is best performed by dissolving a trace of the substance in tolerably strong sulphuric acid and adding a drop of sodium nitrite or bichromate solution when the colouring matter is produced. This reaction can also be employed for the detection of pyrazoles from phenylhydrazine, as these on reduction with sodium and alcohol yield pyrazolines. For this purpose a small quantity of the pyrazole base is dissolved in a test-tube in alcohol and a small piece of sodium thrown into the boiling solution. When the metal is dissolved, water is added, the alcohol driven off, and the aqueous solution extracted with ether. The pyrazoline test is then applied to the ether extract. As to the limits of the reaction the following facts have been observed:—

1. All pyrazole bases derived from phenylhydrazine which do not contain oxygen, show the test.
2. Only some of the pyrazolones obtained from phenylhydrazine give it. For instance, 1-phenyl-3-methylpyrazolone and antipyrine do not give it, whilst 1-phenyl-3-4-trimethylpyrazolone shows it in a marked degree.
3. None of the pyrazoles obtained from hydrazine hydrate give the test.

The colouring matters appear to be salts of a base obtained by condensing two pyrazoline rests. By oxidising 1-phenyl-3-methyl-pyrazoline it yields a base melting at 275°—278° C., which crystallises from glacial acetic acid in characteristic silvery plates and dissolves in mineral acids with a red colour. The salts dissociate easily. If much water be added the colour disappears, but reappears on adding more acid. The same compound is also obtained by oxidising 1·5-diphenyl-3-methyl-pyrazoline.—T. A. L.

New Colour Reactions of Mixtures of Phenacetin, Methacetin and Hydracetin with a Quinine Salt. T. Gigli. Selmi. 1893 [3], 6. Chem. Zeit. **16** (1892), 368.

Flückiger has pointed out that a reddish or brown coloration is produced when saturated aqueous solutions of phenacetin or methacetin are mixed with an equal quantity of chlorine water and then a few drops of ammonia added; the coloration appears more quickly and is more intense in the case of methacetin.

The author finds that when a relatively small quantity of a quinine salt, such as basic quinine sulphate, is added to the phenacetin or methacetin, and the mixture then treated with chlorine water and ammonia, a beautiful blue instead of a reddish-brown coloration is produced.

A solution of hydracetin gives with chlorine water a yellow coloration, which becomes more intense on adding a small quantity of ammonia; if a small quantity of basic quinine sulphate be previously mixed with the hydracetin a fine red colour is produced.

Substances, such as acetanilide and exalgin, which are chemically related to phenacetin, and which do not give any coloration when treated alone with chlorine water and ammonia, give the characteristic quinine reaction when previously mixed with basic quinine sulphate.

Morphine, which alone gives a yellow coloration with chlorine water and ammonia, gives the green quinine reaction when previously mixed with a quinine salt.

—F. S. K.

Detection of Wheaten Flour in Rye Flour. A. Kleeberg. Chem. Zeit. **16**, 1071—1072.

The gluten of wheaten flour can be removed by subjecting the flour to kneading in a current of water, whilst rye-flour gluten cannot be separated in this way. The author has based on this different behaviour a process for detecting an admixture of wheaten flour with rye flour, which he describes as follows:—Place as much of the flour as will lie on the point of a knife on an object-glass of 7·5 cm. by 2·5 cm., add 5—6 drops of lukewarm water (40°—50° C.), and stir well. The quantity of water should be so large that the particles of flour continue to float in the water. The mixture of water and flour is spread over three parts of the object-glass and another object-glass placed on it in such a way that the dry ends protrude on either side. Press the two glasses well, wipe off the liquid, and slide the top glass to and fro several times. During the pressing of the glasses white spots will be observed if wheaten flour be present, which, on being rolled, form "vermicelli"; these are short and thin if the quantity of wheat present is small, and become thicker and longer with increasing amounts of wheaten flour. An admixture of 5 per cent. of wheat flour can thus be recognised with certainty.—J. L.

The Oxidation of Tartaric Acid in Presence of Iron. H. J. H. Fenton. Proc. Chem. Soc. 1893 [123], 113.

If a small quantity of hydrogen peroxide be added to a solution of tartaric acid containing a trace of ferrous salt, a yellow colour is produced, which changes to violet on adding alkali; an excess of the peroxide must be avoided. As other organic acids do not behave in this manner, the interaction may be utilised in detecting tartaric acid. The violet colour is discharged by acids, sulphuric acid producing a transient green colouration, and is reproduced by alkali.

The compound which gives the colour with ferric salts is crystalline, and appears to be represented by the formula $C_2H_2O_3$. It is best obtained by dissolving tartaric acid in a limited quantity of boiling water, and then adding about one-twentieth of its weight of reduced iron; the liquid is then heated until clear. After the solution has been well cooled, hydrogen peroxide is carefully added drop by drop, the temperature being maintained constant until the liquid is nearly black; slightly hydrated phosphoric oxide is next added in small quantities at a time, the mixture being still well cooled, and finally the compound is extracted with ether. The ether is then distilled off, and the residue mixed with cold water; the resulting white powder is washed with a small quantity of cold water. The compound is a powerful reducing agent, and behaves as a ketone with phenylhydrazine, hydroxylamine, and hydrogen cyanide. The author is further investigating the properties and constitution of the product in question.

The Reactions of Sodium Acetate. F. Collischoun. Chem. Zeit. 1892, **16**, 1921—1922.

According to the last issue of the German Pharmacopœia (3rd edition), a solution of sodium acetate turns red litmus-paper blue, but does not redden a solution of phenolphthaleïn. The author points out that this latter statement is erroneous, sodium acetate is alkaline also towards phenolphthaleïn. Although seemingly unimportant this point is of practical interest. Sodium acetate is employed medicinally to a considerable extent, and complaints continually arise because the salt does not conform to the prescribed requirements. As a matter of fact, all, even the purest, commercial sodium acetate is alkaline to phenolphthaleïn, and repeated crystallisation fails to alter its reaction. A number of experiments are detailed which confirm this statement. It appears that sodium acetate, even when crystallised from a solution rendered distinctly acid by acetic acid, retains its alkaline character. A salt thus prepared, on recrystallisation from water, increases slightly in alkalinity (doubtless owing to the removal from it of traces of free acetic acid). After this, the alkalinity remains constant, although the salt be repeatedly recrystallised, or even if its solution be boiled for several hours. 50 grms. of acetate dissolved in 50 cc. of water plus 2 drops of phenolphthaleïn solution (1:100) required on the average 1 cc. of decinormal hydrochloric acid for decolorisation at 17° C.—H. T. P.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Analysis of Butter. Schmidt. Chem. Zeit. 1892, **16**, 1275.

The use of alcohol in Reichert's method of butter analysis is open to objection, since it gives rise to the formation of esters and is difficult to evaporate off completely. The author therefore recommends a method in which the use of alcohol is avoided. 5 grms. of butter fat are treated in a flask with 2 cc. of caustic soda solution (1:1) and 20 cc. of glycerol. Saponification is effected by 10 minutes careful heating of the mixture, which is then acidified with dilute sulphuric acid and treated as in Reichert's process (this Journal, 1888, 185).—C. A. K.

Examination of "High Flash-point" Burning Oils (Safety Oils). R. Kissling. Chem. Zeit. **16**, 1070.

The author proposes to use Abel's apparatus for testing oils of a higher flash-point than 25° C. by raising the temperature of the water-bath to 75° C. for oils flashing between 40° and 50° C., and from 95° to 100° for oils of a still higher flashing-point. The following little table shows that constant results may be expected :—

Safety Oil No.	Experiment No.				
	1.	2.	3.	4.	5.
	° C.	° C.	° C.	° C.	° C.
I.	48·5	49	48·5	49·5	48·5
II.	61	61	61·5	61·5	..
III.	67	67	67	65·5	..
IV.	75	74	75	75·5	..

—J. L.

Estimation of Quinine in Cinchona Bark. J. H. Schmidt. Pharm. Central-H. N.F. 1892, **13**, 594. Chem. Zeit. **16** (1892), 307.

The following method of estimating quinine gives very satisfactory results :—The finely-divided air-dried bark (20 grms.) is macerated for 24 hours in an Erlenmeyer's flask with 10 cc. of 10 per cent. ammonia, 20 cc. of 90 per cent. alcohol, and 170 cc. of ether, the mixture being shaken from time to time; 100 cc. of the liquid are then transferred to a beaker, 27 cc. of water and 3—4 cc. of normal hydrochloric acid added, and the mixture placed aside to evaporate for 24 hours. The ammonia and alcohol are afterwards expelled by warming on the water-bath, and, if necessary, hydrochloric acid is added until the solution is neutral or only very feebly acid; if it be too acid it is neutralised with cinchonine, but in no case with ammonia or potash. As soon as the solution, about 15 cc., has become clear it is filtered from any deposit, 2—3 grms. of potassium sodium tartrate added, the mixture warmed on the water-bath for 15 minutes, and after 24 hours' time the precipitated tartrates separated by filtration and washed with the least possible quantity of water. For every 1 cc. of mother-liquor, 0·0008 grm., and for every 1 cc. of water used in washing 0·0004 grm. of quinine is added to the quantity obtained below. The tartrates on the filter are transferred to an Erlenmeyer's flask, which is fitted up as a wash-bottle, and dissolved in dilute hydrochloric acid; the solution is repeatedly extracted with ether until it becomes colourless, the alkaloids are precipitated with soda, and the precipitate dissolved by gently agitating with ether; the ethereal solution is then blown into a small flask and the extraction repeated. The combined extracts are evaporated, the residue dried at 100—110° and weighed; finally the residue is treated with a saturated ethereal solution of cinchonine, in which the quinine dissolves, and, after decanting carefully and drying until constant, it is again weighed; the difference in weight, plus the quantity added in accordance with the above directions, gives the amount of quinine.—F. S. K.

Contributions to the Analysis of India-rubber Articles. R. Henriques. Chem. Zeit. 1892, **16**, 1595, 1623, and 1644.

The methods for the analysis of india-rubber articles are still in a very unsatisfactory condition, even the estimation of the mineral admixtures offering very considerable difficulties, which further increase with the attempt to estimate the amount of sulphur actually taken up by the india-rubber in the process of vulcanisation. The separation of the india-rubber from the various india-rubber substitutes has scarcely ever been seriously attempted, largely owing no doubt to the chemically indifferent and at the same time so very complex nature of the compounds in question. Great care to begin with is required in the selection of the material for the analysis, the india-rubber articles not being the homogeneous material they appear to be. It is therefore necessary to prepare an average sample from as many as possible different parts of the article and to use rather large quantities of this average sample for actual analysis. The residue after ignition is at present considered the most important item in the analysis of india-rubber articles, but it is really next to valueless, owing to the reducing action of the burning organic matter upon most of the mineral compounds present in india-rubber goods. The estimation of the total sulphur by igniting the sample with sodium carbonate and nitrate, or with addition of magnesium or ammonium nitrate, never gives correct results. Fuming nitric acid easily effects the complete destruction and solution of all india-rubber articles, but the sulphuric acid contained in these solutions cannot be estimated by simple precipitation with barium chloride, considerable quantities of the barium salts of certain organic acids being simultaneously precipitated with the barium sulphate. The following process is therefore employed :—20 cc. of pure fuming nitric acid are introduced into a small dish, which is then covered with a funnel, through the stem of which about 3 to 4 grms. of the india-rubber article are very slowly added to the acid. As soon as the first, often very violent reaction has ceased, the dish is gently warmed on the water-bath and the contents concentrated to the consistency of thin syrup. After adding to this concentrated solution 4 grms. of a mixture of 3 parts of potassium nitrate and 4 parts of carbonate of soda, it is carefully fused, subsequently treated with dilute hydrochloric acid, again evaporated to dryness in order to render insoluble any silicic acid, redissolved with addition of a little nitric acid, and eventually the sulphuric acid is precipitated in the usual manner. The before-mentioned residue of silicic acid may also contain barium sulphate and lead sulphate; the latter is dissolved in ammonium acetate, and the two former are separated in the usual manner and their amounts ascertained by the well-known methods. For the estimation of the sulphur of vulcanisation, including also the excess of sulphur used in this process, it is necessary to separate these two from the sulphur present, in the form of sulphates and sulphides. Of all the methods proposed for this purpose only that based upon the solution of the india-rubber and sulphur in turpentine gives anything like satisfactory results. According to this method the india-rubber is treated with turpentine at a temperature of from 60° to 70° C. for about a week. The solution may, however, be hastened very considerably by using the turpentine at the boiling temperature; two days are then sufficient to complete the solution. At this temperature, unfortunately, sulphur acts upon turpentine, sulphuretted hydrogen being formed, which, acting upon metallic compounds contained in the india-rubber, forms sulphides, thus leading to serious errors. But even where the solution of the india-rubber in the turpentine has been satisfactorily carried out, the subsequent filtration of these solutions is always a most difficult, troublesome, and often even impossible task. Much better results are obtained by substituting for the turpentine that fraction of ordinary petroleum which distils over at from 140° to 250° C. Two days' treatment with such a petroleum at the boiling temperature will dissolve even the most refractory of india-rubber samples within two days. From 5 to 15 grms. of the sample are placed in a weighed flask, and, after adding about 150 cc. of petroleum free from sulphur, the flask is heated with reflux condenser at about 150° C. until all is dissolved, except the inorganic substances present, which form a fine sediment. The solution is then filtered, the flask repeatedly washed with hot petroleum, and finally filter and flask are rinsed with petroleum ether. Filter and flask are then dried together at 110° C. and weighed. After deducting from the weight so found the original weights of the flask and dry filter, the weight of the substances insoluble in petroleum is obtained, and the percentage of sulphur is now easily estimated. Deducting this quantity of sulphur from the total sulphur of the sample, the quantity of free sulphur and sulphur of vulcanisation are obtained. It must be observed, however, that if the sample contains oxidising agents, such as red-lead, together with metallic oxides or carbonates, the above results may be too low owing to some of the free sulphur being oxidised to sulphuric acid. Of course the insoluble residue obtained during the petroleum treatment can also be employed for the purpose of estimating the inorganic bases, as well as the form in which they have been added to the india-rubber. However, ebonite cannot be analysed in this manner, since it even resists the action of boiling petroleum.

Large quantities of india-rubber substitutes, produced by boiling certain oils with sulphur or treating them with monochloride of sulphur, are employed at present in the manufacture of india-rubber articles, and if their qualitative detection is already a matter of great difficulty, their quantitative estimation is much more so. Two samples of these substitutes gave the following figures on analysis :—

—	Sample No. 1.	Sample No. 2.
	Per Cent.	Per Cent.
Water	1·00	0·85
Sulphur	6·17	6·4
Residue after ignition	5·51	0·8

The behaviour of these substitutes towards solvents is very much like that of india-rubber itself, so that their separation by means of solvents appears impossible, although bisulphide of carbon containing 5 per cent. of alcohol will dissolve any free oil they contain, of which there is sometimes as much as from 20 to 30 per cent. In applying Hübl's iodine test for oils to these substitutes the surprising observation was made that practically no iodine was absorbed; in other words, that these substitutes are unsaturated compounds. All these substitutes, however, are easily and completely soluble in alcoholic potash, which saponifies them, so that in alcoholic potash we have a means of separating such substitutes quantitatively from india-rubber, which is scarcely acted upon by that solution. In order to ascertain the exact amount of organic matter extracted from india-rubber by means of alcoholic potash, the residue after ignition, total sulphur, the residue after extraction and its total sulphur, and the corresponding residue after ignition and its total sulphur, must be known. Four complete analyses of the same sample of vulcanised india-rubber gave the following figures :—

—	I.	II.	III.	IV.
1. Residue after ignition 2·80 p.c.	..	..	..	..
2. Sulphur 9·50 p.c.	..	..	..	..
3. Residue after extraction	95·4	95·0	95·55	95·55
4. Residue after ignition of 3	8·49	9·02	9·21	9·17
5. Sulphur in 3	4·5	4·5	4·35	..
6. Sulphur dissolved	5·0	5·0	5·15	..
7. Sulphur in 4	..	1·14	1·42	1·08
8. = SO_3	..	2·85	3·1	2·7
9. Na_2O in 4 (= 4. − 1. − 8.)	..	3·37	3·31	3·67
10. Real residue after extraction (3. − 9.).	..	91·63	92·21	91·88
11. Dissolved { Sulphur	5·0	5·0	5·15	..
11. Dissolved { Organic matter	..	3·37	2·61	3·12

In executing these analyses the following was the mode of procedure :—From 3 to 5 grms. of the substance were cut into small cubes and boiled with 10 times the weight of alcoholic soda (8 per cent. strong) for about eight hours, the solution obtained was poured into a dish, diluted with water, and the alcohol driven off on the water-bath. The residue was filtered through a weighed filter, carefully washed, the filter dried at 100° C. and weighed. For the determination of (4) at least 1 grm. of the extracted residue is used, the ignition being performed in the presence of ammonium nitrate. The sample used for the above analyses had therefore the following composition :—

	Per Cent.
Residue after ignition	2·8
Sulphur	9·5
India-rubber	87·7

Of these was in the average dissolved :—

	Per Cent.
Sulphur	5·05
India-rubber	3·03

It is possible that this dissolved sulphur was contained in the sample as free sulphur. If so, the above method would enable us to determine the invariably used excess of sulphur separate from the sulphur of vulcanisation. As to the nature of the dissolved organic substance above termed india-rubber, nothing definite can be said, but it is a fact that small quantities of the india-rubber substance are dissolved by alcoholic soda from either vulcanised or unvulcanised india-rubber.

In the analysis of two samples of ebonite the following figures were obtained :—

——	A.	B.
1. Residue after ignition	0·01	0·05
2. Sulphur	31·2	40·12
3. Residue after extraction	92·14	90·94
4. Residue after ignition of 3	3·87	6·99
5. Sulphur in 3	22·6	29·43
6. Sulphur dissolved	8·6	10·69
7. Sulphur in 4	0·49	1·51
8. = SO_3	1·22	3·78
9. Na_2O in 4	1·57	3·21
10. Real residue after extraction	90·57	87·73
11. Dissolved { Sulphur	8·6	10·69
Organic matter	0·83	1·58

The analysis of two samples of ordinary india-rubber articles gave the following results :—

——	A.	B.
1. Residue after ignition	1·9	3·0
2. Sulphur	5·1	4·26
3. Residue after extraction	45·8	88·97
4. Residue after ignition of 3	5·31	5·87
5. Sulphur in 3	0·66	2·38
6. Sulphur dissolved	4·44	1·88
7. Sulphur in 4	0·29	0·5
8. = SO_3	0·72	1·25
9. Na_2O in 4	3·12	1·62
10. Real residue after extraction	42·68	87·35
Accordingly had been dissolved { Sulphur	4·44	1·88
Organic matter	52·88	10·77
Undissolved { Sulphur	0·66	2·38
Organic matter	49·12	81·97
Mineral matter	1·9	3·0

The insoluble organic residue is completely soluble in petroleum, and is to all appearances pure rubber. Assuming 3 per cent. of the rubber to have been dissolved by the alcoholic soda, the above two samples would be composed of—

——	A.	B.
India-rubber	41·32	84·43
Substitute	51·68	8·31
Sulphur	5·1	4·26
Mineral matter	1·9	3·0

How much of this sulphur belongs to the substitute and how much to the india-rubber cannot be gathered from these figures.—C. O. W.

The Analysis of India-rubber Articles. D. Holde. Mitt. aus d. kgl. techn. Versuchsanst. 1892, 306.

The fact of the india-rubber substitutes mentioned by Henriques (see preceding abstract) not absorbing any iodine is in perfect accord with the decrease of the iodine absorption in oxidised unsaturated oils. With regard to the question of estimating fatty oils and india-rubber substitutes prepared from them in india-rubber articles, it may be mentioned that india-rubber can be detected in and separated from mineral oils by adding 3 parts of absolute alcohol to 4 parts of the ethereal solution of the oil, whereby the india-rubber is precipitated. In the same manner mineral oils can also be separated from india-rubber, from 3 to 4 per cent. of which are also dissolved. Sulpho-chlorinated substitutes, prepared by treating 4 parts of linseed oil with a mixture of 4 parts of chloride of sulphur and 4 parts of bisulphide of carbon, were found to be perfectly insoluble in ether-alcohol. Through the process of vulcanisation, india-rubber also becomes practically insoluble in that solvent. In treating olive-oil with chloride of sulphur in the above-mentioned manner, substances are obtained which are also almost insoluble in ether-alcohol, and it appears therefore doubtful whether by this treatment drying oils can be detected in non-drying oils as stated by Bruce-Warren.—C. O. W.

The Analysis of Steam Lard. A. Goske. Chem. Zeit. 1892, 1560 and 1592.

The assumption that a steam lard may be considered as genuine when its iodine absorption value is about 60, providing that vegetable oils are absent, must be abandoned as erroneous, according to the researches of the author. Artificial lard is not manufactured from tallow and vegetable oils alone, but as a rule lard is added to give the proper consistency to the product. The practice of the makers of artificial lard is to incorporate with the steam lard, beef- or mutton-stearin and then to add lard oil. Thus they unwittingly produce a fat possessing the correct iodine absorption value. The following mixtures illustrate this assertion of the author :—

Fat No.	Beef Stearin.	Steam Lard.	Mutton Tallow.	Lard Oil.	Calculated Iodine Value.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	10	90	..	..	60·5
2	15	85	..	..	58·25
3	..	70	30	..	57·50
4	25	45	..	30	59·75
5	35	25	40	..	57·27

The iodine absorptions have been calculated assuming the following absorption values :—beef stearin, 20 ; steam lard, 65 ; mutton tallow, 40 ; lard oil, 85.

The iodine values of lard stearin do not differ much from those of beef stearin, just as lard oil does not differ much in this respect from cotton-, sesamé-, and earth-nut oils. The variation of the iodine absorption in stearin depends on the amount of pressure used and on the temperature at which the fat has been expressed : *e.g.*, the iodine value of a lard stearin expressed at 27° R. has been found to be 70, whilst the same material expressed at a temperature of 13° R. absorbed 82·8 per cent. iodine.—J. L.

The iodine numbers of pure lard (I.), and of one adulterated with tallow (II.), were found to be as follows :—

——	I.	II.
Original lard	60·7	59·1
Half pressed	52·1—52·3	45·5—44·8
Strongly pressed	34·5	29·8

Neither the iodine numbers of the original nor those of the pressed greases show differences which would justify a suspicion of adulteration with tallow. No more information is to be gained by estimating the specific gravities or the saponification equivalents. The following is a satisfactory method for the analysis of lards :—The solidification point of the lard is estimated by melting it in a dish floating upon water at about 60° C. The molten lard is then filled into a wide test-tube, which is covered with some non-conducting material. The solidification point is then observed by means of a thermometer divided into one-fifth of a degree. Thus the following temperatures were obtained :—

	° C.
Home made lard........................	27·10—28·62
„	26·64—29·34
„	29·10—29·95
Pure steam lard........................	24·10—26·00
„	25·05—25·50
„	26·40—27·06
„	24·90
„	23·67—26·18
Adulterated lard	30·50
„	29·73—29·80
„	29·90—30·15
„	31·95—33·00
„	35·90—36·58
„	35·50—35·75

Very characteristic is also the form of the crystals of stearin obtained from the ethereal solutions of lards. Two grms. of the lard are weighed in a test-tube and dissolved in 10 cc. of ether. The test-tube is then plugged with cotton wool and left to stand for about six hours in a cool place. As soon as the bottom of the tube contains some crystals the supernatant ethereal solution is poured off and some cc. of cotton oil added instead. Some well-formed crystals are then removed from the oil by means of a platinum wire and examined microscopically. Tallow (beef) stearin crystallises in agglomerated needles, lard (pork) stearin crystallises in well-formed tables. Vegetable oils are best discovered by means of phospho-molybdic acid, the nitric acid, and the the sulphuric acid (Maumené) test.—C. O. W.

The Detection of Fatty Oils in Mineral Oils. Ruhemann.

Mitt. aus d. kgl. techn. Versuchsanst. 1892, 306.

Lux's method of detecting fatty oils in mineral oils by treating them at a temperature of about 200° C. with metallic sodium or solid caustic soda, has been found to yield doubtful results in the case of very viscous and dark mineral oils. The method is quite unavailable for such cylinder oils as are solid at ordinary temperatures, since the formation of a soap jelly cannot be observed in this case. A reinvestigation of Lux's process, saponifying at temperatures varying from 200° to 250° C., gave the following results :—

1. Treatment of the samples at temperatures of from 200° to 210° C. will enable the operator to detect in light coloured mineral oils the presence of 2 per cent. and even less of fatty oils, but in dark oils often larger percentages will escape detection. The test is best performed at about 230° C. for light oils, and at about 250° C. for dark ones.

2. The presence of fatty oils in mineral oils is proved by the complete or partial gelatinising of the treated samples after cooling, and also by the appearance of the characteristic flaky soap froth.

3. This soap froth is also observable on oils which are solid at ordinary temperatures, and its quantity is in distinct proportion to the quantity of fatty oil present.

4. Lux's statement that very small quantities of fatty oils are easier to detect with metallic sodium than with caustic soda is confirmed in many cases, but evidently is also dependent upon the nature of the mineral oils.

5. The smallest quantity of fatty oils recognisable by this test is variable, according to the nature of both the mineral and the fatty oil. In all light coloured mineral oils, half a per cent. of fatty oils, in dark mineral oils, 2 per cent., and sometimes even less, of fatty oils can be easily detected. In the heavy cylinder oils, at a temperature of 250° C., 1 per cent. of fatty oil still showed its presence by the appearance of the soap froth on treatment with sodium or caustic soda.—C. O. W.

The Determination of Alkaloids in Narcotic Extracts. Schmidt.

Chem. Zeit. 1892, **16**, 1275.

Of the numerous methods for the determination of the alkaloids in narcotic extracts, Beckurt's extraction method (this Journal, 1890, 978) and the extraction method of Dietrich (this Journal, 1887, 148, 566, and 609) are the best, and of these the latter is preferable. It is, however, open to the objection that the calcium hydrate used may cause a partial decomposition of the less stable alkaloids ; also in the extraction with ether a portion of the lime may also be carried off, and thus give rise to erroneous results. This last source of error is avoided by employing the paper in which the mass to be extracted is placed, in the form of one large seamless sheet. In the final titration an ethereal solution of iodo-eosine is recommended as an indicator in preference to cochineal or logwood. As soon as the solution to be titrated is alkaline, the iodo-eosine passes from the ethereal to the aqueous solution on shaking, and colours the latter red. This indicator can also be employed in Dietrich's method for morphia determinations, and shortens the process by about an hour. It cannot be used with the cinchona alkaloids owing probably to these bases being more soluble in ether than in water.—C. A. K.

Volumetric Determination of the Alkaloids. E. Léger.

Comptes rend. 1892, **115**, 732.

A priority claim by the author for the method for the volumetric determination of the alkaloids recently described by Barthe (Comptes rend. 1892. **115**, October 10; this Journal, 1893, 294). The method was published by the author in 1885 under the title " A New Application of Phenolphthaleïn in Volumetric Analysis " (J. de Phys. et de Chim. **11**, 425).—C. A. K.

Determination of Nitroglycerin in Dynamite. M. Liebschütz.

Monit. Scient. **41**, 14—16.

Nitroglycerin is easily determined in dynamite by lixiviation with ether, and measuring the nitrogen peroxide evolved in a Lunge's nitrometer if no other substances soluble in ether are present, such as sulphur, resin, paraffin, naphthalene, or camphor. The author gives analytical data showing that presence of glycerin, alcohol, chloroform, sugar, and cellulose, also interfere with the use of the nitrometer. He finds that acetic acid (containing 80 per cent. of the glacial acid) is a very good solvent for nitroglycerin, and proposes to use this substance in conjunction with ether in the analysis of dynamite.

Five or six grms. of dynamite containing guncotton, resin, camphor, paraffin, cellulose, sulphur, and sodium nitrate are lixiviated with ether in an apparatus similar to that of Soxhlet. The solution then contains the nitroglycerin, part of the sulphur, the paraffin, the resin, the camphor, and the soluble portion of the cellulose. The *sodium nitrate* is extracted from the residue with boiling water. The solution in ether is distilled at a low temperature, well lixiviated after cooling with acetic acid (80 per cent.), and filtered through an asbestos plug.

An aliquot part of this solution is decomposed by Schlœsing and Ferdinand Jean's method of determining sodium nitrate, and the volume of evolved nitrogen peroxide compared with the volume of gas evolved by treatment of pure nitroglycerin with acetic acid. The presence of organic matter does not affect the results of this method; the author has not, however, succeeded in determining nitroglycerin in presence of picric acid or nitrobenzene, nor does he know of any method by which a separation of these substances may be effected.

The *sulphur* contained in the asbestos plug, used for filtering, and in the residue (after lixiviation with ether and water) is dissolved by carbon bisulphide. After evaporating this solvent, the sulphur is calculated from the sulphuric acid found after oxidation with aqua regia.

The nitrocellulose (*guncotton*) is determined either by treatment of the residue with a mixture of alcohol and ether, or better still, by treatment with ferrous sulphate and hydrochloric acid, and measuring the gas evolved in the ordinary way.—K. E. M.

The Analysis of Beeswax. H. Röttger. Chem. Zeit. **16**, 1837—1839.

According to the author hardly one of the published methods for the analysis of beeswax give reliable or accurate results. The simplest qualitative and quantitative method for the examination of this substance is still that of Hübl, and this is described in detail.

Analysis.—3—4 grms. of the wax are heated to the melting-point with 20 cc. of neutral alcohol of 95 per cent. strength, then titrated with ½-normal alcoholic potash solution, using phenolphthaleïn as indicator, and a burette with 0·05 cc. divisions. In this way the *fatty acid equivalent* (or fatty acid value) is obtained, expressing the number of mgrms. of KOH required to neutralise the cerotic acid contained in 1 grm. of wax.

An excess of 20—25 cc. of ½-normal potash solution is now added, and the whole is heated to boiling for one hour, the flask being connected to a reflux condenser. The titration with ½-normal hydrochloric acid now gives the *ether equivalent* (or ether value), viz., the number of mgrms. of KOH which are required to saponify the palmitic-myricylic ether. The ether equivalent added to the acid equivalent gives the *saponification equivalent* (or saturation equivalent).

Interpretation of the Analysis.—For pure beeswax the acid equivalent varies from 19—21 (generally 20), the ether equivalent from 73—76 (generally 75), the saponification equivalent from 92—97 (generally 95), the ratio equivalent (viz., the relation between acid equivalent and ether equivalent) from 1:3·6 to 1:3·8.

The materials used for the adulteration of beeswax show quite different values, viz.:—

——	Acid Equivalent.	Ether Equivalent.	Saponification Equivalent.	Ratio Equivalent.
Japan wax......	20	200	220	10
Carnauba wax ..	4	75	79	19
Tallow..........	4	176	180	44
Stearic acid.....	195	..	195	0·195
Resin...........	110	1·6	111·6	0·015
Paraffin and ceresin.	..	..	..	..
Pure wax	20	75	95	3·75

These figures justify the following conclusions:—

(*a.*) If the respective equivalents are found between 19—21, 73—76, 92—97, 3·6—3·8, then the substance will consist of pure beeswax, provided the physical properties do not contradict this assumption.

(*b.*) If the acid, ether, and saponification equivalents are lower, but ratio equivalent is the same as above, then only inert substances are the adulterants.

(*c.*) If the ratio equivalent is over 3·8 then an adulteration with Japan wax, Carnauba wax, or tallow is probable. If the acid equivalent is low Japan wax is not present, and high or low ether equivalents will decide between the presence of Carnauba wax or tallow.

(*d.*) If the ratio equivalent is below 3·6 then stearic acid or resin will be present, which two adulterants may easily be distinguished by well-known reactions.

If the wax only contains one of the adulterants mentioned there will be no difficulty in estimating it qualitatively and quantitatively by this method, but even if several of these adulterants are present simultaneously they may be approximately determined.

Examples.	I.	II.	III.
Acid equivalent	16·4	29·9	27·4
Ether equivalent............	59·2	69·0	62·9
Saponification equivalent ...	75·6	98·9	90·3
Ratio equivalent............	3·61	2·3	2·2

In sample I. 20 per cent. of inert substances will be present.

In sample II. 5 per cent. of stearic acid will be present.

In sample III. stearic acid as well as inert substances will be present.

The author warns the analyst against the use of flasks made of bad glass for saponifying in, as such glass may lead to considerable errors.—K. E. M.

Note on Hübl's Method of Wax Examination. G. Buchner. Chem. Zeit. 1892, **16**, 1922.

The author thoroughly confirms Röttger's (Chem. Zeit. 1892, **16**, 1837; see previous abstract) experience that Hübl's method of wax analysis is simple, rapid, and perfectly reliable, providing all the necessary precautions be properly observed. The chief source of error is incomplete saponification, usually due to insufficient heating (heating on a water-bath is unsatisfactory). The author operates as follows:—3—4 grms. of the wax are heated to the melting-point with 20 cc. of neutral 95 per cent. alcohol, in a conical flask of 150 cc. capacity, and then titrated with semi-normal alcoholic potash, using phenolphthaleïn as indicator, the liquid being continuously heated and shaken, until a permanent red coloration is obtained. A further quantity—20 to 25 cc.—of alcoholic potash is then added, and the contents of the flask *boiled* over a small flame for one hour, alcohol being added to replace that evaporated, *only* at such times when the liquid becomes concentrated to one-half its original bulk. Finally, the titration of the liquid is completed in the usual way.—H. T. P.

Determination of Sulphides, Thiosulphates, and Sulphites in Crude Glycerin. C. Ferrier. Chem. Zeit. **16**, 1840.

Crude glycerin obtained from spent soap-leys is all but valueless if it contain sulphides, thiosulphates, or sulphites. For analysis, the glycerin is diluted with at least 10 times its volume of water and then neutralised with hydrochloric acid. This solution is treated at 60°—70° C. with 2—3 per cent. of carbon residues (from yellow prussiate manufacture), which after having been thoroughly washed with dilute nitric acid and water had been heated in a covered crucible to redness.

Sulphides are detected by bringing one drop of the glycerin so treated on a strip of filter-paper saturated with lead nitrate. Absence of a yellow coloration proves that the glycerin contains less than $\frac{1}{10,000}$th part of sulphides. To detect a yet smaller quantity, the glycerin is heated in a small flask with a few drops of hydrochloric acid and a little sodium bicarbonate, and a strip of paper moistened with lead nitrate is held over the mouth of the flask.

To detect *thiosulphates* and *sulphites*, to the glycerin solution a few cc. of barium chloride solution are added and the liquid is filtered. Barium sulphite is precipitated and the thiosulphates may be found in the filtrate, which on addition of potassium permanganate to the acidified solution will become cloudy even in presence of only $\frac{1}{10,000}$th part of thiosulphates.

The presence of sulphite in the precipitate is proved by washing it repeatedly with boiling water, then adding to the remaining precipitate a few drops of starch and iodine solution; in presence of sulphites the blue coloration will gradually disappear.

Quantitatively the *sulphides* are determined by titration with lead nitrate. The *thiosulphates* and *sulphites* are determined after filtration from lead sulphide with iodine solution.

Another part of the filtrate free from sulphides is treated with 3—4 cc. of strontium chloride solution, again filtered, and the filtrate titrated with iodine solution. The difference of the first and second titration gives the quantity of sulphites present. If other foreign reducing substances are contained in the glycerin a third iodine titration will be necessary to correct these results, after precipitating the sulphides with lead nitrate and decomposing the sulphites and thiosulphates by boiling with acid.

In order to free crude glycerin from sulphides on the large scale the author treats it with ferrous sulphate in excess, precipitates the iron from the boiling liquor with lime, decants, adds sodium carbonate and neutralises with hydrochloric acid. Thiosulphates and sulphites may be oxidised by addition of the exact requisite quantity of chloride of lime.—K. E. M.

The Influences of the Concentration of the Alcohol on the Extraction of Hops. H. Strassmann and M. Levy. Chem. Zeit. 1892, 16, 1123—1124.

In a former paper by Levy (Chem. Zeit. 16, 839; this Journal, 1892, 1019—1021) came to the conclusion that the all important factor in the chemical examination of hops was the determination of the alcoholic extract. It was found that the strength of the alcohol used for the extraction had an important influence on the amount of matter extracted. To arrive at some definite information on this subject 10 samples of hops were extracted with alcohol of concentration varying from 70 to 99·8 per cent. The extracted matter was dried at 60°—70° C., until it ceased to lose weight. The following table gives the results calculated in percentage of dry extract of dry hops:—

—	70 per Cent.	75 per Cent.	80 per Cent.	85 per Cent.	90 per Cent.	95 per Cent.	Absolute Alcohol.
Saaz town	41·69	38·58	35·71	35·70	32·55	29·06	28·26
Saaz country	44·32	40·19	38·35	34·97	31·87	29·20	27·89
Saaz neighbourhood	43·72	39·64	35·23	34·81	29·13	27·72	26·89
Spalt town	35·64	36·76	34·82	30·79	28·12	25·72	25·12
Spalt country, heavy land	36·78	35·23	35·43	27·88	25·39	22·92	22·45
Spalt country, light land	33·98	31·86	28·18	25·85	24·99	22·85	21·83
Kindinger	33·85	31·54	29·86	26·95	24·88	23·24	22·09
Wolnzacher	35·99	34·23	31·68	31·23	29·15	28·07	26·37
Auer	32·97	32·88	31·37	27·86	24·39	21·82	20·08
Roth Auschauer	26·48	25·36	24·14	22·48	21·32	17·55	17·01

By an inspection of this table it will be seen that the order of merit of the hops varies with the concentration of the alcohol used for extraction; the question then arises, what strength of alcohol should be used, so that the true relative value of the hops may be found?

From the fact that all the most valuable constituents of the hops (as resins, &c.) are soluble in alcohol, the authors incline to the belief that the extraction should be made with the strongest alcohol.—A. L. S.

ANALYTICAL AND SCIENTIFIC NOTES.

The Preparation of Magnesium Nitride. S. Paschkowezky. J. Prakt. Chem. 47, 1893, 89—94.

Ammonia, or much more slowly, nitrogen, passed over magnesium powder, whilst the latter is heated in a combustion tube, converts the magnesium into the nitride, in the case of ammonia with evolution of hydrogen. The nitride in either case consists of the compound Mg_3N_2, which as thus prepared is a light yellowish substance with a faint tinge of greyish-green, and here and there a superficial shade of orange. The nitride is very easily attacked by water, a fragment of it treated with not too large a volume, soon commencing to boil with the heat generated during the stormy action. At the same time ammonia is evolved in considerable quantities.—W. S.

The Action of Light on Bacillus Anthracis. H. Marshall Ward. Proc. Roy. Soc. 52, 395—400.

The author starts with the observation that a test-tube, or small flask, containing a few cc. of Thames water with many hundred of thousands of anthrax spores in it may be entirely rid of living spores by continued exposure daily for a few days to the light of the sun, and that even a few weeks of bright summer daylight—not direct insolation—reduces the number of spores capable of development on gelatin. It then seemed worth while to try the effect of direct insolation on plate cultures.

A few cc. of sterile distilled water in a tube were thoroughly saturated with the anthrax spores taken from an old culture which had never been exposed to light, and the tube placed for 24 hours at 56° C., this killed all immature spores, bacilli, and enzymes, and left a crop of the most resistant and fully matured virulent spores. Experiments were made with these to determine the relative power of the different rays of the spectrum to destroy the anthrax. So far it has been found that the inhibiting effects are stronger at the blue end of the spectrum than at the red, and exposures to sunlight passing through coloured glasses confirm this result. When a small patch of sunlight was allowed to fall upon the culture, the rest being kept covered and dark, it was found that in the locality of the patch all the organisms had been killed, and also that the anthrax colonies were the larger and more vigorous, the more distant they were from the clear centre. It was distinctly proved that the spores are not killed by high or low temperatures, but by *the direct solar rays.*—W. S.

New Books.

A Manual of Dyeing, for the use of Practical Dyers, Manufacturers, Students, and all interested in the Art of Dyeing. By Edmund Knecht, Ph. D., Christopher Rawson and Richard Loewenthal, Ph. D. London, Chas. Griffin and Co., Limited, Exeter Street, Strand. Price 45*s*.

This work is based on a foundation similar to that of the late Mr. James Napier's *Manual of Dyeing and Dyeing Receipts*, the authors stating that they like that author whilst commencing as much as possible with first principles, have endeavoured to combine in this treatise both Theory and Practice. The book, in a word, is to serve as a work of reference or *vade mecum* for the educated dyer. The work is one of three volumes, the third or supplementary volume containing specimens of dyed fabrics. The first and second volumes contain 865 pages of subject matter, whilst pages 885 to 907 are occupied by a very complete alphabetical index. There are no less than 116 wood-cut illustrations, and a special index for these is found on the page following the table of contents. The third volume contains 144 specimens of dyed fabrics (cotton and wool) with details given over each sample of materials with percentage proportions of the same employed.

An introduction on the theory of dyeing opens the work, Part II. Treats of the Chemical Technology of the Textile fibres. Part III. of Water. IV. Washing and Bleaching. V. Acids, Alkalis, Mordants, &c. VI. Natural Colouring Matters. VII. Artificial Organic Colouring Matters. VIII. Mineral Colours. IX. Machinery used in Dyeing. X. Investigation into the Tinctorial Properties of Colouring Matters. XI. Analysis and Valuation of Materials used in Dyeing. An Appendix then follows containing a System of Weights and Measures, Specific Gravities, Thermometric Scales, and articles on Evaporation and Boiling, Hygroscopy, Light and Colour, &c.

A Dictionary of Applied Chemistry. By T. E. Thorpe, B.Sc., Ph.D., D.Sc., F.R.S. Assisted by Eminent Contributors. Volume III. London: Longmans, Green, and Co. New York: 15, East 16th Street. 1893. Price 63*s*.

This, the third volume of Thorpe's Dictionary of Applied Chemistry, completes the work, and now that it is completed, but a brief comparison of it with the Dictionary of Watts, so far issued, on Theoretical Chemistry, by Messrs. Morley and Muir, shows what admirable companion works they will prove. Neither, strictly speaking, will seem complete without the other. What was stated of volumes I. and II., also applies to volume III., viz., that the names given in the "List of Contributors" of the articles, are in themselves a guarantee of the value of those articles, and thus of the entire work. It may then be suitable to convert this list into a table of contents, by giving first, the subjects treated of, following them by the names of the compilers.

Fixed oils and fats (A. H. Allen). Destructive Distillation of Wood (G. H. Bailey). Silver (E. J. Ball). Paper (E. J. Bevan). Pottery and Porcelain (W. Burton). Paints (E. G. Clayton). Varnish (J. K. Crow). Steam (H. Davey). Vegeto-Alkaloids (Wyndham R. Dunstan). Borax (E. L. Fleming). Water (Percy F. Frankland). Tea (Mrs. A. H. Green). Spectrum Analysis (W. N. Hartley). Starch, Saccharimetry (J. Heron). Stearin and Stearic Acid (G. T. Holloway). Persian Berries, Quercitron Bark, Safflower, Turmeric, &c. (J. J. Hummel). Phthalic Acid, Quinone and Quinones, &c. (F. R. Japp). Salts of Potassium and Sodium (G. Lunge). Specific Gravity (H. McLeod). Oxazine, Colouring Matters, Primaline (R. Meldola). Sugar (J. A. R. and B. E. R. Newlands). Pyrotechny (G. S. Newth). Pitch (B. Nickells). Solution (W. W. J. Nicol). Ultramarine (G. W. Rawlins). Phosphorus (J. B. Readman). Russian Petroleum and Petroleum Testing (B. Redwood). Waxes (H. H. Robinson). Obsidian, Ochre, Oilstone, and other Stones and Earths (F. W. Rudler). American Petroleum (S. P. Sadtler). Resins, Opium, &c. (A. Senier). Rust (A. Smithells). Thermostats (Wm. Tate). Photography (J. M. Thomson). Oxygen, Ozone (L. T. Thorne). Essential Oils, Resin, Turpentine (W. A. Tilden). Tin, Zinc (Thos. Turner). Strontium (A. E. Tutton). Sodium Chloride (J. I. Watts). Tobacco (A. Wingham). Triphenylmethane Colours. (O. N. Witt). Sulphur and Sulphuric Acid (C. R. A. Wright). Phenanthrene, Phenols, Picric Acid, &c. (W. P. Wynne). Sublimation, Thermometers (Sydney Young).

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

United States.

Customs Decisions.

"Bog iron ore" containing over 53 per cent. of metallic iron having the appearance of a brown earth and containing roots and gravel, which is evidence of its crude condition, used for purifying gas and never as a paint or colour, is dutiable at 75 cents a ton, under paragraph 133 N.T.

Cadmium yellow is dutiable at 25 per cent.

A fine white powder invoiced as "mineral white" composed of corn starch, 7·10 per cent., and hydrated calcium sulphate, 92·90 per cent., is dutiable at 20 per cent. under section 4 N.T., and not as plaster of Paris, ground.

Creolin, a coal-tar preparation and a medicinal preparation, is dutiable at 25 per cent. under paragraph 75 N.T.

Chloride of magnesium is assessed for duty as a chemical salt.

Henry's calcined magnesia is dutiable at 8 cents per pound under paragraph 34 N.T.

Orris powder is dutiable at 10 per cent. under paragraph 24.

Oxide of zinc powder is dutiable at $1\frac{1}{4}$ cents a pound under paragraph 60.

Canada.

Imports of Metallic Copper smelted from Native Ores.

The *Canada Gazette* for the 1st April publishes an order of the Governor-General in Council providing that metailic copper, the exclusive product of Canadian ores, shipped out of Canada by the producers thereof for the purpose of being smelted, such product being returned to Canada direct to the producers of the ores from which smelted, may, until 1st July 1894, be admitted into Canada under such regulations as the Minister of Trade and Commerce may prescribe on payment of duty on the cost and charges to the producers of the ores of or for the smelting thereof.

Customs Tariff of Tasmania.

The following is a statement showing the rates of import duty leviable under the Customs tariff of Tasmania:—

Articles.	Rates of Duty now leviable.			
		£	*s.*	*d.*
Acid, tartaric	Per lb.	0	0	4
Do., sulphuric	Per cwt.	0	2	6
Do., citric	Per lb.	0	0	4
Do., muriatic	Per cwt.	0	2	6
Do., nitric	"	0	2	6
Do., carbolic	10 % *ad val.*			
Do., acetic, containing not more than 33 per cent. of acidity.	Per lb. or pint	0	0	2
For every extra 10 per cent. or part thereof of acidity.	"	0	0	1

Customs Tariff of Tasmania—*cont.*

Articles.	Rates of Duty now leviable.			
		£	*s.*	*d.*
Alum	5 °/₀ *ad val.*			
Arsenic, crude	5 °/₀ *ad val.*			
Blue	Per lb.	0	0	2
Candles	„	0	0	2
Cement	Per cwt.	0	0	9
Cocoa and chocolate	Per lb.	0	0	4
Coke	Per ton	0	1	0
Concentrated effusions and decoctions, druggists' sundries, drugs, and chemicals not otherwise enumerated, patent and proprietary medicines, fluid extracts.	20 °/₀ *ad val.*			
Cornflour and maizena	Per lb.	0	0	1
Carbonate of soda	„	0	0	1
Dynamite, detonators, and all other explosives not otherwise enumerated.	10 °/₀ *ad val.*			
Glucose	Per cwt.	0	6	0
Glue	Per lb.	0	0	1
Gunpowder, blasting	„	0	0	1
Do., sporting	„	0	0	6
Do., FFF loose	„	0	0	1
Malt	Per bushel	0	1	0
Malt liquor, in wood	Per gallon	0	1	0
Do., in bottle	„	0	1	6
Mustard	Per lb.	0	0	2
Matches	20 °/₀ *ad val.*			
Naphtha	Per gallon	0	0	6
Oil, kerozine	„	0	0	6
Oil of all kinds not otherwise enumerated	„	0	1	3
Oils, medicinal and perfumed	20 °/₀ *ad val.*			
Opium or extract thereof	Per lb.	1	0	0
Paints of every description	„	0	0	0½
Paper—viz., all writing paper and white and coloured printing paper, without printing or ruling thereon, imported in original wrappers, and untrimmed edges as it leaves the mill.	5 °/₀ *ad val.*			
Plate and plated ware of every description, Britannia metal, nickel and German silver, similar metals, and all alloys and imitations.	20 °/₀ *ad val.*			
Quicksilver	5 °/₀ *ad val.*			
Salt	Per cwt.	0	1	6
Soap, except fancy or perfumed	Per lb.	0	0	1
Do. fancy or perfumed	„	0	0	3
Soda crystals	„	0	0	0½
Starch	„	0	0	1
Sugar, crushed and loaf	„	0	0	1
Do., all other kinds	Per cwt.	0	6	0
Spirits of tar	Per gallon	0	0	6
Spirits — viz., brandy, cordials, rectified spirits, and all other liquors or strong waters, Geneva, gin, rum, whisky. And so in proportion for any greater or less quantity than a gallon, not being less than one thirty-second part of a gallon, for spirits in bottle, and spirits in bulk for any quantity not being less than one-quarter of a gallon. All spirits under proof to pay duty as if proof.	„	0	15	0
Spirits, methylated, taken as proof containing not less than 10 per cent. of methyle of alcohol. And so in proportion for any quantity less than one-sixth of a gallon.	„	0	3	0
Spirits, perfumed	„	1	4	0
Spirituous compounds	„	0	15	0
Turpentine	„	0	1	0
Varnish or polish not otherwise enumerated	„	0	1	6
Whiting	Per cwt.	0	0	9
All goods not enumerated in table of duties or exemptions. All goods subject to duty at per 100 lb., per cwt., or per ton to pay on net weight.	15 °/₀ *ad val.*			

Exemptions.

Antimony, in ingots; blue stone; bones; brass, sheet and rolled, not perforated; carbolic powder; cocoa-nut and black oil, unrefined; copperas; French polish; dyewoods and dyestuffs for manufacturing purposes only; galvanised iron in plain sheeting; hides and skins, raw; ink, printing; creosote, crude; manures; myrobolams; oil cake; whale oil; oil, palm, unrefined; oil, refuse, shale; oil for tanning purposes; ores of all kinds of metals; paraffin and mineral wax; phosphorus; pitch; potash and pearlash; pottery materials, viz.:—litharge, china clay, felspar, manganese, and oxide of cobalt; salt; soda ash; soda, caustic; soda silicate; solder and soldering fluid; stearine; sumac; tannin and tannin extracts; tar; terra japonica; tin; tinplates; valonia; vegetable black; and all goods for use of H.M. Government.

THE RISKS OF THE CHEMICAL TRADE.

The Home Secretary has appointed Mr. A. E. Fletcher, Chief Inspector of Alkali Works; Mr. J. Henderson, Chief Superintending Inspector of Factories and Workshops; Mr. H. M. Richards, Inspector of Factories; Professor Simpson, and Dr. O'Neil (Farnworth) to comprise a committee to inquire into the injuries to health alleged to be caused to operatives in chemical works, and the desirability of special rules being drawn up for their prevention. It is hoped by this inquiry to ascertain—(1) how far the manufactures, as at present carried on, injuriously affect the health of the workpeople, and how far the injurious effects depend upon the age and sex of the operatives; (2) what means can be adopted to abate the injurious effects of the manufacture; and (3) what special regulations should be adopted to protect vats and other dangerous places and utensils used in the manufacture.—*Chemist and Druggist.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Turkey in Asia.

Opium no Longer Pays.

Last year the production of opium in the Turkish Asiatic province of Kharput was only 500 cases, valued at 20,250*l.*, against 800 cases, worth 54,000*l.*, in 1890. The decrease is attributed entirely to the low prices. "Should the state of the market continue as it is now," says our Consul at Kharput, "the cultivation of opium will be given up, and, consequently the province will be deprived of the benefit of its principal article of export."

The Damascus Liquorice Trade.

A small export of liquorice (8,400 cwt., worth 2,000*l.*) was effected in 1891 from Damascus, whereas in 1890 the article does not figure at all in the returns; this trade is doomed by the discovery of liquorice-root of a superior quality in Asia Minor and elsewhere.

Tunis.

Drug Imports.

The value of drugs imported into Tunis in 1891 amounted to 34,987*l.*, against 15,795*l.* in the previous year. The improvement in this article may be attributed in a great measure to the increase of the European population throughout the regency, and also to the fact that the number of natives who seek medical treatment by Europeans is yearly on the increase. The value of drugs imported from France was 28,000*l.*, the balance being divided between Italy and Malta.

Olive Oil.

The new French Customs law favouring Tunisian agricultural products has given a decided impetus to the olive-oil exports, which in 1891 were valued at 267,920*l.* The return for the previous year was 185,319*l.*, and for 1889, 69,797*l.* The bulk of this article was exported to Marseilles and Nice. From the latter place it is reshipped as fine salad oil to America and Great Britain.

Most of the oil exported to France is of a fine quality intended for cooking purposes and table use. On the other hand, the article exported to Great Britain, valued at about 20,000*l.*, consisted of a cheap oil for industrial purposes.

Soap.

The manufacture of soap is an industry of many years' standing that has prospects of development. Shipments are make to Malta, Italy, Turkey, and Tripoli. The article exported to the latter countries includes soaps prepared for the Hammam baths, and scented with musk, incense, and other favourite Eastern perfumes.—*Chemist and Druggist.*

COCAINE-MAKING IN PERU.

In an official report on the trade of Callao (Peru), which has just been issued, the name of one German firm (Bernard Pruess) is given as the manufacturer of crude cocaine at that port. The leaves used in the preparation of the article are those from the province of Huanoco, and the exports of cocaine during 1892 amounted to 2,672 lb. (value 16,362*l.*) to London, 932 lb. (value 5,711*l.*) to Hamburg, and 221 lb. (1,350*l.*) to New York—a total of 3,825 lb., worth 23,423*l.* We believe that there are at least three or four manufacturers of cocaine in Peru in addition to the firm named, and that the export figures represent their aggregate output.—*Ibid.*

METALS IN AUSTRALIA.

In a recent official report on the mineral wealth of Australasia the following particulars are given concerning metals of interest to the chemical trade :—*Antimony :* Some lodes with occasionally large bodies of ore have been found in the Kempsey division of New South Wales, about 300 miles north of Sydney, and 1,580 tons of this mineral were won in 1891 in that of Armidale, 50 miles further north. Forty-five assays were made during the year by the Government Mines Department, the percentage of antimony ranging from 26·86 to 70·82 per cent., with traces of gold and silver in nine instances. *Bismuth :* During the year 28 assays were made for bismuth from Hillgrove, Pambula, Oban, and Wyndham, New South Wales, yielding from 1·45 to 25 per cent. of metallic bismuth, and in one case as much as 10 dwt. 21 grains of gold and 11 oz. 6 dwt. 11 grains of silver per ton. *Mercury :* In May 1891, cinnabar was found in a lode deposit near Bengara, about 350 miles north of Sydney; in alluvial form it had been known to exist many years previously. The cinnabar is distributed through the mass in small spots from the size of a pin's head to that of a pistol bullet. No bulk tests have been made to give reliable data, but three assays showed 0·63, 0·65, and 0·01 per cent. of metallic mercury respectively. Estimating the market price of cinnabar at 157*l.* per ton, that contained in this deposit would not pay working expenses unless concentrated by some cheap process, *Platinum :* Platinum has been found at Broken Hill in concentrates assaying from 9 dwt. 18 grains to 16 dwt. 7 grains per ton, and in the Richmond district, some 40 miles distant, concentrated beach sand has yielded 4·3 per cent. of platinum and 15·38 per cent. of tin.—*Ibid.*

THE MANUFACTURE OF BRONZE-POWDER IN GERMANY.

In the cities of Fuerth and Nuremberg, in Bavaria, nearly a hundred establishments are engaged in the manufacture of bronze-powder, which is exported thence all over the world. Bronze-powder is composed of copper, tin, zinc, and antimony, melted in proper proportions and cast first into rods of $\frac{1}{2}$ inch in diameter and about 3 feet long. These rods are rolled until about 2 inches wide, and then cut into suitable lengths for handling. The pieces are beaten very thin by hammers, and are taken to the sulphuric-acid bath, where each sheet is washed to remove all impurities, rust, and dirt. After being thoroughly dried the sheets are again hammered by steam-hammers until the limit of thinness is reached. The sheets are next cut up into small particles by shears, and become known as clippings. These are now ready for the stamp-mills, which are run in batteries, enabling one man to run or attend fifty or more. When sufficiently pulverised, the powder is sifted. The heavier and better qualities go to one receptacle and the inferior grades to another. The cheaper qualities are mixed with quartz-powder to enable them to be sold cheaply. The expense of manufacturing bronze-powder rests largely in the production of the clippings, a great deal of hand work being required. Lately, some firms in the United States have begun the manufacture of bronze-powder, and have purchased the raw material in Bavaria. This has exited fears that ultimately the manufacture will be successfully installed in America and the German business broken up. In order to prevent this, the manufacturers of bronze-powder have agreed not to sell any clippings to be exported to the United States, except through a committee and at the price of about 1*s.* 3*d.* per lb., which will virtually stop the demand.—*Ibid.*

GENERAL TRADE NOTES.

INSECTS ON FRUIT TREES.

The Board of Agriculture have issued a leaflet calling the attention of fruit farmers to the caterpillars which are said to be observable in alarming numbers in many orchards and fruit plantations, especially on apple and damson trees, eating the forming fruit and the leaves.

The caterpillars at first are greyish, and so small as to escape notice unless attention is specially directed to them. In their later stages the caterpillars are light green, and nearly $\frac{3}{4}$ inch long.

First.—Syringing the trees has proved advantageous in many places in previous seasons. Large old apple trees are beyond the reach of ordinary garden-engines used for this purpose, and it is only in hop-growing districts where hop-washing machines are generally used that systematic syringing of large standard trees has been adopted.

The mixtures for syringing fruit trees are—

1. The extract of 10 lb. of quassia, obtained by boiling quassia in water, to 100 galls. of water and 7 lb. of soft soap.
2. The extract of 5 lb. of quassia to 100 galls. of water, with 6 lb. of soft soap and 4 pints of paraffin, well stirred.
3. The extract of 5 lb. of quassia to 100 galls. of water, with 6 lb. of soft soap and 4 pints of Calvert's carbolic acid, No. 5.
4. 8 lb. of soft soap and 2 lb. of finely-ground hellebore, and a quart of paraffin, boiled and well stirred together. This is sufficient for 100 galls. of water.

The soft soap is dissolved in a tub with hot water. The quassia chips are boiled in water and put into another tub. Where paraffin is used it should be well stirred up with boiling soap-and-water before it is mixed with the cold water. Water-carts, ordinary barrels, or wine casks set upon frames with wheels, should be brought full of water to where the materials are being prepared, either at the farm-buildings or in an extemporised shed with a copper in it, and the requisite amount of dissolved soap and other ingredients added. The Éclair and other similar hand-machines can be used for small apple trees, plum and damson trees, and for filbert and cob nut trees, which are also badly infested.

It is important that syringing should be done at once, as to be effective it must be commenced early. Directly there are signs of infestation the process should be begun. As the hatching-out of the caterpillars is not simultaneous, but is extended over some days, the syringings must be renewed.

Secondly.—The arsenical insecticides used extensively in the United States and Canada have not been generally adopted in this country on account of their poisonous properties. The time has now arrived when they should be fully tried.

There are two special substances of this nature. The one, "Paris green," or "emerald green," is strongly recommended by several American and Canadian entomologists.

Professor Lintner, the Entomologist of the State of New York, says that, in his opinion, fruit-growers who do not use Paris green as a remedy against caterpillars infesting fruit trees are guilty of culpable negligence. Professor Lintner believes that the produce of fruit-land may be doubled by the judicious use of this substance.

A full trial of this is urged. Care must, however, be taken to observe strictly the regulations laid down for its use, or injury will be caused to the foliage and blossoms.

The latest advice from experienced practical entomologists is to put 1 lb. of the Paris green, in the form of paste, which is far better than powder, into from 165 to 200 gallons of water.

The mixture must be kept well stirred in order that the solution may be maintained at a uniform strength.

The object is not to dislodge the caterpillars, but to poison their food with the arsenical solutions, which should fall like gentle rain upon the leaves and blossoms. For this purpose fine "rose" jets should be used. Riley's "cyclone nozzle" is used in America. The Vermorel nozzle is also a good distributor.

The other arsenical compound is "London purple," obtained in the manufacture of aniline dyes, and composed of lime and arsenious acid.

Gold in Russian Copper Ore.

The copper ore from the Caucasian mines, which is smelted and wrought at the works of Messrs. Siemens Brothers at Kedabek, in the Caucasus, has recently been found to contain a considerable percentage of gold.—*Standard.*

The Nitre Industry.

Zeits. des landw. Central-Ver. der Prov. Sachsen. 1893, 43.

The nitre question has entered upon a new phase, inasmuch as producers have hit upon the plan of re-extracting the residues accumulated from previous operations. Owing to imperfect working a certain proportion of nitre was left in these residues, mixed with all the less soluble salts such as saltpetre. But whilst the former contains $16\frac{1}{2}$ per cent. of nitrogen, the latter contains only 13·8 per cent. of nitrogen, and hence the percentage of nitrogen will be reduced in the mixture of the two. Prof. Märcker, of the Agricultural Chemical Laboratory in Halle, tested in the last year 361 samples of nitre, of which 79 contained less than 15·5 per cent. of nitrogen, and some as little as 14·4 per cent. Prof. Märcker speaks very emphatically as to the abolition of the "Hamburg test," by which nitre is generally sold, since in this test moisture, chloride, and sulphate are deducted from the weight of substance taken and the difference assumed to be sodium nitrate, and hence the presence of potassium nitrate escapes detection.—H. A.

Copper in Tasmania.

It would appear from the report of Dr. E. D. Peters, jun., on the Mount Lyell Company that Tasmania may yet be an important producer of copper. He says that there are several bodies of barren iron pyrites in the world as large or larger than this one, but its only competitor among the valuable pyrites bodies of the world is the Rio Tinto mine in Spain, which is three or four times as large as the Mount Lyell mine, but only one-third as rich. He also says that, after making deductions for poor parts of the ore body, there are several million tons of good ore available above the present drainage level of the valley, which can be extracted by simple quarrying and without cost of pumping or hoisting.—*Eng. and Mining Journal.*

The Chinese Trade in Aniline Colours.

According to the *Journal des Mines* for the 20th April the importation of aniline colours into China is increasing every year. The colour most in demand is scarlet, which is used for dyeing paper and cotton. Yellow is little used; it is the imperial colour, and it is only employed in the imperial workshops. For this article great attention should be paid to the labels and description under which it is introduced and brought under the notice of Chinese purchasers. Shanghai is still the centre for the importation of colours; this trade is in the hands of German houses, although all the products introduced are not of German origin; they also come from England, Belgium, and France. —*Board of Trade Journal.*

The New French Tariff and Foreign Trade.

The Tariff Act passed in France, February 1st, 1892, by which the duties on many classes of merchandise were greatly increased, has caused a pronounced falling off in the foreign trade of that country, as is shown by the value of the imports and exports during the first two months of the present year and compared with those of 1892. The total value of imports this year was 637,764 francs, against 961,862 francs in 1892. Exports, however, showed little change, the values being 489,604 francs in 1893, and 496,782 francs in 1892.—*Eng. and Mining Journal.*

Deep-Lying Phosphates in Florida.

The last report of the State Chemist of Florida, Mr. Norman Robinson, notes that indications derived from artesian wells and other deep borings have been confirmed by later investigation and justify the belief that there is a bed of pebble phosphate underlying a considerable part of the State. The depth at which this bed is found varies from 125 ft. to 300 ft., and its thickness from 25 ft. to 50 ft. When the easily worked surface deposits are exhausted, Mr. Robinson believes that these deep deposits will be mined and furnish an abundant supply.—*Ibid.*

Mineral and Metal Exports and Imports of Spain during 1892.

During the year the exports of ores of iron, lead, manganese, and pyrites showed a marked increase over the corresponding movement in 1891; while the exports of copper ore showed a considerable decrease, as did likewise the exports of pig iron and mercury. The imports of coke were 49,128 tons less, and of iron and steel 26,000 tons less than in 1891. The imports of coal, tin-plate, and pig tin showed a slight increase. On the whole, it may be said that trade in the articles named has been steady, as, indeed, might be expected from the slowness of that country to adopt improvements. Leading articles of import in 1892 were: Coal, 1,688,537 tons; coke, 178,872 tons; iron and steel, 71,836 tons. The exports included 4,773,827 tons iron ore; 512,015 tons copper ore; 454,451 tons pyrites; 153,859 tons lead; 1,643,731 kilogs. quicksilver.—*Ibid.*

Chemical Analysis at the Chicago Exhibition.

One of the most interesting exhibits in the Department of Mines and Mining will be the Analytical Laboratory in the south-east corner of the gallery in the Mining Building. The determination of ores of commerce, the composition of alloys and metals, and complete analysis of all commercial products will form the exhibit, which is to continue throughout the entire length of the Fair. The latest volumetric and gravimetric systems of analysis and also fire assaying will be employed. The object of the laboratory will be a practical exhibit of the analytical methods used in inorganic chemistry. Work will be done for the entire Fair; and should not enough material be had from exhibitors, work will be taken in from the outside. All experiments will be made as interesting as possible, and the determination of rarer metals will receive a goodly portion of the chemists' time. The title of chemist and assayer to the Fair belongs to Mr. J. S. Cory, a prominent chemist of Chicago, the position being purely honorary. Mr. Cory is a graduate of

Sheffield Scientific School, Yale College, and spent three years in Germany under Fresenius, of Wiesbaden. Mr. Emil Furste, a graduate of Berlin, will be assistant chemist. Several colleges will send young men to act as assistants, arrangements having been made for two men each month. Exhibitors will do well should they give their patronage to this most interesting branch of the Fair. As perfect an analysis of products of any kind will be made as is possible. Mr. Cory, whose office is in the Unity Building, Chicago, will be pleased to answer any question put to him concerning the Fair Laboratory.—*Ibid.*

FULLER'S EARTH AT DUNNING.

The village of Dunning, near Crieff, has a new industry within its borders, for there the Scottish Fuller's Earth Company have taken up their headquarters, and are working a bed of fuller's earth in the neighbourhood. This bed is on Lord Rollo's estate, and was discovered thirty years ago when Duncrub House was being built. The nature of the deposit was recognised. Dr. John Clark, late of Hertford Street, London, became much intersted in the discovery, and introduced it to the notice of the late Dr. Percy, the metallurgist, Sir Alfred Garrod being consulted as to its utility. The result proved that, after various manipulations, the earth can be produced free from mechanical impurities, and, what is still more rare, it possesses a delicate flesh tint. The company, which has been formed under the management of the Hon. Bernard Rollo, has laid down extensive machinery and plant for the purification of the earth. The tank-room contains five settling-tanks, 80 feet long by 9 feet broad, the rest of the accommodation being occupied by kilns, boiler-house, engine, &c. There is also a packing-house 84 feet in length, and in the village of Dunning there is a large kiln-drying and finishing mill. The chief difficulty hitherto experienced has been the unwillingness of the railway companies to adjust their rates so as to place Dunning on equal terms to compete with Bath. The rates have now been slightly reduced.—*Chemist and Druggist.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

—	Month ending 29th April	
	1892.	1893.
	£	£
Metals	1,837,214	1,599,233
Chemicals and dyestuffs	586,848	490,855
Oils	608,168	550,430
Raw materials for non-textile industries.	3,138,986	2,941,535
Total value of all imports	34,920,272	32,125,359

SUMMARY OF EXPORTS.

—	Month ending 29th April	
	1892.	1893.
	£	£
Metals (other than machinery)	3,179,216	2,622,875
Chemicals and medicines	677,211	818,711
Miscellaneous articles	2,463,592	2,586,400
Total value of all exports	17,865,876	16,617,977

IMPORTS OF OILS FOR MONTH ENDING 29TH APRIL.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Cocoa-nut	Cwt.	14,015	5,946	16,397	7,695
Olive	Tuns	1,976	2,407	74,965	92,705
Palm	Cwt.	111,069	82,304	130,430	106,222
Petroleum	Gall.	10,493,718	9,333,610	222,377	165,118
Seed	Tons	1,972	2,262	48,373	55,805
Train, &c.	Tuns	587	1,580	12,519	30,398
Turpentine	Cwt.	19,259	11,212	22,922	12,318
Other articles ..	Value £	..	..	80,185	80,139
Total value of oils		..	..	608,168	550,430

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 29TH APRIL.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Bark, Peruvian ..	Cwt.	9,075	8,007	21,613	14,646
Bristles	Lb.	144,703	305,186	21,753	47,899
Caoutchouc	Cwt.	20,915	21,224	203,159	286,966
Gum :—					
Arabic	„	4,636	6,681	12,830	13,368
Lac, &c.	„	19,370	18,270	75,204	80,875
Gutta-percha	„	5,844	1,024	70,847	10,871
Hides, raw :—					
Dry	„	42,904	34,143	110,049	93,716
Wet	„	38,010	33,643	82,064	67,772
Ivory	„	1,246	558	62,126	25,452
Manure :—					
Guano	Tons	1,278	2,676	9,411	10,268
Bones	„	11,042	2,683	50,040	12,539
Nitrate of soda.	„	21,863	5,171	196,826	53,675
Phosphate of lime	„	22,030	14,911	48,801	24,466
Paraffin	Cwt.	43,651	73,102	59,110	76,179
Linen rags	Tons	3,349	349	29,529	1,890
Esparto	„	16,340	18,185	74,796	87,921
Pulp of wood	„	13,344	18,361	69,099	99,842
Rosin	Cwt.	166,286	101,625	34,344	22,299
Tallow and stearin	„	122,519	148,369	157,406	209,862
Tar	Barrels	1,275	2,660	709	1,517
Wood :—					
Hewn	Loads	219,072	153,167	372,004	288,180
Sawn	„	211,333	165,039	492,112	359,730
Staves	„	11,734	8,321	66,962	52,673
Mahogany	Tons	6,883	8,445	62,521	78,225
Other articles....	Value £	..	..	755,671	920,704
Total value		..	..	3,138,986	2,941,535

Besides the above, drugs to the value of 80,333*l.* were imported, as against 81,277*l.* in April 1892.

Imports of Metals for Month ending 29th April.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Copper :—				
Ore .... Tons	11,594	4,112	82,478	23,525
Regulus .... „	11,562	8,291	294,529	204,118
Unwrought .... „	2,329	2,382	109,842	112,644
Iron :—				
Ore.............. „	311,713	323,127	230,810	217,141
Bolt, bar, &c.... „	3,446	2,521	28,058	20,691
Steel, unwrought.. „	352	391	3,596	3,880
Lead, pig and sheet „	18,454	14,822	203,376	147,450
Pyrites .... „	62,691	56,496	109,986	96,066
Quicksilver .... Lb.	137,435	45,140	12,260	3,766
Silver ore....... Value £	..	..	327,746	248,714
Tin .... Cwt.	46,948	70,424	213,097	328,466
Zinc .... Tons	3,424	3,951	79,087	69,828
Other articles ...Value £	..	..	142,355	122,944
Total value of metals	..	..	1,837,214	1,599,233

Imports of Chemicals and Dyestuffs for Month ending 29th April.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............. Cwt.	5,503	6,919	2,997	5,828
Bark (tanners', &c.) „	36,071	22,310	17,129	8,414
Brimstone .... „	59,036	34,685	16,669	7,919
Chemicals...... Value £	..	..	115,593	92,034
Cochineal .... Cwt.	363	289	2,273	1,666
Cutch and gambier Tons	2,484	2,529	57,032	56,888
Dyes :—				
Aniline .... Value £	..	..	14,263	12,865
Alizarin ...... „	..	..	20,126	25,769
Other .... „	..	..	1,439	1,179
Indigo .... Cwt.	2,287	2,339	39,044	41,781
Nitrate of potash . „	30,832	12,578	25,804	10,638
Valonia .... Tons	4,356	5,108	61,487	62,674
Other articles... Value £	..	..	212,992	163.200
Total valuc of chemicals	..	..	536,848	490,855

Exports of Drugs and Chemicals for Month ending 29th April.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	462,650	647,179	169,344	202,445
Bleaching materials „	114,588	143,934	45,149	59,730
Chemical manures. Tons	23,006	24,791	159,809	188,709
Medicines....... Value £	..	..	82,214	87,210
Other articles ... „	..	..	217,695	280,608
Total value	..	..	677,211	818,711

Exports of Metals (other than Machinery) for Month ending 29th April.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	8,496	8,913	38,254	35,213
Copper :—				
Unwrought ..... „	79,662	57,595	194,669	140,957
Wrought......... „	27,007	28,925	80,395	83,719
Mixed metal .... „	26,869	24,943	67,883	59,509
Hardware ..... Value £	..	..	181,401	162,857
Implements....... „	..	..	112,499	94,875
Iron and steel..... Tons	223,518	252,159	1,835,715	1,821,265
Lead .... „	4,073	2,913	61,518	35,523
Plated wares... Value £	..	..	21,060	26,179
Telegraph wires „	..	..	447,883	43,475
Tin .... Cwt.	8,594	6,965	40,719	33,659
Zinc .... „	21,742	20,567	20,245	17,198
Other articles .. Value £	..	..	76,975	68,446
Total value	..	..	3,179,216	2,622,875

Exports of Miscellaneous Articles for Month ending 29th April.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	622,800	858,700	15,144	25,792
Military stores.. Value £	..	..	88,352	75,258
Candles.......... Lb.	1,422,500	1,466,600	27,387	27,961
Caoutchouc ..... Value £	..	..	97,582	93,312
Cement.......... Tons	34,978	39,461	66,038	67,096
Products of coal Value £	..	..	123,256	134,290
Earthenware ... „	..	..	151,867	150,176
Stoneware ...... „	..	..	13,696	14,695
Glass :—				
Plate........... Sq. Ft.	191,468	125,087	11,390	6,371
Flint........... Cwt.	7,446	7,292	16,659	19,031
Bottles......... „	62,559	57,080	29,811	26,092
Other kinds.... „	21,514	19,918	16,575	16,577
Leather :—				
Unwrought .... „	11,818	11,568	112,211	110,177
Wrought ..... Value £	..	..	21,582	23,010
Seed oil.......... Tons	5,906	5,366	117,476	118,705
Floorcloth ..... Sq. Yds.	1,155,100	1,306,900	48,380	54,369
Painters' materials Val. £	..	..	118,335	128,402
Paper .... Cwt.	79,457	80,247	131,991	126,259
Rags............. Tons	4,606	5,057	31,858	40,426
Soap .... Cwt.	48,359	41,722	52,142	48,705
Total value	..	..	2,463,592	2,586,400

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

7763. W. Donaldson. Improvements in apparatus for the evaporation of liquids. April 17.

7912. T. R. Murray. Improvements in pumps for pumping or compressing gases or vapours. April 19.

8125. W. H. Webb. Improvements in or connected with apparatus for cooling liquids. April 22.

8134. R. S. Brownlow. Improvements in apparatus for heating feed water, applicable also for evaporating and for cooling or condensing. April 22.

8424. F. M. Robertson, W. S. Miller, and H. S. Fearon. Improvements in the process of and apparatus for evaporating or drying. April 26.

8646. C. Huelser.—From A. Bloch, Germany. Process and appliance for mixing gases with liquids, especially carbonic acid, with water for baths and the like. April 29.

8817. E. Ruud. Improvements in automatic distilling apparatus. Complete Specification. May 2.

9006. O. Guttmann. Improved apparatus for concentrating and distilling liquids. May 5.

9147. J. Bouvier. Improvements in filters. May 8.

9514. G. Siebert. Improvements in evaporating and concentrating apparatus, particularly applicable for concentrating sulphuric acid. Complete Specification. May 12.

9538. E. Schindeler. Improvements in centrifugal apparatus for extracting liquid from solid matter for filtering and other similar purposes. May 12.

Complete Specifications Accepted.*

1892.

9499. W. J. Mirrlees and D. Ballinghall. Apparatus for evaporating, concentrating, and distilling liquids. April 26.

10,126. D. Wickham. Improvements connected with apparatus for aërating malt and other liquors and liquids. May 3.

10,595. A. Chapman. Improvements in apparatus for evaporating or concentrating alkaline or other solutions. April 26.

11,078. E. Schellerrer. Improvements in couplings for pipes for conveying heating liquids and for similar uses. April 26.

11,705. E. J. Barbier. Method and apparatus for distilling, separating, and concentrating acids of mixed liquids, and treating substances in solution. May 17.

20,541. J. Whyte, H. Whyte, and A. W. Cooper. Evaporative condensers. May 3.

21,264. E. Hesketh and A. Marcet. Apparatus for producing cold. May 3.

1893.

1297. G. Schmidt and E. Loh. Process and apparatus for purifying water. April 26.

6441. G. Sinclair. Improvements in boilers for boiling or chemically treating fibrous materials. May 10.

II.—FUEL, GAS, AND LIGHT.

Applications.

7968. W. L. Malcolmson. Improved fuel. April 20.

8040. D. W. Nightingale and S. G. Wicking. An improved fuel. April 20.

8318. H. M. Merry. An improved firelighter. April 25.

8371. L. L. Merrifield, J. T. Westcott, and W. H. Pearson, jun. Improvements in apparatus for the manufacture of carburetted water-gas. Complete Specification. April 25.

8499. E. Hedges. Improvements in the manufacture of fire-lighters. April 27.

8510. J. Moeller. A process for the manufacture of oil-gas. April 27.

8559. J. Addie, J. C. Cunninghame, and W. Macfarlane. Improvements in the production of ammonia and cyanogen and compounds of ammonia and cyanogen. April 28.

8650. P. H. Bracher. Improvements in or relating to fuel particularly applicable for lighting fires. April 29.

8759. J. H. R. Dinsmore. Improvements in and connected with the manufacture of illuminating gas. May 2.

9141. J. Laing. Improvements in the manufacture of gas from mineral or other oils and in apparatus therefor. May 8.

9177. W. P. Thompson. Improvements in separating gases of different specific gravities, and in apparatus therefor. May 8.

9230. W. H. Telford. Improvements in or connected with the construction of coke-ovens. May 9.

9274. W. F. Stanley. Improvements in mantles for incandescent lighting by gas. May 9.

9634. W. Foulis and C. Hunt. Improvements in apparatus for purifying coal-gas from sulphur. May 13.

Complete Specifications Accepted.

1892.

9265. F. B. Hill and R. D. Brett. Improvements relating to the utilisation of liquid hydrocarbons for lighting and heating purposes, and to apparatus therfor. May 17.

11,102. R. B. Anderson. Furnaces for heating gas retorts. April 26.

11,809. S. Marcus and E. F. Bothe. Improvements in air and gas carburetting apparatus. April 26.

12,390. S. Pitt.—From C. Heinzerling. Process for the separation and recovery of benzol, alcohol, ether, and other easily volatile substances from air or other gas. May 17.

12,441. H. H. Lake.—From W. W. Harris. Manufacture of gas. May 10.

23,419. J. Gray. Apparatus for the manufacture of gas. May 3.

1893.

5806. J. West. Improvements in machinery or apparatus for charging and drawing gas retorts. April 26.

6142. W. F. Richie.—From J. B. Archer. Process of manufacturing gas. April 26.

IV.—COLOURING MATTERS and DYES.

Applications.

8093. H. E. Newton.—From the Farbenfabriken vormals F. Bayer & Co., Germany. The manufacture or production of dyestuffs. April 21.

8184. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture of new sulpho-acids of phenylrosinduline and analogues and homologues thereof. April 22.

8221. W. H. Claus. Manufacture of blue colouring matter containing sulphur. April 24.

8511. C. D. Abel.—From L. D. Huguenin and Co., Switzerland. Manufacture of polyazo colouring matters derived from dioxydiphenylmethan and condensation products of formic aldehyde with benzidine, tolidine, or dianisidine. Complete Specification. April 27.

8604. J. B. F. E. Roy. An improved process for the purification of tanning and dye extracts. Complete Specification. Filed April 28. Date applied for 28 October 1892, being date of application in France.

8771. J. Emmett. Direct woollen black. May 2.

8824. H. E. Newton.—From the Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of basic compounds derived from pyrazine. May 2.

8898. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters and materials therefor. May 3.

8973. A. Liebmann and A. Studer. Improvements relating to the production of colouring matters. May 5.

9182. J. C. L. Durand, D. E. Huguenin, and A. J. J. D'Andiran. Manufacture of new colouring matters derived from dioxydiphenylmethan. Filed May 8. Complete Specification. Date applied for 27 January 1893, being date of application in France.

9183. J. C. L. Durand, D. E. Huguenin, and A. J. J. D'Andiran. Manufacture of new colouring matters derived from the condensation products of formic aldehyde with benzidine, tolidine, or dianisidine. Complete Specification. Filed May 8. Date applied for 27 January 1893, being date of application in France.

Complete Specifications Accepted.

1892.

10,138a. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of a new class of basic dyestuffs or colouring matters, and of materials and intermediate products relating thereto. May 3.

10,138b. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Improvements relating to the manufacture of sulpho acids of a new class of basic dyestuffs or colouring matters, and of materials and intermediate products relating thereto. May 3.

10,138c. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of a new class of basic dyestuffs or colouring matters, and of sulpho acids thereof, and of materials and intermediate products relating thereto. May 3.

10,915. Brooke, Simpson, and Spiller, Lim., and T. A. Lawson. Partly communicated by A. G. Green. Manufacture of azo colouring matters. April 26.

11,395. B. Willcox. From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the production of azo colours on fibre. May 17.

11,522. B. Wilcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of dihydroxynaphthalene sulpho acids. May 10.

11,533. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture of new colouring matters. May 10.

11,865. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of naphthalene sulpho acids. May 10.

11,876. B Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of new basic colouring matters. May 10.

12,579. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of anthraquinone derivatives. May 17.

12,580. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture and production of new alizarin derivatives. May 17.

12,720. J. R. Geigy. Production of blue triphenylmethane colouring matters or dyes. May 10.

13,147. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of mordant-dyeing colouring matters. May 17.

13,475. O. Imray.—From The Society of Chemical Industry. Production of a red azo-colouring matter. May 17.

1893.

2316. A. E. Alexander.—From H. P. Wells. A colouring matter obtained from logwood and the process of producing same. May 10.

3737. C. D. Abel.—From Kern, Sandoz, and Co. Manufacture of colouring matters capable of dyeing cotton direct. April 26.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

8717. J. C. Mewburn.—From J. Cardon, France. Improvements in machinery for breaking, softening, and removing the gummy matter from hemp, ramie, and other fibrous materials. May 1.

8966. T. Buzzi and R. Menochio. An improved process for separating vegetable impurities from wool. Complete Specification. May 4.

9266. T. Birnbaum. Improvements in the manufacture of coloured waterproof fabrics. May 9.

Complete Specifications Accepted.

1892.

10,612. C. A. Sahlstrom and E. Parr. Improvements in and connected with the cleansing and bleaching of wool, hair, silk, cotton, flax, and other vegetable or animal fibres or fabrics; the recovery of bye-products such as oil and fat, such as contained in such fibres or fabrics, and the recovery of the whole or part of the ingredients used in the process. May 10.

10,642. R. Dewhurst and Co., Lim., and A. Stockdale. *See* Class VI.

11,581. W. E. Heys.—From E. F. Dranez, H. P. J. Vassart, and J. H. S. M. Delattre. Improvements in the method of and apparatus for removing fatty matters and other impurities from wool and similar textile materials. April 26.

11,994. T. J. Hutchinson and R. B. Hardman. An improved process for the recovery of the cloth from damaged waterproofed fabrics. May 3.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

Applications.

7841. E. Gessler. Improvements in dyeing apparatus. April 18.

8167. F. R. Wells. A process for colouring paper and cardboard. April 22.

8787. M. Harding. Improvements in jigs for bleaching and dyeing. May 2.

9062. A. Duncan. An improved method of fixing tin and tannin as a mordant on vegetable fibres. May 6.

9095. T. Lye and W. T. Lye. Improvements in the bleaching of straw and straw plaits. May 6.

9096. T. Lye and W. T. Lye. Improvements in the bleaching or dyeing of chip, chip-plait straw, or straw plait. May 6.

9317. L. A. Gillet. Improvements in dyeing textile fabrics. May 9.

9371. C. D. Abel. — From The Farbwerke vormals Meister, Lucius, und Brüning, Germany. A process for dyeing wool with fast colours. May 10.

9526. J. N. Harrison and C. A. N. Harrison. Improvements in the method of printing and fixing patterns upon fabrics, and in printing patterns upon paper, and apparatus and means therefor. May 12.

Complete Specifications Accepted.

1892.

10,612. C. A. Sahlstrom and E. Parr. *See* Class V.

10,642. R. Dewhurst and Co., Lim., and A. Stockdale. A new or improved means or process of producing coloured patterns or designs upon silk plushes, or upon wool or velvet plushes. April 26.

11,027. W. J. S. Grawitz. Improvements in dyeing or printing with alkaloids. May 17.

11,057. G. M. Marchant. Machinery for scouring, dyeing, and drying hanks of yarn. May 3.

11,395. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. *See* Class IV.

11,529. B. Willcox.—From The Farbenfabriken vormals F. Bayer and Co. Improvements in dyeing and printing with azo dyestuffs. May 10.

1893.

629. C. D. Abel.—From O. Keferstein, sen., and O. Keferstein, jun., and Siemens and Halske. An improved bleaching process for yarns, piece goods, and other materials. May 17.

4417. J. Bromley. Improvements in machinery for bronzing, colouring, and similarly ornamenting paper or other material in sheets or continuous rolls. May 17.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

7794. H. Aitken. Improvements in and apparatus for the obtainment or production and utilisation of cyanogen or cyanides and other substances from gases containing them, or from carbonaceous matter or substances containing ammonia or nitrogen or compounds thereof. April 17.

7799. C. Ullmann. Improvements in the production of peroxide of lead and certain by-products. April 17.

7846. C. Raspe. Improved process for the manufacture of carbonate of ammonia. April 18.

7895. R. Wilson. Improvements in apparatus employed for concentrating sulphuric acid. April 19.

8064. H. C. Bull. A new or improved process and apparatus for the production of silicates suitable for use in glass making, and for the recovery of hydrochloric acid as a by-product. April 21.

8148. J. Young. Improvements in the manufacture of cyanides. April 22.

8902. M. Prentice. Improvements connected with the manufacture of nitric acid, muriatic acid, or the like, where sulphuric acid is employed, and of superphosphate of lime. May 3.

8907. H. R. Browne and M. Guthrie. Improvements in the manufacture or production of soda crystals. May 3.

9042. M. Prentice. Improved means for use in the manufacture or production of sulphurous acid and sulphites. May 5.

9114. C. Haeussermann. A process for preparing simultaneously hydrate of sodium and bichromate of the same metal from the neutral chromate. May 6.

9271. G. S. Albright and J. J. Hood. Improvements in the manufacture of manganese peroxide. May 9.

9294. T. Craney. Improvements in salt purifiers. Complete Specification. May 9.

9521. W. V. Wilson and J. J. Lundy. Improvements in the manufacture of sulphate of lead. May 12.

Complete Specifications Accepted.

1892.

10,517. E. Hermite, E. J. Paterson, and C. F. Cooper. A process for purifying bleaching liquor. May 10.

12,155. H. S. Ellworthy. Manufacture of carbonic acid gas. May 10.

13,686. E. de Cuyper. Improvements relating to the collection of ammonia and ammoniacal salts from gaseous and liquid mixtures. May 3.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

8554. A. D. Brogan and The Glasgow Plate Glass Co. Improvements in apparatus for rolling glass. April 28.

8555. A. D. Brogan.—From The Glasgow Plate Glass Co. Improvements in apparatus for rolling glass. April 28.

8758. W. W. Pilkington. Improvements in apparatus for forming molten glass into sheets. May 2.

8863. F. T. Pover. Improvements in or relating to ovens or kilns for the firing of bricks, tiles, potters' goods, and the like. May 3.

Complete Specifications Accepted.

1892.

8896. T. H. Hunt. Appliances employed in glazing earthenware pipes and analogous articles. May 3.

10,123. H. L. Doulton and S. H. Leech. Manufacture of terra cotta and like materials, and apparatus therefor. May 3.

10,532. M. Laffont. *See* Class IX.

1893.

6971. R. Haddan.—From S. Evans, C. L. Rawson, and C. T. Brown. Improvements relating to processes of chipping glass. May 10.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

7894. C. H. Haigh. A new or improved material for use in the construction of pavements, floors, walls, stairtreads, and the like. April 19.

8142. E. A. R. Avenarius. Improvements in and connected with moulding boxes for the manufacture of artificial sandstone. Complete Specification. April 22.

8212. J. C. Sellars. Improvements in or connected with the production of facing materials for building and other surfaces, and surfaces generally. April 24.

8441. N. Rigby. An improved material for covering or decorating walls and the like, and the method of producing the same. April 26.

8488. H. T. Grainger and J. P. Clark. Improvements in road-paving blocks. April 27.

8518. R. Stone. Improvements in the manufacture of fireproof plastic material for cement, also applicable to smelting and various other useful purposes. April 27.

8524. J. W. Leigh. Improvements in the construction of fireproof floors and roofs. April 27.

8828. J. W. Leigh. Improvements in the construction of fireproof floors and roofs. May 2.

8869. J. O. McQuone and R. S. Turnbull. An improved composition or concrete pavement applicable for sporting tracks, footpaths, garden walks, and like purposes. May 3.

8893. J. Lyle. An improved combination and treatment of ingredients to form asphalt and asphaltic compounds or mixtures. May 3.

8897. G. Prüssing. A process for improving cement. May 3.

9044. H. H. Leigh.—From A. Jumeau, France. Improvements in the mosaic reproduction of decorative painting. May 5.

9550. R. Haddan.—From G. R. Anderson, A. H. Shotter, W. Koehler, and C. H. Dover, United States. An improved artificial asphaltum or pitch and process of making same. Complete Specification. May 12.

9629. J. T. Chappell. An improvement in fireproof floor structures. Complete Specification. May 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

9857. H. B. Price. Fireproof floors and other structures. May 10.

9974. H. A. Majewski and W. Beyenbach. A process of manufacture of artificial marble. May 10.

10,532. M. Laffont. Manufacture of material suitable for building and architectural purposes, and for ceramic and other similar works. May 3.

11,766. W. H. Talbot and C. H. Venning. A process for hardening and preserving natural and artificial stone and other like building material. April 26.

21,640. K. S. Meyer. Process for the manufacture of artificial building and other stone. May 10.

1893.

4825. E. Nelson. Improvements relating to damp course materials used in the foundations of buildings. May 10.

X.—METALLURGY, MINING, Etc.

APPLICATIONS.

7791. C. T. J. Oppermann. An improved process for the preparation of iron or steel plates for nickel or other plating. April 17.

7920. H. Burton. Anti-friction bronze. April 19.

8057. A. Sattmann and A. Homatsch. Improvements in the manufacture of iron and steel. April 21.

8346. C. M. Allen. Improvements in and relating to the smelting of ores and refining of metals, and to apparatus therefor. Complete Specification. April 25.

8456. B. H. Thwaite. Improvements in the manufacture of steel and in the refining of fluid iron. April 27.

8572. R. Clayton. A process for preparing iron or steel for tinning, galvanising, or otherwise coating. April 28.

8584. R. S. Garton. From P. Naef, United States. Improvements in desilverising lead. April 28.

8669. A. Wilson and S. Oates. Improvements in the manufacture of armour plates. April 29.

8964. J. A. Mays. Separating and purifying metals. May 4.

9045. H. W. G. Fairfax. Improved method of and apparatus for hardening and moulding or shaping steel plates and other articles. May 5.

9085. S. Meredith. Improvements in puddling furnaces used in the manufacture of iron and steel. May 6.

9406. J. H. Ladd. Improvements in treating malleable or wrought iron. May 10.

9619. E. Casper. Improvements in obtaining copper. May 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

7448. W. Mayer. Improvements in slag boxes and similar moulds for blast furnaces, steel works, and the like. April 26.

7473. C. H. Aston. Methods of utilising slag made in connection with iron and steel furnaces. April 26.

8861. C. F. Hengst. Improved metallic alloy. April 26.

9127. J. Y. Johnson.—From N. Lebedeff. Extraction of metals from ores or metalliferous materials. May 17.

9765. W. E. May. Manufacture of steel and other metal castings. May 3.

10,459. F. G. Bates and W. R. Renshaw. Improvements in coating iron and other metals with lead, and in the alloying or treating of lead to render it suitable for this purpose. April 26.

10,756. J. Lakin. Manufacture of wrought iron. May 3.

12,492. J. David. Improvements in extracting silver and certain base metals from ores or compounds containing the same. May 3.

19,600. J. Buchanan, jun. Apparatus for charging furnaces with metal. April 26.

1893.

3111. C. Vattier. Process and apparatus for roasting pulverulent materials. May 10.

4072. H. Bird. Improvements connected with the production of purple ore bricks or blocks for use in blast furnaces or other furnaces for the production of iron, and for other furnaces. May 10.

4251. F. B. Stone. A process for freeing copper from arsenic. April 26.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Applications.

7756. W. T. Gibbs and S. P. Franchot. Improvements in the process of obtaining chlorates of the alkalis or of the alkaline earth metals by electrolysis. April 17.

7897. W. Jones. Improvements in galvanic batteries for utilising the waste. April 19.

8035. H. D. Cunningham. Electro-plating aluminium. April 20.

8176. C. Hanbury. Improvements in electrolytic apparatus. April 22.

8177. E. Andreoli. Improvements in electrolysis. April 22.

8571. H. C. W. Emery. Improvements in or connected with cells for electric batteries. April 28.

8675. R. J. Crowley and J. R. Grant. Improvements in or relating to galvanic batteries. April 29.

8808. H. Lehmann. Improvements in electric accumulators or storage batteries, partly applicable as a constant primary element. Complete Specification. May 2.

8908. M. Guthrie. Improvements in apparatus for the electrolytical decomposition of brine and other liquids. May 3.

9295. T. Craney. An improved electrolytic apparatus. Complete Specification. May 9.

9296. T. Craney. Improvements in apparatus for the electrolysis of salt. Complete Specification. May 9.

9297. T. Craney. An improved electrolytic apparatus. Complete Specification. May 9.

Complete Specifications Accepted.

1892.

9569. C. P. Shrewsbury and J. L. Dobell. Improvements in or connected with electric batteries. May 3.

9799. D. G. FitzGerald. Apparatus and means for the electrolysis of alkaline chlorides. May 10.

11,382. H. Niewerth. Process for manufacturing compound and elementary bodies or chemical products by means of electricity, and apparatus therefor. May 10.

11,532. W. A. Boese. Secondary or storage batteries. May 3.

11,835. E. J. Finot. Process and apparatus for tanning hides and skins with electrolytic action. April 26.

12,731. Siemens Bros. and Co., Lim.—From Siemens and Halske. Electrolytic extraction of zinc. May 10.

19,170. H. Blackman. Production of chlorine, soda, and other products by electrolysis, and in apparatus employed therein. May 17.

1893.

1229. H. H. Lloyd. Improvements in secondary or storage batteries. May 3.

4356. W. P. Thompson.—From C. L. Coffin. Welding metals electrically. April 26.

6565. Siemens Bros. and Co., Lim., and E. F. A. Obach. An improvement in dry voltaic cells and in conducting connections for the carbons of these and other electric cells. May 10.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

7712. J. E. Bedford and C. S. Bedford. Improvements in the manufacture of linoleum oil. April 17.

7775. A. Armand and B. Hilaire. Improvements in oil presses. April 17.

8367. W. H. Wayland. *See* Class XVI.

8621. H. Hamilton. A new or improved composition of soap. April 29.

8740. W. J. Fraser and T. C. Palmer. Improvements in tallow melting or rendering. May 1.

9105.—C. D. Abel.—From Fabriques de Produits Chimiques de Thann et de Mulhouse, Germany. An improved manufacture of oils, fats, wax, and other analogous substances freed from odour and flavour. May 6.

9291. H. H. Lake.—From W. N. Blakeman, jun., United States. Improvements relating to the treatment of oils for imparting drying properties thereto. Complete Specification. May 9.

9292. H. H. Lake.—From W. N. Blakeman, jun., United States. Improvements relating to the treatment of drying-oils for thickening the same. Complete Specification. May 9.

9315. W. N. Hartley and W. E. B. Blenkinsop. Improvements in or relating to the treatment of oils for refining, bleaching, and boiling the same. May 9.

9540. G. R. Geldard. A process for testing for water in butter and other fatty matters, and appliances for that purpose. Complete Specification. May 12.

Complete Specifications Accepted.

1892.

10,612. C. A. Sahlstrom and E. Parr. *See* Class V.

14,287. A. Paget. Apparatus employed in the treatment of oleaginous and other seeds. April 26.

1893.

6564. O. Imray.—From J. F. Newell. Improvements in compositions for self-lubricating bearings. May 10.

7562. J. Soler. Process for the extraction of oleïne from tallow. May 17.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

7784. L. Paget. Improvements in processes of preparing pyroxyline solvents and their products. Complete Specification. April 17.

8345. H. H. Lake.—From A. B. Browne, United States. Improvements in the manufacture of white lead. Complete Specification. April 25.

8368. R. Irvine. Improvements in the manufacture or production of lamp black. April 25.

9194. W. H. Hyatt. Improvements in the manufacture of paint. May 8.

9293. H. H. Lake.—From W. N. Blakeman, jun., United States. Improvements in and relating to the manufacture of pigments or paints. Complete Specification May 9.

9329. P. C. Bjerke and P. Ewens. Improvements in the manufacture of blacking and dubbing. May 10.

9493. A. C. Wilson and S. Broadbank. A composition for the protection of stonework or the like porous material against damp. May 12.

9568. G. A. Grierson. The use of celluloid or xylonite scrap in the manufacture of collodions and varnishes. May 13.

9611. W. P. Thompson.—From G. Leuchs and C. Leuchs, Germany. Improvements in the manufacture of glazes, enamels, and the like. May 13.

Complete Specifications Accepted.

1892.

9812. W. H. Bodin. Improvements in or relating to colour washes. May 3.

11,166. H. E. Serullas. Improvements in or connected with and apparatus for the obtainment or extraction of gutta-percha or the like. May 17.

22,175. W. Baker. The manufacture of an improved composition for waterproofing and other purposes. May 17.

1893.

3034. A. M. Dumoulin. Improvements in varnishes. May 3.

3557. J. Perl. Improved liquid bronzing composition. April 26.

5939. R. J. Doyle. Non-inflammable paint. May 10.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

8026. H. W. Brüning. An improved process for continuously treating hides in tanning liquors, and apparatus therefor. April 20.

8604. J. B. F. E. Roy. *See* Class IV.

9026. L. Alexander. Improvements relating to softening, roughening, waterproofing, and increasing the durability of leather, and a composition therefor. Complete Specification. May 5.

9441. G. MacLellan and Co., P. Hodge, and J. W. O. Walker. An improved process or manufacture for rendering leather waterproof. May 11.

9511. H. A. Leverett and S. M. Thomas. An improved process of rapidly making leather. May 12.

9613. W. H. E. Boulton. Improvements in or relating to the manufacture of cement applicable for leather belting and other purposes. May 13.

Complete Specifications Accepted.

1892.

18,443. C. A. Jensen.—From W. M. Walters. A new or improved putty or marine glue. May 3.

1893.

6061. H. H. Lake.—From A. M. Goodale and M. W. A. Spring. Treatment of hydrated phosphates of alumina and iron for obtaining an improved fertilizer. May 10.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

8367. W. H. Wayland. An improved apparatus and process for purifying sugar, saccharine, and the like; also applicable to oils, alcohol, and other liquids which need purifying. April 25.

8718. W. H. Schwartz. An improved syrup for jam and golden syrup manufacture, also for yellow crystal makers and brewers. May 1.

8793. J. Hanson, P. C. D. Castle, and J. H. Morrison. Improvements in or appertaining to the utilisation of a waste or nearly waste product, and the manufacture of a useful gum or gummy compound therefrom. May 2.

8795. F. Graeger. Improvements in the treatment of molasses. Complete Specification. May 2.

XVII.—BREWING, WINES, SPIRITS, Etc

Applications.

8005. C. H. Meyer. Improvements in or connected with brewing and distilling. April 20.

8144. C. Rach. Improvements in the preparation of wort from Indian corn. Complete Specification. April 22.

8367. W. H. Wayland. *See* Class XVI.

9415. G. F. Strawson. An improvement in the manufacture of Bouillie Bordelaise or Bordeaux mixture in powder. May 11.

Complete Specifications Accepted.

1892.

9165. R. G. Ross, J. B. Hilliard, and W. Paterson. A new or improved method of purifying and hardening water for use in the manufacture of malt extract, and for brewing and analogous purposes. May 17.

10,078. H. Myers. A process for the manufacture of compressed brewers' yeast into bakers' yeast, and for use in distillers' worts. May 3.

10,126. D. Wickham. *See* Class I.

10,780. C. H. Jolliffe. Improved means and ingredients for preserving wines, beers, and yeast. April 26.

11,638. R. C. Scott. Improvements in treating or ageing spirit. May 3.

13,846. H. Rinck. An improved ferruginous beer. May 10.

1893.

4927. W. P. Thompson.—From J. Ulhmann. Improvements in the preparation or treatment of beer, and of an extract of malt to be used therefor. April 26.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

7747. A. Shiels. An improved method of preserving meat, fish, fruit, and other substances. April 17.

7748. A. Shiels. Improvements in apparatus for preserving meat and other food substances. April 17.

8027. C. B. Waller. A material for improving the flavour and digestibility of tea or other infusions containing tannin. Complete Specification. April 20.

8505. A. J. Boult.—From F. Jas and C. Henny, Holland. Improvements in or relating to the sterilisation of milk. Complete Specification. April 27.

8726. H. Trillich. Improvements in or relating to the preparation of substitutes for coffee. May 1.

9145. L. Hausler. Improvements in the method of and means for preserving articles of food. Complete Specification. May 8.

B.—*Sanitary Chemistry.*

7929. J. Fenton. A means of purifying sewage and trade refuse water by precipitation and oxidation, and the treatment of the refuse therefrom. April 19.

7958. H. B. Ransom. Improvements in or relating to the treatment of town refuse for the purpose of obtaining a valuable product therefrom, and in apparatus for the purpose. April 19.

9063. R. C. Tanner. A new or improved method of treating sewage by means of ferric compounds. May 6.

C.—*Disinfectants.*

8429. S. Pitt.—From The Chemische Fabrik auf Actien vorm. E. Schering, Germany. Improvements in the preparation of antiseptics. April 26.

9359. G. Whalley. A new compound or mixture for purifying sewage and foul water or liquid. May 10.

Complete Specifications Accepted.

A.—*Chemistry of Foods.*

1892.

7789. E. Edwards.—From F. Grognet. Process and apparatus for preserving meat, fish, and other perishable substances. April 26.

1893.

2152. A. Bay. Process and apparatus for treating newly-ground flour and the like with air for the purpose of seasoning or maturing it. May 3.

2675. The Nutriment Company and C. P. Eyre. Improved preparation for coagulating milk. May 17.

B.—*Sanitary Chemistry.*

1892.

6882. H. C. W. Baldwin. Improvements in the construction and arrangements of purifying and disinfecting apparatus. May 3.

10,308. H. Lockwood. Improvements in tanks or vessels and apparatus used in the purification of sewage and other foul waters by precipitation, and in the treatment of the sludge obtained in such process. May 3.

C.—*Disinfectants.*

1892.

12,392. A. S. Chinnock, W. Fairley, C. E. McLaren, and P. Meeks. A new compound suitable for the purification of sewage and other polluted liquors. May 17.

13,291. J. Y. Johnson.—From F. von Hayden. Manufacture of antiseptics. May 3.

1893.

1738. M. Rees. An improved disinfecting fluid. April 26.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

8165. G. Roberts. An improvement in the manufacture of celluloid goods. April 22.

8334. G. L. Jaeger. Method of and apparatus for the manufacture of blotting paper. Complete Specification. April 25.

9202. W. Allan, jun., and R. A. Kolb. Improvements in or relating to the manufacture of bank-note paper to prevent forgery of such paper. May 8.

Complete Specifications Accepted.

1892.

21,485. E. Cadoret and E. Degraide. A new or improved process of manufacturing incombustible and inodorous celluloid. May 10.

1893.

7221. G. C. Marks.—From R. B. McEwan, J. L. McEwan, and R. W. McEwan. Paper board. May 17.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

8735. J. C. W. F. Tiemann. Manufacture of a new chemical substance from orris-root. May 1.

8736. J. C. W. F. Tiemann. Manufacture of new chemical substances suitable for perfumery, confectionery, and the like. May 1.

9028. Sir J. B. Lawes, Bart. Improvements in the manufacture of cream of tartar. May 5.

Complete Specification Accepted.

1892.

12,166. C. D. Abel.—From C. F. Boehringer and Sohne. Manufacture of lactyl derivatives of methylaniline, ethylaniline, paranisidine, and paraphenetidine. May 10.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

7743. J. Joly. Improved method of photographing in colours. April 17.

8956. C. E. Pettitt. Improvements in the manufacture of sensitive plates and films for photographic purposes, and in the treatment of such plates and films after exposure in the camera. May 4.

Complete Specifications Accepted.

1892.

11,175. H. van de Weyde. Photography. May 17.

11,254. J. T. Clarke. Improvements in or relating to the manufacture of sensitised films for carbon printing. April 26.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

7933. G. A. Lesieur. Improvements in matches and vestas. April 19.

8226. G. Pinder. Improvements in or connected with ships' rockets, signal lights, Roman candles, and other fireworks. April 24.

8262. C. F. Cross, E. Bevan, and C. Beadle. An improvement in the nitration of cellulose. April 24.

8392. G. Kynoch and Co., Lim., and E. Jones. Improvements in cordite loading machines. April 26.

8677. J. V. Landuyt. Improvements in apparatus for use in the manufacture of matches and for putting the same in boxes. April 29.

8720. Leon de Rigaud. An improved self-lighting firework. May 1.

8947. F. M. Carulla. Improvements in the manufacture or composition of explosives. May 4.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

9177. W. P. Thompson. *See* Class II.

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Edward C. Cortis Stanford.
Thos. Tyrer.

With the Chairmen and Secretaries of Sections.

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E. Rider Cook, East London Soapworks, Bow, E.

Honorary Foreign Secretary:
Ludwig Mond, F.R.S.

General Secretary: Charles G. Cresswell.

Offices:
Palace Chambers, 9, Bridge Street, Westminster, S.W.

THE JOURNAL.

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C. Otto Weber, Ph.D.	IV., XIII.
J. G. Wells	XVII., XX.
A. Wingham	X.
C. R. Alder Wright, D.Sc., F.R.S.	VII., X., XI., XII.

NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. E. C. C. Stanford has been nominated to the office of President; and Sir John Evans, K.C.B., F.R.S., has been nominated Vice-President under Rule 11.

Sir Frederick Abel, K.C.B., F.R.S., Mr. H. Brunner and Mr. Horace Brown, F.R.S., have been nominated Vice-Presidents under Rule 8; and Prof. G. G. Henderson, D.Sc., has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. E. C. C. Stanford, nominated President.

Mr. E. K. Muspratt has been nominated a Vice-President under Rule 24, and the Treasurer and Foreign Secretary have been nominated for re-election.

Mr. J. B. Alliott, Prof. Frank Clowes, DSc., Mr. Thos. Fairley, Mr. Robert Irvine, Prof. G. G. Henderson, D.Sc., Mr. Manning Prentice, and Mr. Frank Wilson have been nominated under Rule 18 to fill five vacancies among the Ordinary Members of Council.

A Ballot List and Member's Ticket is enclosed herewith.

Annual General Meeting.

The Annual General Meeting will be held in Liverpool on the 12th, 13th, and 14th July next. The following is a synopsis of the arrangements :—

Wednesday, July 12th.

2.30 p.m.—Council Meeting.
3 p.m.—General Meeting, Victoria Buildings, University College.
4.30 to 6 p.m.—Inspection of the College Laboratories; tea.
8 p.m.—Reception and Soirée—Walker Art Gallery.

Thursday, July 13th.

Morning.

1. Works of the United Alkali Co., Widnes.
2. Messrs. Lever Brothers', "Sunlight" Soap Works, Port Sunlight.
3. Messrs. Laird Brothers', Shipbuilding Yard, Birkenhead.
4. Messrs. Cope Brothers', Tobacco Factory, Liverpool.

Afternoon.

1. Lancashire Watch Co., Prescot.
2. British Insulated Wire Co., Prescot.
3. Liverpool Overhead Railway.
4. Alexandra Dock Grain Warehouses.
5. Visit to Atlantic Liner.

7.30 p.m.—Annual Dinner, Adelphi Hotel, Liverpool.

Friday, July 14th.

Visit to the Manchester Ship Canal and Northwich.
9 p.m.—Smoking Concert.
A charge will be made to cover the cost of the excursions.

Special Train Facilities from London.

Members leaving London on the morning of the Meeting, Wednesday, July 12th, may travel by the 10 a.m. Scotch Express as far as Crewe, where a train will be in waiting to convey them to Liverpool, reaching Lime Street at 2.5 p.m. As the accommodation in the Scotch Express is limited, the General Secretary will be obliged if members intending to avail themselves of this train will inform him by card as early as possible, that he may tell the Superintendent of the Line how many are likely to travel thereby. If enough members so signify their intention a saloon will be provided.

Post Office Orders should be made payable at the General Post Office, London, to the Honorary Treasurer, E. Rider Cook, and should be forwarded to him at Bow, unless it be desired to notify a change of address.

Members who require extra sets or back numbers of the Journal are requested to make application, accompanied by remittance at the rates quoted on the first page, to the General Secretary only, to whom also changes of address should be communicated.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

The World's Congress Auxiliary of the Chicago Exhibition.

Proposed Congress of Chemists.

It is proposed to hold a Congress of Chemists under the auspices of the World's Congress Auxiliary and the American Chemical Society, in Chicago, during the Columbian Exposition of 1893. The exact date of the Congress will be announced later, but it can now be said that it will be held after the middle of August, and at a time as near as possible to that at which other similar congresses will be held, in order to accommodate the greatest possible number of scientific men.

While it is expected that a very general attendance of American chemists will be secured at this Congress, it is hoped that it may be honoured also by the presence of a large number of our foreign colleagues to take part in the discussion of topics from the various fields of theoretical and applied chemistry. During the congress two classes of sessions will be held :—

a. International scientific meetings for the discussion of questions of interest to specialists. The programmes will be arranged by the committees after they shall have received the advice and suggestions of persons interested. To these meetings all chemists and others working in scientific fields are invited.

b. Popular lectures on scientific topics of general interest, to be given by men of recognised prominence in the profession. It is expected that most of these lectures which will be open to the general public, will be given by chemists from foreign countries.

For the convenience of specialists working in different fields it is proposed to divide the discussions of the scientific meetings into 10 sections, as follows :—

1. Agricultural Chemistry.
2. Analytical Chemistry.
3. Didactic Chemistry.
4. Historical Chemistry and Bibliography.
5. Inorganic Chemistry.
6. Organic Chemistry.
7. Physical Chemistry.
8. Physiological Chemistry.
9. Sanitary Chemistry.
10. Technical Chemistry.

The World's Congress Auxiliary agrees to provide suitable halls for these scientific meetings as well as for the large popular gatherings. In this preliminary notice it is not intended to present more than an outline of what can be done, but later a more detailed statement will be made.

J. H. Long. W. L. Brown.
W. S. Haines. M. Delafontaine.
A. V. E. Young.
Committee of the World's Congress Auxiliary.

Wm. McMurtrie. C. E. Munroe.
C. F. Chandler. H. W. Wiley.
A. B. Prescott.
Committee of the American Chemical Society appointed to Co-operate with the World's Congress Auxiliary.

British Institute of Public Health.

The annual Congress of the above Institute will take place this year in Edinburgh from Thursday 27th July to Tuesday 1st August inclusive. The Congress will be arranged in three Sections: (*a.*) Preventive Medicine. (*b.*) Engineering and Building Construction. (*c.*) Chemistry and Climatology. The subjects for discussion will include the following:—The Disposal of Refuse, Water Supply, Pollution of Rivers, Treatment of Sewage, Treatment of Outbreaks of Infectious Disease and Working of the Sale of Food and Drugs Act. Communications relative to the above should be addressed to the Hon. Secretaries of the Institute, 20, Hanover Square, London, W., or to Dr. Littlejohn, City Chambers, Edinburgh.

LIST OF MEMBERS ELECTED, 23rd JUNE 1893.

Breeze, J. A. E., 70, Oxton Road, Birkenhead, analytical chemist.

Carey, Arthur, Browside, Gateacre, near Liverpool, chemist.

Cowper, Chas. E., 6, Great George Street, Westminster, S.W., civil engineer.

Davis, W. Wailey, jun., c/o Crozer Iron Co., Roanoke, Va., U.S.A., analytical chemist.

Edwards, Henry W., Murray Mines, Sudbury, Ont., Canada, smelting works manager.

Haller, H. Loft, St. Faith's House, St. Faith's Lane, Norwich, analytical chemist.

Holzapfel, Max., Quayside, Newcastle-on-Tyne, manufacturer.

Mann, Harold H., 7, Minster Yard, York, chemical esearch student.

STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR 1892.

REVENUE.

	£ s. d.	£ s. d.
Annual Subscriptions for 1892:—		
80 subscriptions received in 1891 .	160 0 10	
2,444 subscriptions received in 1892 .	3,054 19 2	
21 subscriptions received in 1893 .	26 5 0	
(3,159l. 11s. 7d.)		3,181 5 0
(2,528) 2,545		
4 Life Composition Fees ....*(75l.)*	60 0 0	
Interest on Deposit Account....*(24l. 7s. 7d.)*	..	18 9 7
Interest on Metropolitan Stock ..*(113l. 10s.)*	..	127 6 6
Amount received from Economic Fire Office on account of the fire which occurred at Messrs. Eyre and Spottiswoode's on the 4th April 1892:—		
Claim for loss and damage to Journals ..	250 0 0	
Cost of separating damaged Journals ...	3 10 0	
Journal:—		
Advertisements ....*(588l.)*	536 0 0	
Sales......................*(271l. 17s. 4d.)*	318 1 3	
(859l. 17s. 4d.)		854 1 3
(4,157l. 6s. 6d.)		£4,181 2 4

EXPENDITURE.

£ s. d.		£ s. d.	£ s. d.
	Journal Expenses:—		
(1,442 2 9)	Publishing	1,498 8 6	
	Insurance of Stock	2 6 11	
	Editorial:—		
500 0 0	Editor's Salary.. 500 0 0		
29 12 7	„ Expenses 34 8 7		
378 11 9	Abstractors...... 369 13 5		
100 0 0	Portion of Secretary's Salary... 100 0 0		
72 12 7	Patent Lists..... 72 6 11		
40 16 0	Indexing Journal 51 0 0		
10 7 0	Foreign Journals 10 15 6		
2 17 9	Sundry Journals. 3 3 1	1,141 7 6	
(2,577 0 5)			2,642 2 11
	Fire Account—Cost of separating damaged Journals..............................	3 10 0	
	Sundries—Printing........................	*(48 14 0)*	40 17 6
	Sectional Expenses	*(214 1 11)*	213 7 2
	Secretary's Salary (Balance not included in Journal Expenses)	*(250 0 0)*	300 0 0
	Expenses in connection with Annual Meeting	*(189 12 5)*	115 17 6
	Hon. Treasurer's Assistant	*(52 0 0)*	52 0 0
	Office Expenses..........................	*(108 1 1)*	102 10 1
	Stationery................................	*(41 11 3)*	44 4 9
	Auditors' Fee.............................	*(10 10 0)*	10 10 0
	Library—Binding Books	*(18 14 11)*	8 0 10
	Bank Charges.	*(2 3 6)*	1 12 1
	Treasurer's Petty Cash	*(24 1 2)*	16 3 4
	Secretary's Petty Cash....................	*(77 7 8)*	43 3 10
	Balance of Revenue over Expenditure...........................	*(553 8 8)*	590 12 4
			£4,181 2 4

THE TREASURER—IN ACCOUNT WITH THE SOCIETY OF CHEMICAL INDUSTRY FOR THE YEAR 1892.

Dr.

	£ s. d.	£ s. d.
To Cash on Deposit (31st December 1891)...	500 0 0	
Balance at Bank (31st December 1891) ..	181 10 0	
Balance in Treasurer's hands (31st December 1891)	6 16 0	
Balance in Secretary's hands (31st December 1891)	3 17 4	
		692 3 4
Annual Subscriptions:—		
30 subscriptions for the year 1891.	37 10 0	
(2,403) 2,444 subscriptions for the year 1892 (less 10*d*. short paid)..........	3,054 19 2	
88 subscriptions for the year 1893 (less 10*d*. short paid)..........	109 19 2	
(2,479) 2,562		
Sundry amounts received on account of Subscriptions for the Years 1892, 1893, and 1894	2 11 0	
(3,121l. 1s. 5d.)		3,204 19 4
Life Composition Fees.............*(75l.)*	..	60 0 0
Interest on Deposit Account *(24l. 7s. 7d.)*	..	18 9 7
Interest on Metropolitan Stock *(113l. 10s.)*	..	127 6 6
Amount received from Economic Fire Office in settlement of claim for loss of, and damage to, Journals in the fire which occurred at Messrs. Eyre and Spottiswoode's on the 4th April 1892:—		
Claim	250 0 0	
Cost of separating damaged Journals	3 10 0	
		253 10 0
Journal:—		
Advertisements ....*(588l.)*	544 0 0	
Sales ....*(276l. 0s. 8d.)*	309 19 7	
(864l. 0s. 8d.)		853 19 7
(4,570l. 2s. 5d.)		£5,210 8 4

Cr.

£ s. d.		£ s. d.	£ s. d.
	By Journal Expenses:—		
1,497 7 5	Publishing	1,425 10 5	
1,150 16 10	Editorial	1,126 8 6	
1 5 0	Cost of separating damaged Journals—*re* "Fire"	3 10 0	
	Insurance of Stock	2 6 11	
(2,649 9 3)			2,557 15 10
(44 15 0)	Sundries, Printing, &c.		40 13 0
	Sectional Expenses:—		
	Glasgow Section	22 5 4	
	Liverpool Section	31 8 6	
	London Section	56 2 8	
	Manchester Section.......	55 13 10	
	Newcastle Section	11 8 0	
	Nottingham Section	10 13 5	
	Yorkshire Section	25 15 5	
(214 1 11)			213 7 2
(250 0 0)	Secretary's Salary (balance not included in Journal Editorial Expenses)		300 0 0
(42 0 0)	Hon. Treasurer's Assistant (for work in 1891)		52 0 0
(41 6 3)	Stationery		43 17 9
(189 12 5)	Expenses in connection with Annual Meeting		115 17 6
(108 1 1)	Office Expenses		102 10 1
(105 0 0)	Purchase of 493*l*. 3*s*. 8*d*. Metropolitan Consolidated Stock		500 0 0
(10 10 0)	Auditors' Fee		10 10 0
	Solicitors' Charges		0 18 8
(18 14 11)	Library—Binding Books		8 0 10
(2 3 0)	Bank Charges		1 12 1
(24 1 2)	Treasurer's Petty Cash		16 3 4
(77 3 1)	Secretary's Petty Cash..................		43 3 10
(692 3 4)	Cash on Deposit (31st December 1892)	1,000 0 0	
	Balance at Bank (31st December 1892) .	197 13 3	
	Balance in Treasurer's hands.............. ditto ..	1 9 0	
	Balance in Secretary's hands.............. ditto ..	4 16 0	
			*1,203 18 3
			£5,210 8 4

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* In addition to this there is an amount of 4,476*l*. 9*s*. 2*d*. Metropolitan 3 °/₀ Consolidated Stock, invested in the names of Mr. David Howard and Mr. Edward Rider Cook.

P.S.—The figures in italics show the corresponding amounts paid or received during 1891.

We have compared the above Statement with the Receipt Book Counterfoils, Vouchers, and Books of the Society, and certify it to be correct. We have also verified the amount of the Metropolitan 3 °/₀ Consolidated Stock, 4,476*l*. 9*s*. 2*d*., by reference to the Books of the Bank of England.

23, St. Swithin's Lane, London, E.C., (Signed) THEOBALD BROS. & MIALL,

LIST OF MEMBERS ELECTED—*cont.*

Napier, Jno. W., Chemical Laboratory, Minto House, Edinburgh, chemist.

Ogura, Kenji, Army Survey Department, General Staff, Tokio, Japan, photographer.

Scott, Andrew R., Carntyne Chemical Works, Parkhead, Glasgow, manufacturing chemist.

Shimer, Porter W., Lafayette College, Easton, Pa., U.S A., lecturer on chemistry.

Sowter, Alf., Fairview, The Knoll, Beckenham, Kent, assayer.

Thomas, Edouard, 107, Disraeli Road, Putney, S.W., chemist.

Thompson, Geo. Rudd, 57, Dock Street, Newport, Mon., analytical and consulting chemist.

Wagner, W. G., Glyndhurst, Ealing Common, W., analytical chemist.

Wander, Dr. Albert, 122, Edith Road, West Kensington, W., chemist.

Welles, Albert H., Lafayette College, Easton, Pa., U.S.A.

Whitaker, Alf., Woltaire, Horsforth, Leeds, dyer.

CHANGES OF ADDRESS.

Adam, A. Learmouth, l/o Greenock; 88, Great Clyde Street, Glasgow.

Bishop, G. A., l/o Royal Bank House; Gartverrie Fire-clay Works, Coatbridge, N.B.

Broom, Wm., l/o Mount Albion; Muldiva, North Queensland.

Cawley, Geo., l/o Industries; 29, Great George Street, Westminster, S.W.

Colman, Dr. H. G., l/o Duchess Road; 29, Noel Road, Edgbaston, Birmingham.

Dowson, Wm., l/o Surgeon's Hall; 168, Bruntsfield Place, Edinburgh.

Duckworth, C. W., l/o Garner's Buildings; 51, North Road, Clayton, Manchester.

Earnshaw, Edwin, l/o 72; 24, Mark Lane, London, E.C.

Elmore, A. S., l/o Leeds; Oulton Green, Oulton, Yorks.

Fletcher, E. Morley, l/o Upper Bedford Place; 82, George Street, Portman Square, W.

Fletcher, R. J., Journals c/o R. Jaques, Esq., The Hawthorns, Bromley, Kent.

Frost, Dr. Howard V., l/o Brooklyn; Arlington, Mass., U.S.A.

Hailes, A. J. de, l/o Stoke Newington; 2, Fisher Street, Red Lion Square, W.C.

Hamlen, G. J., l/o Ardeer; c/o Repauno Chemical Co., Chester, Pa., U.S.A.

Johnson, E. E., l/o Loughton; 25, Henrietta Street, Old Trafford, Manchester.

Karslake, W. J., l/o Pennsylvania; Le Roy, Genesee Co., N.Y., U.S.A.

Lovett, W. J., l/o Crumpsall; 12, Beech Avenue, Urmston, near Manchester.

Moss, John, l/o Norbury; 39, Tressilian Road, St. John's, S.E.

Müller, G., l/o Ironwood; c/o Puget Sound Reduction Co., Everett, Wash., U.S.A.

Renaut, F. W., l/o Westminster; The Brambles, Elmbourne Road, Tooting Common, S.W.

Riddell, R., Journals to 86, Derby Street, Burton-on-Trent.

Siebold, L., l/o Exchange Street; Broomville Avenue, Sale, Manchester.

Strangman, J. Pim, l/o Paris; retain Journals until further notice.

Thornton, H., l/o Stanford-le-Hope; 5, George Street, Euston Road, N.W.

Wilde, Thos., l/o Penclawdd; Vivian Arms Hotel, Sketty, near Swansea.

CHANGE OF ADDRESS REQUIRED.

Warne, Thos., l/o 6, Wakefield Road, Thwaitegate, Leeds.

MEMBER OMITTED FROM LIST.

Graham, J. A., The Rookery Farm, Dovercourt, Essex.

London Section.

THE CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE, W.

Chairman: Wm. Thorp.
Vice-Chairman: W. Crowder.
Committee:

C. F. Cross.
A. G. Green.
D. Howard.
C. C. Hutchinson.
W. Kellner.
B. E. R. Newlands.
W. Ramsay.
F. G. Adair Roberts.
A. Gordon Salamon.
G. N. Stoker.
F. Napier Sutton.
T. E. Thorpe.
T. Tyrer.
Frank Wilson.

Hon. Local Secretary: John Heron,
74, North Side, Clapham Common, S.W.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Committee:* E. J. Bevan, W. G. Blagden, T. A. Lawson, R. Messel, and C. R. Alder Wright.

Meeting held Friday, June 5th, 1893.

MR. WM. THORP IN THE CHAIR.

The CHAIRMAN said before beginning the ordinary business of the evening there was a subject to which he felt compelled to refer. Since the last meeting they had lost by death two gentlemen from whom they had lately heard much of great interest. The first was Mr. Cowper, who recently gave a very excellent paper on the means of heating air and other gases. He was a man who belonged rather to the old school of engineers, ripe in years, for he believed he was 74 or 75 years of age, but his death was quite sudden. His name was on the list produced at the last council meeting for election as a member, but he had already passed away. He had the pleasure of some conversation with him before the reading of the paper referred to, and from the little he mentioned then of the various things in which he had been engaged it was evident that he was a man of remarkable power and ability. The world of technology at large had lost in him a useful worker. Mr. W. Foster, Professor of Chemistry at Middlesex Hospital, and a most regular attendant at the meetings, had also died quite suddenly. His name was down in the minutes just now as having spoken at the very last meeting, and he too, though only in middle life, was called away by acute pneumonia after only three or four days' illness. He thought it was only fitting that some reference should be made to these losses.

THE APPLICATION OF AIR IN MOTION TO CHEMICAL INDUSTRY.

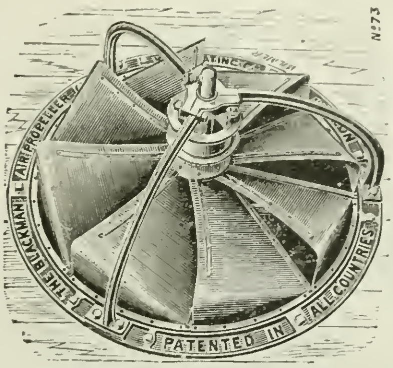
BY HENRY G. WATEL, B.SC.

It is only in recent years that the value of air in motion as applied to trade and industry has been at all recognised, and although a considerable amount of attention has been given to the subject, air in motion is not as fully applied as would no doubt be the case if manufacturers and others were more acquainted with the numerous services it can render.

I am not now speaking of the mere fact of churning air about in a room or in a machine, either by means of revolving paddles or swinging punkahs, both of which have been used, so to say, from time immemorial, but of the positive and certain movement and renewal of air, either warm or cold, moist or dry, by means of mechanical appliances, such as fans, blowing engines, &c. Of these, fans, except in special cases, have long ago proved themselves the most convenient of application and economical in use; but it is necessary at the outset to consider the immense difference between "pressure" and "volume." Except for the purpose of overcoming a very heavy resistance to the motion of the air, in most cases it is volume and not pressure that is required, although even now blowers and centrifugal fans are often improperly applied when open types of fans should be used. Of course for blast furnaces, smiths' fires, for lifting grain, heavy coarse dust, &c., pressure is absolutely necessary: but this pressure is only obtained at very great expense, for the expenditure in moving air under pressure is practically proportional to the square of the pressure, or more, *i.e.*, to move the same volume of air at twice the pressure costs four times as much; and if this pressure is not required, three-quarters of the expenditure is wasted completely, and only three-quarters of the desired effect is produced in a given time. It is therefore more particularly to air in motion in large volume, but at low pressure, that I wish to call your attention.

It is now some thirty years ago that the movement of air in large volume was first sought after with the recognition of the fact that air will not displace itself alone without some impelling power; and the natural tendency of heated air to rise in a colder atmosphere was one of the first methods tried, but, although the principle is correct, it is expensive. Many mines are still ventilated by means of a large furnace at the bottom of a shaft, and on the surface many buildings are still ventilated by means of a furnace at the base of a chimney. A Frenchman, M. Motte, was at that time, I believe, the first to attempt to move air in volume, with more certainty and less cost, by mechanical means, and the celebrated General Morin gave the subject considerable attention and applied mechanically-driven fans in many cases. But the fans of that period were extremely inconvenient to apply, for they were simply Archimedean screws such as are used for lifting water. Now water is practically incompressible, while air is compressible, and the coefficient of slip is consequently very different; and as air needs therefore a comparatively high speed of revolution of the screw, such fans were hardly suited for general use.

In the same way, although for propelling ships by means of a screw the Archimedean screw was applied at first, it was soon found that a short screw, consisting of only the fraction of a turn instead of many turns, gave the best result, so it was also soon found that for moving air, instead of a long screw, a short screw, but at a higher speed of revolution, answered better. But another difficulty then appeared, which was that air, being much more mobile and compressible than water, could not be efficiently gripped by the fan, since, even under the slightest resistance, it was at once scattered centrifugally from the tips of the blades without being impelled forwards to effect the desired purpose. Many devices were tried to overcome this defect, such as various shapes of blades, applied as in the Archimedean screw, a short length of tube round the fan, &c.; but it was not until the blades were bent over at the edge (so that although the air was perfectly free to enter under the blade, once under it the air could not escape) that the problem of moving air cheaply in large volume was solved. That the problem was solved is proved by the fact that there are now some 12,000 fans of this type as illustrated in Fig. 1 in use for industrial purposes alone, displacing hourly over eight thousand million (8,000,000,000) cubic feet of air.



The problem of efficiently moving air in volume having thus been solved, it then became a question to study its best and most valuable applications to industry. As air had at first been put in motion by means of fires, it was natural that one application should be that of moving air through a fire to ensure perfect combustion. Chemically speaking, combustion is the combination of the carbon and hydrogen of the fuel with the oxygen of the air, and, if the air supply is insufficient, more or less of the carbon will be carried away up the chimney as soot, thereby increasing the smoke nuisance; carbonic oxide escapes also unconsumed, and probably some hydrogen and hydrocarbons as well, which all contribute to vitiate the atmosphere and produce waste. Many will no doubt have noticed that immediately after putting fresh fuel on a fire, the amount of smoke issuing from the chimney is very much greater than at other times, which is due to the fact that the thicker fire does not allow the air to pass so freely through it, and also to the cold fuel chilling the ascensional power of the air and gases up the chimney. When the fire door is opened the smoke soon disappears, the air then arriving on the top of the fire as well as underneath, and thus ensuring better combustion. Taking good coal with say 82 to 85 per cent. of carbon and 2 to 5 per cent. of ash, it is apparent that about six hundred thousand cubic feet of air per ton are necessary to ensure perfect combustion. To obtain the movement of this amount of air through the fire during the time necessary for the disappearance of the ton of coal by the unaided ascensional power of the resulting gases up the chimney is generally impossible, but if plenty of air is supplied to the fire underneath the bars by means of a fan, the fuel is completely consumed. To take an extreme example, it would at first sight appear impossible to keep steam in a boiler with a fire six inches thick of the finest coal dust, yet this has been easily and completely burnt with the aid of an 18-in. fan and only three-tenths of an inch of water-gauge in pressure in the air it was delivering. Steam and heat being so universally in use in every industry, the value of their economical generation and of the application of air in motion for this purpose, is therefore obvious.

From this it is also apparent that there is no necessity to use any great amount of pressure or water-gauge for the perfect combustion of fuel. Of course, if it be a question of burning a maximum of fuel in a given time, more air to the square foot of grate surface will give the desired result: but it may be taken that anything above half an inch of water pressure is not only useless but detrimental for many reasons; the coal is carried up the chimney by the rapid air current before it has time to burn completely, the strain on the boiler is enormously increased, and the tubes and flues both suffer; but the use of a slight air pressure is both economical and beneficial. For instance, the discharge through about 18 square feet of the area of an 84-in.

Blackman at low speed into the stokehold of a steamer burning about 60 tons of coal in 24 hours, effected a saving of about five tons of coal a day, with an increase of about three-quarters of a knot an hour in speed; although in this case the fan had been fitted up only for the ventilation of the holds, the water-gauge was practically nil, and the air supply was limited by the fact of it having to pass through a bulkhead door.

To come now to the application of air in motion to the various chemical industries or to the materials manufactured, the subject may be considered under four different headings:—

Removing heat, foul air, fumes, dust, steam, &c.
Warming.
Cooling.
Drying.

Apart from any question of the comfort of the workers, the removal of heat usually gives also a direct corresponding advantage, because the workers do their work better and quicker when in comfort, and give a direct increase of output. For instance, in a large cold air producing installation the temperature in the compressor room was about 120° F. It certainly seemed rather anomalous to be producing cold air in such a temperature, but the room would not ventilate itself. The application of a fan brought the temperature down to within two or three degrees of the outer air, and the natural result was that the compressors needed far less steam to drive them and gave a correspondingly greater output. In another instance, in a dynamo room, where considerations of silence practically precluded any ventilation, the temperature was often as high as 180° F. It being impossible to ventilate the room, a fan was fitted on the spindle of the dynamo, with the result that its output was increased 25 per cent. As an instance of the value of air in motion in removing foul air and fumes in nitrophosphate and superphosphate works, the application of a fan to the den removes the fumes and acid vapours produced during the mixing, and later, when the men are digging out the mass, as they are working with a continual supply of fresh air arriving behind them, they are not incommoded by the remaining fumes, and can get to work sooner and work faster in consequence. Dust can also be removed, as in the grinding rooms of cement and pottery works, carding rooms, flax and jute mills, &c. And in many cases it is not only advisable for the comfort of the workers, but is also necessary to avoid the risk of explosion which nearly always exists when the air in a room is charged with particles of fine dust, should a light be incautiously introduced. Besides, in many industries, the dust is not only disagreeable, but is positively a source of disease. It is a well-known fact, for instance, that in the woollen industry the fine dust arising in sorting the wool is charged with germs and microbes, which sooner or later produce the "wool-sorters' disease." This has now, to a very large extent, been stamped out by the use of fans which draw away these germs before they can reach the mouths of the sorters. In grinding, the fine particles of steel and iron reaching the lungs become permanently imbedded in them, with the most serious results. In white lead works the particles of lead in the air end by poisoning the workers, producing paralysis. In match works the fumes of phosphorus produce "phossy jaw," and in "silvering" the fumes of mercury have an equally disastrous effect upon those who breathe them. Explosive gases produced in any process are also easily removed by plenty of air in motion. And not only can these various dusts or fumes be removed, burnt, washed, or destroyed, but also in many cases where they have any value they can be collected; thus a nuisance is not only removed, but a direct source of income takes its place. A 42-in. fan recently applied to collecting charcoal dust is saving 130*l*. a year. In many industries the presence of steam is a continuous source of loss and trouble, for its condensation on the ceilings or floors overhead rots them, its condensation on the machines rusts and destroys them, and in many cases it is a direct source of danger, as the workers cannot see around them. As an instance of its successful removal, in a room of about 3,500 cubic feet, in spite of 24 gas jets, it was impossible to see one's hand before one's face. A fan was fitted, with the result that no gas was any longer necessary, that the saving in gas more than paid for the cost of running the fan, that there was no longer any condensation, and that in addition an excellent ventilation was obtained throughout the whole building.

For the purpose of warming for any desired object, air in motion will generally prove much more economical, in first cost of erection and in maintenance, than any other method. In many cases steam pipes are still employed or even now erected where warm air in motion would give infinitely better results, and provide ventilation as well. The best steam boiler is at best but a more or less wasteful means of transmitting heat from one part of a factory to another, for the loss of heat by radiation is very great, not to mention the difficulty of keeping an expensive and complicated system of pipes in repair. By the use of air in motion it is easy to warm any room or building to any desired extent, and at so small a cost that 1,000 cubic feet of pure fresh air can be raised 50° F. per minute, and constantly renewed, with an expenditure of gas coke not exceeding eight pounds per hour, and in many cases not exceeding six. Besides, in many cases heat is generated in one part of a building where its presence is far from desirable, but if this air is moved to another part of the same building, it is then available for warming, at a nominal cost. Many high-pressure steam engines are at present in use, where the steam exhausts directly into the atmosphere. But if this steam were condensed by means of a coil of pipes and a fan, the immediate result would be that a large supply of pure warm air would be obtained, and that the rapid condensation of the steam producing a vacuum in the cylinder of the engine, either an increase of power or an economy of fuel would be realised at the same time. It has long ago been proved that if a fan is thus applied the engine runs easier with the fan at work than when the fan is not. Another great advantage is also obtained, which is a supply of pure water, and therefore if this water, still more or less warm, is returned to the boiler the deposition of scale is absolutely avoided.

The subject of cooling may be considered under two heads. 1st.—The cooling of a hot material or liquid down to the normal temperature. This is easily and rapidly obtained by the use of air in motion. The cooling effect may be increased by using wet surfaces or ice where the air is admitted, but the temperature of the material cannot be reduced very much below that of the air brought into contact with it. This application is nevertheless often of very considerable value. At a large rolling-mill, situated on the top of a hill, the only water supply was obtained from a tiny brook and the rain-water from the roofs. The mill was driven by a single cylinder engine of 3,000 h.p. It was therefore obviously impossible to condense the exhaust of this engine by the usual means, as there was not a hundredth part of the water necessary to fill a "lodge." But six 10-ft. fans, delivering nearly a million and a half of cubic feet of air per minute, were applied to cooling the water as it left the pumps, so that it could at once be used again, and with the most complete success. The pressure in the boilers being 75 lb., and the resulting vacuum being over 28 in., in rough figures, it is at once obvious that one-fifth of the horse-power was gross profit, say 600 h.p. Taking from this the power expended in driving the fans, pumps, loss in friction, &c., amounting to about 200 h.p., there would have been a saving of 400 h.p., and it was in reality considerably over 300 h.p., or more than 10 per cent. clear saving. Thus the mills, which had been erected in this inconvenient locality on account of the presence of the ore at the top of this hill or mountain, were by air in motion able, in spite of the other disadvantages of their position, to secure a very large reduction in their working expenses. Taking this subject from another point of view, it of course is in one sense merely a repetition of what has been already said as to the removal of heat. But it is often necessary to extend the cooling still further, or secondly, to cool or refrigerate substances from a normal temperature to a much lower one. In this case special machinery is of course necessary in addition to the fan, but the results are even here much better if the air is put in motion. For instance, it was formerly the practice in cold-air stores to place the cooling pipes on the ceiling of the rooms, and to trust to the natural tendency of the colder air to fall and of the warmer air to rise, to ensure a regular distribution of the cooling effect throughout the store. But now by the additional application of a fan or fans to put the air in motion with certainty, any dependence on the natural ascent of the warmer air to the cooling surface is completely avoided, and the air as fast as it is warmed by contact with the substances to be cooled, is brought infallibly back to the cooling surface to be again reduced to the desired temperature.

The subject of drying is perhaps the one most generally interesting to all those engaged in chemical industries, and it has certainly until recently been one of the least understood. The general idea of drying appears to have been to get a room heated as much as possible, put the goods in it, leave them in until dry, not to trouble in the least degree about the resulting humidity, to trust to their drying if sufficient time was allowed, and in fact to trust to luck. That all this is exceedingly unpractical and wrong should be sufficiently apparent. In one of my early experiences of drying I was called into a series of rooms on a hot summer's day, and happened to be carrying a black leather bag. These rooms were used for drying a liquid for the purpose of obtaining the 1 or 2 per cent. of solid matter it contained, and were heated to some 150° F. At once on entering, I found myself covered with a profuse cold perspiration, and on looking at my bag, I saw it was simply streaming and running with water. I was told the drying in spite of very heavy expenditure was not satisfactory, and very slow, for each room contained some 400 pints of water to remove, and the remainder suffered from prolonged stewing. It never seemed to have occurred to the manufacturer that it was necessary to get rid of the resulting steam as quickly as possible, and I could quite understand that in an atmosphere so charged with moisture that it could condense as rapidly as it did on the body, whose temperature is 98½° F., the material did not dry as fast as he would have wished. As another instance, I have been called into a room containing goods heated to 150° or 160° F. with a very small percentage of water, and was told that they took 24 hours to dry. I offered to dry the goods in 24 minutes, and was told that these rooms had been fitted up by the firm's ancestor, who had made it a reputation of unrivalled quality, and was simply laughed at. However, after about a year's occasional visits the firm were finally brought to believe that it was just possible that something better might be done, and consented to try an experiment as they called it. With air in motion the result was that the goods dried thoroughly in 16 minutes, and that being no longer stewed, their appearance, beauty, brilliancy of colour, and quality were such as had never been seen before. In France I was called in to see some machines for drying cotton and woollen goods in the piece, which I was told cost each some 16*s.* a day for steam. They had been provided with air in motion, but the air was simply put in motion by means of revolving paddle-wheels taking a lot of power, and simply churning the saturated air in the machines round and round inside them. The top of these machines was stuffed with rags and hay to the depth of some nine inches to absorb the water, which nevertheless was streaming down inside them, but again it had never occurred to the firm to remove the saturated air by putting air in motion as it should be; that is to say, to remove the water evaporated and not simply to churn it round and round inside the machine. Here I was told that if I introduced other air into the machines the temperature would fall to such an extent that no drying would be possible. They had never considered the fact that the air might be renewed so slowly that no perceptible fall of temperature would result, and that the damp air need not be discharged until it was absolutely saturated with moisture, when being as damp as it could possibly be, it could have no further drying power, and was consequently quite useless. The application of air in motion practically at once proved its value by much more rapid drying, better results, and about half the expenditure.

These few instances, which I could multiply by hundreds, should suffice to show what can be done in this direction, and at once suggest the remedy: Renew the air as may be necessary, and test the humidity of the air in the room or machine. For the latter purpose I wish to call your attention to the valuable indications afforded by a simple instrument, the psychrometer, which consists simply of a pair of thermometers, the bulb of one being kept continually moist by means of the water supplied to it through a cotton mesh and the muslin wrapped round it. Heat is abstracted from the mercury in the wet bulb, and the consequence is that it indicates a lower temperature than the dry one. The greater the degree of dryness of the air, the more rapid the evaporation, the greater the quantity of heat abstracted from the wet bulb, and consequently the greater the difference between the two readings. If the air is saturated there is of course no evaporation, and the two thermometers read precisely alike. Therefore, to consider the matter roughly, the mere difference between the two readings is an indication of the drying power of the air, for the greater the difference between the two readings the dryer the air, and consequently the greater its absorbing power for moisture. But to consider the matter accurately it is very easy to construct a table, based, it is true, on a somewhat complicated formula, and data investigated more exactly by Regnault than by any other scientist, which gives at sight the exact percentage of moisture in the air, and which therefore at once shows how near it is to its point of saturation, and how much more moisture it can take up.

This has long ago been done for the ordinary temperatures of the atmosphere for meteorological observations, say up to 100° F., but much higher temperatures are often necessary for drying rapidly certain classes of products. Some time back I received an inquiry from a firm for such a pair of thermometers for use in a drying room, the temperature of which was given me as 250° F. As may be at once seen the inquiry appeared at first sight rather extraordinary, considering the usual form of the instrument, for 250° being above the boiling point of water, the water in the tube would of course boil, and be expelled by the resulting steam; or, taking another form of the instrument which is often used, the water in the reservoir would of course also boil, thereby adding to the moisture in the air in the room, and would also soon be evaporated. This firm was so anxious to have a psychrometer indicating to this temperature, that I determined to try some experiments to ascertain how far it was possible to comply with their desire. I therefore placed a pair of long-range thermometers, one with a dry bulb and the other with a bulb covered with muslin and continually kept wet by water led from a reservoir placed outside of the reach of the hot air blown past the bulb, in the stream of air from a heater delivering some 7,000 cub. ft. of air a minute at temperatures up to 248° F. Much to my surprise I found that the indications of the pair of thermometers were even at this temperature practically correct, and most valuable observations were thus obtained. It was, for instance, probably the first time that 135° F. difference in the readings of the two thermometers had been observed, the air with 80 per cent. of moisture of the atmosphere at 50° having been so heated that at 28° it only contained 2 per cent. of moisture. It will be at once apparent how enormous the drying capacity of such a stream or air must be, and how avid it must be of moisture. On placing a disc of thick cotton tissue in its passage, I found it, so to say, impossible to keep this cotton wet except by continuously spraying it with a very large quantity of water delivered from a jet under high pressure. Taking the atmosphere at 50° F., with 80 per cent. of moisture, the absorbing power of each cubic foot of air would be about 0·82 grains of water, but this same air after being thus treated, at its exit at 28° F., with only 2 per cent. of moisture would theoretically be capable of absorbing some 469·28 grains of moisture per cubic foot, and admitting in practice that only two-thirds of this amount was absorbed, it still leaves over 300 grains per cubic foot as the amount of water it is capable of removing. And this air being delivered at the rate of 7,000 cub. ft. per minute would seem to show a removing or drying capacity of 300 by 7,000 grains per minute (and as 7,000 grains are one pound) or 300 lb. of water per minute. Yet the consumption of fuel for obtaining this stream of air was only about 2 cwt. per hour.

This shows at once that there is some other factor to be considered, for I need not say that with some 3½ lb. of fuel per minute it is absolutely impossible to evaporate 300 lb. of water in the same time, but I have placed the matter in this way before you to make this factor more apparent, for it is only too often totally neglected in practice.

It is therefore easy to determine at any given moment, and in any drying room up to 250° F., and probably further, the hygrometric condition of the air, by the use of a pair of thermometers mounted as I have just described; and while avoiding, on the one hand, the too rapid renewal of the air, which would simply mean expelling so much warm air before it had done its work, it at once gives a means of avoiding, on the other hand, what is only too often the case—stewing the materials in an atmosphere so saturated with moisture that no drying can possibly take place, with all the attendant loss of time, money, quality, and colour, of the materials, not to mention room-space, rent, and other expenses. Had such a pair of thermometers been mounted in the drying-rooms I have just mentioned, and their indications attended to, they would at once have shown the fault, and the absolute necessity of the renewal of the saturated air, so that it should be impossible for it to condense on the body in the manner it did on any person entering the room. As I have already said, although the formula for ascertaining the percentage of moisture of the air by means of the readings of a pair of wet and dry bulb thermometers is rather complicated, or at least tedious to calculate, yet the results are easily tabulated, and then the result is obtained by the mere inspection of the table. Although tables are easily obtainable for temperatures up to about 100° F., yet I am not aware or able to learn of any being in existence for temperatures up to, say, 250° F. From the interesting indications obtained in the experiments I have just described, I have been engaged in calculating a table reading up to 250° F. for differences in the readings of the two thermometers as high as 135° F., as such differences are obtainable. Readings taken even only every 9° F., within these limits, would appear to be all that is required for practical purposes, as one or two per cent. of moisture does not much affect the result, and it is also easy to interpolate roughly by guessing with sufficient accuracy. In this table there appear to be some 200 results necessary to complete it, yet to obtain them something like 400,000 figures are necessary, besides continual reference to tables of the elastic force of steam, &c., so that it will easily be apparent that its compilation is a work of patience. I regret that I have not yet been able to find sufficient leisure to complete it, although I have been at work on it for some months past, or I should have had much pleasure in placing it before you to-night.

To return now to the seemingly enormous evaporative or drying power of the heated air at 248° F., of which I was speaking in referring to these experiments, and what no doubt would at once appear to many its power of evaporating water at a fabulous rate. Of course nothing so wonderful is possible; for water, in order to pass from the liquid to the gaseous state, requires a large amount of heat, and some heat is also necessary to warm the goods up to the temperature of the drying room; besides there are sorts of losses by radiation through the walls, floors, ceilings, &c., but more especially through the windows. There is also to be considered the dewpoint or temperature at which the heated air becomes saturated so that it cannot any longer maintain the water in suspension; and as the whole of this heat must be taken from the heated air, its temperature and moisture-absorbing capacity are thereby at once lowered.

It is not difficult to determine approximately how much air and how much heat is necessary for the evaporation of any given amount of water in drying at any given temperature, and also to examine the relative amount of heat expended in each of the various losses. To take an instance. Let us suppose it is necessary to evaporate every hour 220 lb. of water, the external temperature of the atmosphere being 59° F., and the temperature of the damp and cooled air at the exit from the room being 95° F. It will be necessary to send hourly some 12,940 lb. of dry air through the room, and the bulk or volume of this weight of air will therefore be about 172,348 cub. ft. Then suppose the external air to be saturated, which it seldom is, the average amount of saturation of the air here being probably about 80 per cent.; but it is of course advisable to consider the outer air under the worst possible conditions, so that the drying may be accomplished with certainty in all states of the weather, even if it is more rapid on fine, dry days. It will then be necessary to send the 172,348 cub. ft. of air into the drying room at a temperature of 175° F., and the heat will be expended in the following proportions:—The air itself will absorb 4·75 calories, the steam contained in it 0·12 calories, and the water vaporised 10·62 calories, total 15·49 calories. There will therefore be some 91,112 calories to supply per hour, which shows a consumption in fuel, of good coke for instance, of about 40 lb. per hour. As to the efficiency of this application, these figures show at once that it is $\frac{10\cdot62}{15\cdot49}$ or 68 per cent.; that is to say, that out of the total 15·49 calories sent in, the 10·62 calories expended in vaporising the water in the room represent the part of the total heat usefully employed. In reality the efficiency will be somewhat less, for a further amount of heat is necessary—that necessary to warm the substance to be dried from 59° to 95° F., and no allowance is made for radiation losses, &c.

In passing air in motion through a room it is of course impossible to make sure or to obtain that every particle of air will meet with a particle of water to absorb, but if the goods are carefully disposed so as to obtain the best contact possible with the air in motion, something like two-thirds of the theoretical amount of absorption may be obtained. And it is now apparent to you why the 7,000 cub. ft. of air a minute at 248° F. I mentioned in the experiments with the thermometers, could not, in spite of their only containing 2 per cent. of moisture, evaporate the 300 lb. of water per minute I then spoke of, as the heat necessary for the evaporation of the water would have had to come from the air; to how great an extent you now see, for in the example I have just given you, the 172,348 cub. ft. per hour is 2,872 cub. ft. per minute, which, although heated to 175° F., can only evaporate about 220 lb. of water per hour, or say 3·5 lb. of water per minute.

I have not wished to weary you with figures, and have therefore summarised the results in the foregoing example, the more so that all these problems are much easier to deal with in cubic metres and centigrade degrees, and are even then complex and tedious to work out. To show how far this is so, I give here the formula for determining the efficiency of a drying application, that is to say, the proportion of the heat actually expended in vaporising the water to the total amount of heat expended, premising it with the indication that the $\frac{2}{3}$ is the two-thirds of the theoretical duty which constitute good practice, and that p_t is the weight of steam in one kilogramme of dry air at t° C., and that $p\theta$ is the weight of steam in the air at θ°, t°, and θ° being respectively the temperatures of the outer air and of the air of the drying room at its exit:—

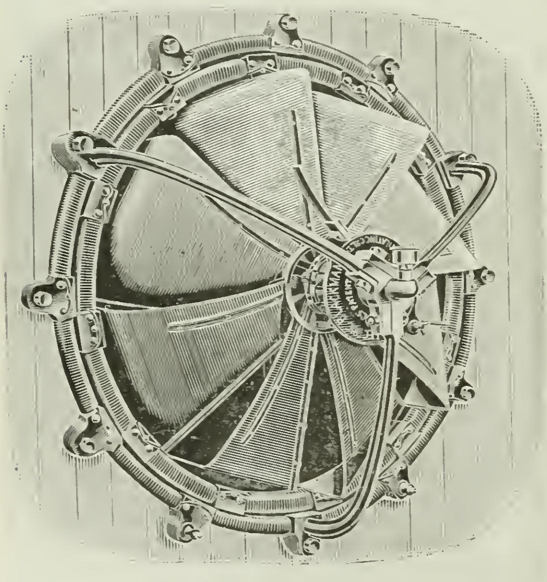
$$\frac{\frac{2}{3}\,(p_\theta - p_t)\,[606\cdot5 + 0\cdot305\,(\theta - t)]}{0\cdot2377\,(\theta - t) + 0\cdot475\,p_t(\theta - t) + \frac{2}{3}\,(p_\theta - p_t)\,[606\cdot5 + 0\cdot305\,(\theta - t}$$

That it is sufficiently complex is at once apparent, and in Fahrenheit degrees, pounds, grains, cubic feet, &c., it is still more so, but as these are our current measures in England, I have used them in all other parts throughout this paper.

The applications therefore of air in motion to drying, both in chemical industries, and in the allied trades are so numerous that in the time and space at my disposal I can only call your attention to some of the most important. Beginning with those trades which are perhaps more strictly speaking users of chemicals than chemical industries, one of the first is that of the cotton, woollen, silk, flax, hemp, jute, and other textile manufacturing. In all of these trades at some period of the process of manufacture the goods have to be dried, and I have already shown how the process can be accelerated by using fans properly applied. In the leather trade the use of air in motion is of peculiar value. It is, however, necessary to distinguish the great difference between the drying of oak-tanned and extract leather. The treatment which would dry the oak-tanned perfectly would irretrievably injure and blacken the extract leather, which is much more delicate while still damp. And this leads me to call your attention to the extreme importance of recognising a fact too often completely ignored, which is that a fan is not a machine like a grindstone or a sewing-machine, which will do its work no matter where it may be placed. The fan, on the contrary, demands very careful thought in its installation, it being generally found that there is but one place in a room or machine where a fan can be placed to do good work, and that placed anywhere else it may be worse than useless. Some years back I remember a firm in the leather trade buying a fan and erecting it where it was easiest to drive, quite regardless of the effect it might have on their skins, but I believe simply from the fact that a neighbouring competitor was getting excellent results from his fan, and they wished to compete with him at an equal advantage. About two days after the fan was erected (it was in the month of August) a very warm day was followed by a cold, rainy night, and I believe that night cost them several hundred pounds, for the whole of the goods in their loft, which was a very large one, were completely ruined, and they were then fully convinced of the necessity of erecting the fan "judgmatically," for on re-erecting it in another position and in another manner, where it should have been placed at first, it gave excellent results, and others were subsequently placed in other lofts. Glue and gelatin are materials most particularly subject to the state of the air brought into contact with them, and are among those substances which it is most important to dry with the least possible amount of heat; here, then, air in motion is of the greatest value. I will take the extreme instance of gelatin as combined with salts of silver as used for coating the photographic dry-plates. These, according to their formula of preparation, will not bear a temperature higher than 70° or 75° F., and in addition it is most important to dry them rapidly and without the slightest particle of dust falling on the damp surface. If left to themselves in a room in which the air is simply heated without being in motion, they seem to get surrounded by a film of damp air and take as much as 24 hours to dry. With air in motion in the room, properly warmed and applied, they dry easily in a half or a third of that time, or even less, without the slighest risk of their being damaged by a speck of dust. But if the air is at all overheated the emulsion will not set, or if it does, sooner or later, changes take place in the film, and the plates become unreliable or worthless. On the other hand, starch and goods containing starch appear to need a considerable amount of heat to dry them, and are not so easily dealt with by cool air. Products in which linseed and other oils are used also dry best with a certain amount of heat, but the value of plenty of air in motion is most plainly evident in those cases where the so-called drying is in reality the oxidation of the oils in or on the various articles. In the paper trades the drying is really of course mostly done by steam cylinders, but air in motion is decidedly useful for drying the machine. Taking the glazed papers, for instance, if there is any condensation above, every drop of water falling on the paper leaves its mark. Taking wall-papers, simply printed or both printed and varnished, it is very often a very slow and tedious matter to dry them without air in motion, and the same applies to cardboard and other kindred products. A firm manufacturing a sort of brown paper papier-maché, half or three-quarters of an inch in thickness, found the drying so slow that the manufacture of these goods, which were very often bulky, could not possibly have paid. With air in motion the drying became easy, such articles being easily dried in 12 to 15 hours, and the result was that the manufacture of these articles became remunerative. At the beginning of this paper I mentioned the difference of air in volume and air under pressure, and spoke of the small amount of pressure generally sufficient to overcome an apparently considerable resistance. I then gave one instance, that of a coal-dust fire; malt-drying supplies another. It would at first sight seem impossible to overcome the resistance of two floors of wet malt each 15 in. thick, without considerable pressure, but such is not the case, for it has long been proved that air in large volume and almost without pressure can be rapidly passed through it, thereby producing a most excellent and rapid drying. Hops are also easily dealt with in an almost similar manner. For bricks, tiles, pottery, porcelain, &c., the use of air in motion offers peculiar advantages, and even saggers and other large pieces are easily dried without risk of fracture, the waste heat for the stoves or ovens being used for the purpose of increasing the drying power of the atmosphere. Timber is also rapidly and efficiently seasoned, for no nearer approach to the effect of a summer wind can be produced. In cement works the drying of the slurry is accomplished much more rapidly, and almost any kind of fuel can be used in the kiln should its shape admit of this. In the chemical industries properly speaking, fans have been applied with perfect success for drying gunpowder, smokeless powder, oxide of zinc, superphosphate of lime, white lead, sulphate of copper crystals, transparent soap, cellulose wood-pulp, delicate dyes such as saffranin, &c., diatomite, kaolin, anthraquinone, guncotton, photographic films, &c. I cannot give a better instance of the value of air in motion in the chemical trades than the following:—Some time back I had handed to me a lump of wet crystals of the consistency of thawing snow, and was told that although it had been lying on the top of a boiler for a fortnight it showed no signs of drying. I was warned not to exceed a temperature of 190° F. On placing it in a drying stove with air in motion at this temperature, after 48 hours continuous running it still showed no sign of drying, and was practically in the same condition as on starting. The workman in charge got impatient with it and forced the heat. When at 200° F. the substance immediately melted, and he, not to spoil it, at once stopped the heat and sent air at about 60° F. through the stove instead. The material dried up at once. We subsequently found that this was the only manner to dry this product, and that it suffered no damage by this treatment. At a sewage works the residue of the filter-presses is now completely dried without loss of the large amount of free ammonia it contains, at a cost of about 10*s.* per ton, and finds a ready sale at 25*s.*, the only fault being that there is not more of the sludge to increase the profit. For evaporating liquids the use of air in motion offers one of the cheapest and most rapid methods of concentrating chemical solutions.

So far I have only spoken of the application of air in motion to one purpose, but it can often be applied to more than one. For instance, in a laundry the hot air exhausted from the ironing-room can, after being warmed, be used for drying the linen, and after leaving the drying-room it is still able to assist very materially in removing the steam in the wash-house, which it dispels in a double manner, first, because this air, not being saturated, has still a capacity for absorbing steam, rendering it invisible, and preventing condensation; and secondly, by driving it out of the laundry. In an installation erected some years back the whole of these various duties are most satisfactorily performed, and in addition the exhaust of the engine being passed through the steam coils used for heating the air of the ironing-room before its entrance into the drying-room, the additional power thus imparted to the engine is more than sufficient to run the fan, the proof of this being that the engine runs more easily with the fan than without it, so that in addition to the air in motion not costing anything there is also a margin of power obtained for nothing. I will mention one more instance. It is well worthy of consideration if what is objectionable in one firm of business is not valuable in another. Some time back I was called in to a large electric station to remove the heat from the engine and dynamo room, and the best place for doing this adjoined a neighbour's property. Upon calling upon him I found he was a timber merchant, and so the matter was easily dealt with as follows:—The fan was erected to remove the hot air from the engine-room, and he erected a drying-room for his timber, and each paid one half of the cost of running the fan, the value of co-operation between separate firms being thus fully demonstrated.

So far I have only dealt with the question of putting air in motion by mechanical means, especially by the use of fans, and this leads me to say a few words on the subject of so-called "automatic" ventilation. Many so-called automatic appliances have been invented for the purpose of removing the air out of a building, but if they are correctly investigated they will generally be found, I might say always, to be worse than useless. The mere word automatic immediately suggests that the air can put itself in motion alone and unaided, and I am afraid that, notwithstanding the advance of science, perpetual motion is likely to remain one of the impossibilities. Many of these appliances aim at more still, for they expect not only that the air shall put itself in motion, but do work, that is to say, move something else on its way. It can be proved, and is in fact almost obvious, that the best way to take advantage of any natural tendency of air to displace itself is to leave it to escape through a perfectly free opening, for anything placed in the opening can but impede the motion of the air in the same way that an obstruction impedes the flow of water, or that a turnstile or barrier retards and impedes the exit of a crowd of people. Some of these appliances are put in motion by the external motion of the atmosphere, all forgetful of the facts that if there were any motion in the atmosphere the wind would naturally displace air through the building, and that if there is none it is the very time when they are most wanted that they are ineffective and therefore worse than useless. There are also, of course, other means of imparting motion to the air, such as gas-jets burning underneath an opening, or applying a steam jet to it on the exhaustor principle, but on duly valuing their efficiency it will be found that had the same amount of gas or steam been used in an engine driving a fan, a very much higher displacement of air with consequent economy would have resulted; still, they are so far correct that they put the air in motion positively, by supplying it with motive power, and help it to move without expecting it to produce its own motive power. The same applies to water, for although of course a water-spray or jet will put air in motion, the same amount of water will give a greater displacement of air if utilised in a motor driving a fan. Electricity is also one of the most convenient motive forces possible for driving, as where in many cases it would be almost impossible to apply a gas, steam, or water motor, or to transmit power by means of pulleys and a rope or belt, a pair of wires and a motor can be erected without any difficulty. There is also another matter to consider in putting air in motion, and that is the cost of the driving power. Many buy fans because they are a few pounds or shillings cheaper than others, and think that they have made a good bargain and saved money, without the slightest thought that in moving such a mobile and compressible matter as air there are all sorts of considerations, such as the slip of the air in the fan, and that the cost of the fan is a small matter compared with the cost of the power expended in driving it. For instance, a fan costs 25*l.* and takes $2\frac{1}{2}$ h.p. to drive it with a duty of 30,000 cubic feet of air per minute. Another fan costs say 20*l.*, displaces the same amount of air in the same time, but takes 3 h.p. to drive it. As every horse-power costs from 10*l.* to 40*l.* per annum, according to the size of the engine producing it, whether it is one of 40 h.p. or of 4 h.p., say an average of 25*l.* per annum, then the additional half horse-power costing 12*l.* 10*s.* being added to the cost of the fan, makes the relative expense even at the end of the first year 87*l.* 10*s.* for the fan which originally cost the most money, and 95*l.* for the cheaper fan, which will in addition be wasting continually 12*l.* 10*s.* per annum in every successive year, even if it can move the volume of air or do the work. If I emphasise this by saying that I have tested fans of the same dimension, where one took not only 3 h.p., but nearly 12 h.p. to drive it, instead of the $2\frac{1}{2}$ of which I have just spoken, it will at once be seen that the cost of the "cheaper" fan at the end of the first year would amount to 300*l.* as against the cost up to the same period of its "dearer" rival of 87*l.* 10*s.*, and all to try to save 5*l.* in tangible cash. There is also another point here to which I wish to draw your attention, which is, that if you can displace 15,000 cubic of air per minute for 1 h.p. you are doing excellent work, and that fans professing to do nearly this amount of work per man-power, or say 150,000 cubic feet per horse-power will, when you come to test them scientifically, not do what you may have expected of them. And whilst speaking of the amount of motive power necessary to drive a fan, and the subject of cost and economy, I wish again to recall to your attention what I said in beginning, about the great difference between pressure and volume. It always costs much more to move the same volume of air at a high velocity than at a low one. $1\frac{1}{2}$ h.p. expended on a 36-in. fan costing say 17*l.* will move 14,000 cubic feet of air per minute. $1\frac{1}{2}$ h.p. expended on a 60-in. fan costing 37*l.* will move 21,000 cubic feet of air per minute. At the end of the first year, still taking the horse-power at 25*l.* per annum, the 36-in. fan will have cost 54*l.* 10*s.*, and the 60-in. fan will have cost 74*l.* 10*s.* With the smaller fan each thousand cubic feet of air per minute will have cost 3*l.* 17*s.* 10*d.*, with the larger one the thousand feet of air will have cost 3*l.* 16*s.* 9*d.*, and every following year half as much air again will be displaced without extra cost, and therefore with corresponding economy. Therefore it is at once apparent that it is generally a false economy to employ a small fan driven at a high speed; on the contrary (except for special purposes where some amount of pressure is necessary) or to drive any faster than is needful for the purpose to be attained. This is due to the fact that air at double the pressure takes twice the power to move it, and more, and at three times the pressure it takes three times the power, and more, and so on.



There is one point to which I should have been glad to refer in this paper, but, although many of you will doubtless have expected me to say something on the subject, I have carefully refrained from so doing, and this is, how to apply the fan to put the air in motion. As I have already said a fan is not a machine like a grindstone or a sewing-machine, that will do useful work no matter where it may be placed, and as it is usually a case of applying a fan to existing buildings, and as except in special cases—malt-kilns, for instance—no two buildings are alike, and each building almost certainly differs from any other building, therefore no two applications except in these special cases are exactly alike. On this point it is most desirable therefore that special experience should be brought to bear; and those requiring the fan, on the one hand, knowing the result they wish to obtain, and those having the practical experience of air in motion, on the other hand, will always obtain the best result by discussing the application together and thus obtain a successful application which otherwise might, more likely than not, result in disastrous failure. This is doubly undesirable, for not only is the whole matter given up in disgust, to say nothing of the possible loss, but it also discredits the use of air in motion, although its use might have been, not only probably but almost certainly, of the greatest service. And in nearly every case it will also be found that to secure the most efficient application, it is not sufficient to merely consider the room or building in which a result is desired, but all the surroundings, even those of the neighbours.

And to conclude, I will only add that one firm alone, having gone on buying fans until they have now over a hundred running in their works, capable of displacing 3,000,000 cubic feet of air per minute, or 180,000,000 cubic feet of air per hour, having probably cost over 3,000*l.* to erect and apply, taking probably over 250 h.p. to drive them, at a yearly cost of perhaps some 6,000*l.*, seem to have found that there is some advantage to be derived from the application of air in motion.

Discussion.

The **Chairman** said this was a most interesting communication, which showed amongst other things that there was much ignorance amongst manufacturers and others as to the real problem of drying. He was sorry to say that he had known personally of drying rooms very much like those Mr. Watel had described, where apparently the object was to make everything as hot as possible and take care that no water was lost in the process. The experience of many present would no doubt furnish cases of a similar character. Some years ago he tried to heat air before it went into a drying room, but the difficulty met with was that the iron pipes used for conveying the hot air were rapidly burnt out and the method had to be given up. Perhaps Mr. Watel would be able to tell them how to avoid that difficulty.

Mr. **W. Crowder** asked if the fan on the table was one which could be recommended for use with a Lancashire boiler without a chimney, and would it also be applicable to a reverberatory furnace?

Mr. **Watel** said it would drive a Lancashire boiler very well, and would be suitable for some types of furnaces, but where there was a very heavy resistance it would be perfectly useless. It was quite opposite in its effects to such machines as the Roots' blower or a Beale exhauster. He had seen a blast fan which gave a very high pressure with a small volume; perhaps 54 inches of water-gauge, but with 40 or 50 h.p.; it could not fill more than a $1\frac{1}{4}$-in. tube. This fan was exactly the reverse; it moved a large quantity of air at low pressure. With regard to its use with a reverberatory furnace, it would depend greatly on the construction of the furnace itself, but for a Lancashire boiler, where one had simply to send the air under the fire-bars, one could send any amount of air at anything under 1 in. pressure.

Mr. **Crowder** said that from 7 lb. to 9 lb. of water could be evaporated in an ordinary steam boiler for 1 lb. of coal. What would be the corresponding effect in driving off water from any material such as had been spoken of by the use of this machine? Could it be done to the same extent?

Mr. **Watel** said as a rule to a considerably less extent, because there were a great many conditions which came in. In the first place, a boiler once warmed was always the same, but in drying goods the goods themselves had to be warmed up to the temperature of the drying-room, which necessitated a certain amount of waste heat. Again, all the water within a boiler was in a certain space and could only escape by vaporisation through the steam-pipe, but if air were sent through a drying-room it was not certain that every particle of hot air would find a particle of water to absorb, and, therefore, there was heat wasted in that way; but with the apparatus well devised and the goods properly arranged there was no difficulty in getting between 60 and 70 per cent. of efficiency.

Mr. **R. J. Friswell** said many years ago he made use of the wet and dry bulb thermometer for the purpose of ascertaining whether a drying-room was acting properly, but he was very much troubled with the growth of the mycelium of a fungus which attacked the wick conveying the water to the bulb, and in a short time destroyed its efficiency and rendered it utterly repellent of water. He therefore found it necessary to use distilled water and sterilise it with carbolic acid in order to make it act efficiently. He also discovered that one of the very best tests of the drying-room was the condensing power of the human skin. Its normal temperature was somewhere about 97°, and if on going into a drying-room one felt that cold perspiration to which Mr. Watel had referred suddenly settling on the skin, one might be perfectly certain the room was not acting efficiently, that there was not sufficient air passing through it. This was a test which anyone could apply; and by having proper dampers and regulating the rate at which the current of air was passing through the conditions might be altered.

Mr. **B. Blount** thought the efficacy of forcing a draught under boilers might be considerably overrated. The use of an excess of oxygen should not be the aim of the engineer who sought to get the utmost efficiency out of his coal. He had analysed the gases issuing from the waste-pipe when this forced draught was on, and he knew very well that although the black smoke which disfigured the end of the chimney when the draught was defective soon ceased when a forced draught was put on, yet as a matter of fact there was a much larger excess of air in the exit gas in the boiler than before, and all that air had to be warmed up, which meant coal, and was not economical. They should therefore be a little chary of suppressing mere smoke by such means.

Mr. **Watel** said tables were prepared for use with the thermometers which showed at once the percentage of moisture due to any difference between the two thermometers, and gave at once the actual percentage of moisture in the air. Another table gave the number of grains of vapour in the cubic foot when saturated, and if the air had 80 per cent. moisture one knew how much it could still absorb. He quite agreed with what had been said as to the value of distilled water for use with the thermometer; in fact it ought always to be used, otherwise in many cases a sort of scaly deposit formed, probably of salts of lime and other matters, on the muslin, which very seriously impeded evaporation. With regard to forced draught, he quite agreed that it might be excessive. He had seen forced draught in a closed stokehole when under 2 in. of water-gauge and more, and knew that not only must there be a great deal of air going up the chimney, but a great deal of coal too. That was why he expressed the opinion that something like 500,000 to 600,000 cub. ft. of air per ton of coal was about the right amount, and should not be exceeded.

Mr. **Newlands** said there were a great many interesting points arising on this paper, and seeing that there was not time to fully discuss it then he moved that the discussion be adjourned to next session.

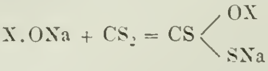
Mr. **Guttmann** seconded the motion, which was carried unanimously.

Mr. **Watel** said he hoped if any gentleman had any particular points to bring forward they would give him notice of them beforehand, so that he might be prepared to meet them when the discussion was resumed.

NEW CELLULOSE DERIVATIVES AND THEIR INDUSTRIAL APPLICATIONS.

BY C. F. CROSS, E. J. BEVAN, AND C. BEADLE.

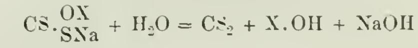
We have recently published (Chem. Soc. J., 1893, 837) a brief account of a new series of synthetical derivatives of cellulose, produced by the interaction of alkali cellulose and carbon disulphide. The reaction may be formulated as under, using the symbol X to represent the reacting cellulose unit or residue :—



$$\mathrm{X.ONa} + \mathrm{CS_2} = \mathrm{CS}\Big\langle\begin{matrix}\mathrm{OX}\\ \mathrm{SNa}\end{matrix}$$

Alkali-cellulose. Cellulose-xanthate.

and the reversal of the process or decomposition of the product, which is readily determined in presence of water, may be expressed with equal simplicity as—

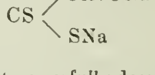


$$\mathrm{CS}.\begin{matrix}\mathrm{OX}\\ \mathrm{SNa}\end{matrix} + \mathrm{H_2O} = \mathrm{CS_2} + \mathrm{X.OH} + \mathrm{NaOH}$$

Cellulose-xanthate. Cellulose.

The purpose of this communication is to describe these reactions somewhat more in detail, and to indicate some of the industrial developments which are opened out by the recognition of this particular synthetic capacity of cellulose. At the same time it is a duty we owe our colleagues, not to present the subject in any narrowed or exclusive view of utility, and we shall rather attempt its treatment from the broader view of cellulose technology, as the adaptation to more or less similar uses in the arts of the structural materials which nature employs in the plant world in endless variety and quantity. Our methods of working up cellulosic raw materials may be conveniently classified as mechanical and chemical. In the former we may include textile manufactures and paper-making; for any chemical treatments which are involved are designed to produce the minimum of change in the fibrous basis of the raw material, and are in fact merely auxiliary to the preparation of these in suitable condition. In the latter we include all processes based upon a definite chemical change wrought upon the raw material. Such processes are few in number, and, in relation to the former group, of minor importance. Confining ourselves to those which produce fabrics or structural materials, we may cite (*a*) the applications of the cellulose nitrates to the production of materials and goods known as celluloid, xylonite, &c.; and (*b*) the conversion of cellulose—in the form of fabrics—into hydrated modifications having special properties, *e.g.*, by treatment with strong alkaline solutions (mercerisation), or with strong acids or zinc chloride solution (parchmentising), or the production of an actual solution of cellulose and applying this in various ways, as in the processes of the "Willesden" Company. It is unnecessary for us to say anything as to the value or the defects—the net value, if we may so speak—of the products of these processes. One conclusion, however, we are entitled to draw from the enormous amount of practical research which has been devoted to cellulose in the working out of these processes, that is, the recognition, in this raw material of the natural world, of "plastic" capabilities of a high order, and requiring only the right treatment, *i.e.*, chemical modification, to enable us to follow nature in working it up into endless varieties of form and substance. It strikes one as not a little remarkable that the search for a plastic modification of cellulose itself appears to have been entirely shelved, assuming it to have been entered upon, by the discovery of similar properties in its nitrated derivatives, and by the many ingenious and valuable developments which have resulted from this discovery. Of these perhaps the most interesting from our present point of view are the attempts, more or less successful, which have been made to spin these nitrated products from their viscous solutions in special solvents into the form of a continuous cylindrical thread. The "artificial silk" so produced by the process of Dr. Lehner, and of which specimens are submitted, manufactured during a recent demonstration of the process in London, affords the most perfect illustration of the plastic properties of these nitrated celluloses, and also of an important property of the cellulose molecule itself, viz., that of preserving its essential characteristics though such considerable variations as are involved in combination with nitric acid in large molecular proportions.

In investigating the thiocarbonic esters of cellulose we have been still further impressed with this property or characteristic of preserving its molecular integrity through a series of reactions of an equally severe order, but in direct antithesis to those involved in the treatment with the powerful acid mixtures used in nitration. The alkaline thiocarbonates of cellulose are produced by direct synthesis in two stages: (1) the fibre is treated with strong solution of the caustic alkali at the "mercerising" strength, *e.g.*, a solution of NaOH of 15 per cent. The product may be conveniently termed alkali-cellulose, and the proportion of the reagents giving the best results may be expressed in the simplest terms by the ratio, $C_6X_{10}O_5 : 2NaOH$; (2) this alkali-cellulose is exposed to the vapour of carbon disulphide in a closed vessel, reaction ensues, and in the course of 2—3 hours a yellowish mass is obtained, which dissolves in water to a solution of enormous viscosity. The proportion of CS_2 used is expressed by the ratio $CS_2 : 2NaOH$ In regard to the composition of the product so obtained, we have shown (*loc. cit.*) that it must be considered rather as a thiocarbonate of the alkali-cellulose residue, which may therefore be expressed by the general formula—



$$\mathrm{CS}\Big\langle\begin{matrix}\mathrm{OX.ONa}\\ \mathrm{SNa}\end{matrix}$$

It will be noted that powerfully deoxidising conditions are superadded to the hydrolytic action of the alkali throughout this reaction, and the fact that the cellulose molecule withstands the combined and prolonged assault of the alkali in concentrated solution and alkaline sulphocarbonate, is an important point of evidence as to its constitution.

This power of resisting disintegration is an expression of the general inertness of the cellulose molecule, but in the reaction which we are studying this becomes rather a positive property of integration or aggregation. This point we illustrate by a brief notice of the conditions under which cellulose is regenerated from solution of these thiocarbonates or xanthates. After the synthesis of the compound is completed on the lines above described, and in presence of excess of water we have a swollen mass of bright yellow colour—this colour being due to by-products of the reaction, viz., tri-thiocarbonate. In further combining with water the mass behaves and must be treated very much like gelatin, excepting that solution completes itself spontaneously, and requires no application of heat. From this crude solution we can precipitate the cellulose sodium xanthate by suitable dehydrating agents; the best results being obtained with common salt and with alcohol. In using the former we find it best to coat a glass plate with the viscous solution and submerge in brine. A thin coating is solidified in a few seconds to a continuous film of the purified substance in a hydrated condition, which has a greenish colour, is very elastic, and of course readily redissolves in water. This precipitation has been carefully studied and yields, as we find, a continuous series of products in which the ratio of alkali to sulphur remains as in the original reaction, viz., $Na_2O : S_2$, but with a diminishing ratio of both to the cellulose. Thus starting at the percentage ratio—[Cellulose = 100]—100 : 38 we have obtained soluble compounds, having a ratio 100 : 4, and every intermediate stage has from time to time been observed. Even at the ratio 100 : 2 the compound gelatinises with water and passes into a condition of semi-solution. If, therefore, we take the reacting unit of cellulose, in the first instance, as $C_6H_{10}O_5$, the unit in these later stages of solubility must be from 10 to 20 times these dimensions. In fact we have no evidence of any break of continuity in passing, by this extremely simple method of decomposition, from the xanthate synthesised according to the equation, to cellulose itself, obtained of course as a gelatinous hydrate.

The precipitating action of alcohol follows a similar course, but the decomposition of the xanthate is much more gradual under its action.

For industrial purposes the salting process fulfils a wide range of requirements enabling us at small cost (1) to isolate the soluble compound from the by-products of the reaction —sodium trithiocarbonate, &c., and to prepare it in any convenient form, such as films or threads; (2) to fix the compound upon any surface; or (3) to fix the compound in any of the stages of dissociation or decomposition above indicated, terminating in the insoluble condition in which it approximates in composition to cellulose itself.

The tendency of cellulose to aggregation, which is the theoretical point we wish to emphasise, is still further demonstrated by the properties of the solution of the sodium compound itself, which we may now consider in the purified state. The viscosity of these solutions is quite remarkable. A 7 per cent. solution of the compound, *i.e.*, containing, say, 5 of cellulose to 100 of water, has a viscosity equal to that of glycerin, measured by rate of flow.

It cannot be considered a constant property, nor, indeed, is this to be expected. With the same cellulose, *e.g.*, cotton, the viscosity varies considerably with the method of prepation, and of course with the actual composition, *i.e.*, ratio of cellulose to alkali and sulphur in combination, of the compound in solution. We cannot at this stage attempt to express the physical properties of the solution in specific terms. Putting the matter generally, it results from these observations, added to countless others which have preceded, that cellulose has an exceptional capacity for solidifying water. In the solutions of these soluble derivatives we are dealing with a series of transitions to the condition of an insoluble jelly of the regenerated cellulose; such transitions in physical condition in the case of many other colloids, *e.g.*, gelatine and soap, are determined by changes of temperature, but in this case are the expression or result of chemical change. Without, therefore, any attempt at a precise definition of the terms we may describe the solutions of the compounds with a high alkali and sulphur ratio as *viscous*, with a low ratio as *gelatinous*.

We must now turn our attention to the decompositions of the xanthate which have been already alluded to.

As the compound may be considered as formed by the synthetical *association* of alkali cellulose and carbon disulphide, so the decomposition which ensues spontaneously may be taken as the corresponding *dissociation* into carbon disulphide and alkali cellulose. When the purified compound is kept in the dry state this decomposition is realised, though very gradually, with only slight complications due to secondary reactions.

This property of course constitutes a limit to the usefulness of the compound in one direction, at the same time that it is the essential condition of what are without doubt its most important applications.

The decompositions in presence of water are very gradual at the ordinary temperature, and are complicated by the formation of alkaline thio carbonate by secondary interaction between the carbon disulphide and alkali. The rate of decomposition remains slow at temperatures below 60°, and in fact the solutions, in thin films, may be evaporated to dryness, at 50°—60° without sensibly prejudicing the solubility of the compound. At 70°—80° we approach the critical temperatures of the compound, and at 80°—90° the decomposition may be considered as instantaneous. These resolutions, which have the simple character of dissociation, have the advantage of regenerating cellulose in a form in which it is easily freed from alkaline compound by merely washing. The sulphur remaining after thorough washing is very small in amount, and the last traces are easily removed by light oxidising treatment.

Certain characteristics of the final stage of the decomposition, *i.e.*, the regeneration of cellulose have now to be noted. The spontaneous gelatinisation of the solutions appears to take place without change of volume, the coagulum invariably reproducing the details of the surface of the containing vessel. Shrinkage then ensues, the form of the coagulum being perfectly retained. Solutions exceeding 10 per cent. strength (cellulose) give a coagulum of great solidity; even when diluted to 0·5 per cent. strength the cellulose jelly obtained has sufficient consistency to be handled.

The variety of solid forms of cellulose obtainable by means of these solutions is considerable. From the finest films to solids resembling horn, all grades of variation in substance can be obtained. From the properties of the solution its various possible application will be readily inferred by technologists. It is not our intention to deal with these at all in detail, merely indicating those which have been found workable.

(1.) As an adhesive substance—substituting glue, flour, paste, gums, india-rubber solution, &c. The solution has been successfully used for such "inferior" purposes as bill sticking, and for the more refined operations of book binding.

(2.) For sizing and filling textiles. Beginning with the sizing of cotton warps, we have tested a variety of applications in this province, including the operations of "finishing" cotton and linen cloth. In this direction the important advantage of depositing a substance of the same chemical composition and physical properties as the material of the textile does not need to be insisted upon. Moreover, the filling can be carried out at a stage in the bleaching process, *e.g.*, immediately after the "heavy" treatment with boiling alkalis. The cloth having in this treatment undergone from 85 to 95 per cent. of its total loss of weight, *i.e.*, substance, the cellulose can be deposited upon a basis of pure fibre, *i.e.*, an approximately pure cellulose, and when deposited and fixed as above described perfectly withstands the subsequent actions necessary for the whitening or bleaching proper, of the fabric. We have in this way introduced from 15 to 30 per cent. of additional cellulose without the possibility of its presence being appreciated except by comparison with the unfilled fabric, which it need hardly be said is very much to its disadvantage.

(3.) For purposes of producing casts and moulds. By coating surfaces with the solution or filling hollow vessels, perfect reproduction of form and structural details can be obtained in the form of a more or less solid mass of cellulose (hydrate). Shrinkage is very gradual when the solutions employed exceed 10 per cent. in strength, and in presence of water tends necessarily to a limit, the mass still remaining a hydrate with a considerable ratio of water to cellulose. The cellulose when fully dried (dehydrated) forms a transparent mass resembling horn, which can be worked in the lathe, taking a brilliant surface under the cutting and polishing tools.

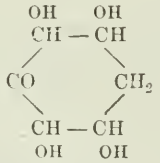
(4.) The applications of the various forms of the solid cellulose, solidified, *i.e.*, in film or block form, will be evident to anyone who handles them and their destiny in this direction must resolve itself rather on such questions as cost of production.

Many other possible applications will no doubt occur to specialists, and will arise in the course of the development of the matter. Those that we have cited are a sufficient illustration of the general principles involved, and we may conclude this portion of our exposition with a few practical demonstrations of the properties of the solution.

We revert to the rather more theoretical questions involved in the problem of the constitution of cellulose. In regard to this particular reaction, it must be noted that from a given weight of cellulose dissolved as thiocarbonate and regenerated either spontaneously or by decomposition with acids—(1) the product obtained shows a slight increase upon the original; there is therefore no evidence of hydrolysis of the cellulose molecule, and (2) the regenerated cellulose, with the exception that the empirical formula corresponds with a hydrate of the original, viz., is similar in chemical properties, and may be considered as identical in all the negative characteristics by which the normal cellulose is distinguished.

It follows in a very distinct way from the study of the decomposition of the thiocarbonate solutions that cellulose is proximately an aggregate of great complexity. We do not refer of course to the complexity of the visible structure of cellulose; what the properties of the molecule may be which condition this species of configuration is a very far off problem. We refer to the aggregation of the reacting units into groups of large dimensions, the proofs of which have been sufficiently given above. Having shown that the reacting unit is of variable magnitude in the one direction, we may conclude conversely that the simplest unit is a C_6 group, *i.e.*, either $C_6H_{10}O_5$ or $C_6H_{10}O_5mH_2O$, for the reason, amongst others, that there is no evidence for assigning any other limit, such as a C_{12} formula. It is true that the formula $C_{12}H_{20}O_{10}$ is convenient since it enables us to avoid fractional expressions for the composition of many of the derivatives of cellulose, and it may be used in all cases where nothing is implied as to the ultimate reacting unit of cellulose. But with regard to this unit it appears more than probable that it is of the dimensions of C_6.

In the lignocelluloses—notably jute—the differentiating groups are certainly of the keto. R. hexene type, and there is a weight of evidence to show that the cellulose groups, if not of this type, readily pass over into the cycloid or closed ring. In fibres of this class the ease with which derivatives of low molecular weight are obtained impresses us with simplicity of ultimate composition, although the simple constitutional units may be and no doubt are put together—in extremely complex configurations. We cite this instance, however, only for the purpose of showing that there is no *a priori* improbability in the view that the ultimate groups of which the cellulose molecule is made up may also be of simple type. If this view is taken we have then to search for the connecting "bond" or "link," which must necessarily be of the C — C or C — O — C type. From what we know of the function of the latter grouping in the carbohydrates, we should expect to find it correlated with extreme susceptibility to the action of hydrolytic agents. Now cellulose is not only resistant to hydrolysis even when aided by powerfully oxidising and deoxidising conditions, but as we have shown, shows the very opposite tendency, viz., to build up reacting units of very large dimensions. This is a fact which must be accounted for, and we submit the following as a working hypothesis, which certainly contravenes none of the evidence which has been accumulated up to the present; that cellulose is made up of unit groups of the type—



and that the linking of these groups into complex molecules is effected by the union of CO to CH_2 in which there is a transition to the form CH – C(OH). The synthesising functions of this grouping are a conspicuous subject of modern systematic investigation, and there is every temptation to regard it as a probable factor in the building up of carbon compounds by the plant. Whether it play the part in cellulose chemistry which we are inclined to assign to it, further investigation must show.

This is not the occasion to extend the discussion of these more theoretical points. It is quite clear, however, that if we are to have a development of cellulose technology which is to be a following however humble and "afar off" of the revelations of the plant world—we must continue to work from the strictly theoretical standpoint. It is from this point of view that we have been careful not to ignore the important problem of the actual constitution of the cellulose molecule.

Discussion.

The Chairman said it had been a great treat to listen to this paper, which opened up a field for industrial work of the most ample dimensions. As it was so late he would content himself with putting one or two questions. In the first place he would ask how these films behaved if used for dialysis, and also whether the specimens shown were really free from water except that present as hydrate; whether such solids would undergo any further shrinkage so as to develop cracks or fissures either by loss of substance or by twisting so as to render the solid unsound. It also occurred to him to ask whether the regenerated cellulose could be passed again through the same series of reactions if the operations described were repeated upon it, and whether it was subject to any change on mere exposure to water. Perhaps it might be used for the formation of a sort of paper which would be—not waterproof in the sense that it would not allow water to pass through it—but which would be indestructible by water; whereas ordinary paper, in which the fibres were merely felted together, became so tender on exposure to water that it was practically destroyed.

Mr. Royle asked whether the authors made any experiments with respect to the affinity of this substance for colouring matters, and whether it gave any clue to the action of dyes on fabrics, whether it was mechanical or chemical.

Mr. Watson Smith said one very important point touched upon in the paper was the treatment of cotton cloth by this method. If anything could be done to abolish the practice of filling cotton with China clay and other weighting materials, it would be an exceedingly good thing. He believed Lancashire cotton was sent to India and sold there by weight, which might account for the tendency of manufacturers to put in these heavy substances. This cellulose would not add much to the weight, and if some important property could be conferred upon the cotton by treatment with it, it would be a good reason for adopting it, and it might lead to the disuse of China clay. To give an illustration of the immense viscosity and tenacity of this substance, he might mention that Mr. Cross kindly gave him a small quantity of a 5 per cent. "viscose" solution, a little of which he, on one occasion, got over his hands. An insoluble skin or film was quickly formed, and he found it utterly impossible to remove this by washing with cold acid water, and almost so with hot water and soap. Finally, he had to use sand and pumice stone along with soap.

Mr. E. F. Hooper asked whether these films would do for photographic purposes? It looked as if there might be a great future for this sort of thing. He should also be glad to know if it would stand the action of chemicals, as it might come in very useful for chemical operations and apparatus.

Mr. De Mosenthal said this was quite a new subject to most of them, and of course opened up the large question of the nature of cellulose and of the cellulose molecule. He had had the advantage of being allowed to cut a little disc off one of the specimens and put it under a microscope, when he found it looked very much like celluloid in section. This new substance would probably have an enormous advantage over celluloid, which was exceedingly inflammable, whilst this was not, but it would require a great deal of study before any one could know much about it. It seemed to be exceedingly similar to celluloid, but without its disadvantages.

Mr. Guttmann said of course Mr. Cross could not have completed his experiments on a new material like this. He should like information on two points, first, whether the solid mass which could be turned and polished retained its elasticity, or whether it became brittle, and secondly, whether it became electrical on rubbing.

Mr. Cross, in reply, said that forms in which the solid products have been submitted might be considered fully dehydrated and permanent. A certain degree of elasticity was a permanent property of the cellulose. The elasticity of the partially dehydrated products appeared to be preserved in contact with water. With regard to the re-solution of the regenerated cellulose, he supposed the Chairman had in his mind the question whether its constitution was that of the normal. It was found in effect to behave under treatment by the synthetical process described exactly as the normal. With regard to the relations of this form of cellulose to colouring matters, and the theory of dyeing, this was a matter under investigation, and requiring very systematic study. So far the substance appeared to show more basic properties than the ordinary cellulose, and it had a fairly free "affinity"—for want of a better word—for the azo colouring matters. The application of the ferric ferricyanide reaction also gave interesting results. The xanthate films treated with this reagent gave a perfect deposition of Prussian blue without affecting the continuity or translucency of the film. It was in fact a complete drying of the material with soluble Prussian blue. Mr. Smith's strictures upon the Lancashire trade were, to a certain extent, justified, but it must be remembered that there were conventions governing all trades, and he believed no one would be better pleased than the manufacturers to get rid of the practice of heavy weighting with China clay and similar materials. They had no particular fancy for putting these things in, but they were demanded by certain markets. With regard to the possible application of this substance to photography, this was a development of the greatest interest, and was under careful consideration. For that purpose there was wanted not merely translucency, but a pretty high degree of transparency; when that was obtained no doubt the substance would fulfil a much larger range of requirements. With regard to chemical inertness, it had all the resistance and rather more than cellulose itself. With regard to electrical properties, they had investigated its insulating capacity. They had compared a film of this substance, about $\frac{1}{32}$ of an inch, with paper and vulcanite, and found that the insulation was very much in the ratio of the normal hygroscopic moisture of the substances, somewhat to the disadvantage of this material. This had rather higher hygroscopic moisture than ordinary cotton, viz., 10 per cent., whilst cotton paper would be about $7\frac{1}{2}$, and vulcanite practically nil. The insulating capacities were inversely as the hygrometric moistures. When perfectly dehydrated it was of course capable of holding an electric charge. With regard to the permanence of the solid, they had now kept slabs for many months, and put them through all kinds of operations, and had come to the conclusion that the amount of tenacity shown in the solids was the true property of the cellulose molecules when solidified in that continuous form.

Newcastle Section.

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Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

The names in italics are those of members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* T. W. Lovibond and W. Martyn.

SESSION 1892—93.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

NOTE ON THE COMPOSITION OF EGYPTIAN BARLEY AND WHEAT.

BY W. COSSAR MACKENZIE, D.SC. (EDIN.).

Although Egypt was for long the granary of the old world, the use of artificial manure to increase the crops never approached to anything comparable with the high farming of the present day in Europe. The fellah depends almost entirely upon the water and suspended matter of the River Nile to restore his land to its original fertility; he does however apply farmyard manure of an inferior quality containing—

	Per cent.
Nitrogen	0·20—0·30
Phosphoric acid	0·15—0·25
Potash	0·10—0·30

Dry earth is used as litter for cattle.

The remains of old villages, consisting of broken pottery and all kinds of *débris* mixed with organic matter, is sifted and also applied to the land. It contains—

	Per cent.
Nitrogen	0·88
Phosphoric Acid	0·27
Potash and soda	2·25 (Gastinel Bey).

Barley and wheat then are practically grown on unmanured land, compared with the cultivation of the same crops in Europe, nevertheless on good land I have heard of crops of barley up to 100 bushels per acre and over, but 35 bushels is nearer an average. Wheat is got up to 40 bushels, but 20 to 25 per acre is about an average crop. Barley and wheat are winter crops, being planted about the middle of November and ready about the middle or second half of May. Before the cereal crops are planted there is, in the case of land with canal irrigation, a four months' fallow preceded by the bersim or clover crops which in their turn followed the cotton crop of the previous winter.

A great objection to wheat and barley from eastern countries is the presence of considerable quantities of earthy matter due to the methods employed for harvesting and thrashing the grain. The straws are at present plucked by the roots, but scythes have been introduced and found to work satisfactorily; reaping-machines can make slow progress only owing to the want of capital, the number of very small farmers, and also the surface of the land being broken up by little ridges into squares of six yards or so each way to facilitate the irrigation and spread the water equally over the surface, these ridges interfere with the machines.

Thrashing-machines are being gradually introduced by the large proprietors, but the want of capital is again an obstacle to its employment by small farmers, and the absence of roads makes a travelling thrashing-machine impossible. The native method is to have all the crop spread out on a part of the field where the surface has been levelled and hardened and drag over it small heavy machines on low wheels until the grain is completely thrashed and the straw broken up into tibbin. The norag, as this machine is called, is drawn by two bullocks, while one and sometimes two men sit on it.

On the farm of the Agricultural College at Gheezeh, in addition to native ones, several foreign varieties are grown, and as the land in all cases is similar and the treatment the same a comparison of their compositions is interesting. The most prominent facts brought out are the dryness of all the varieties and the uniformly high percentage of fat · both of these may perhaps be accounted for by the dryr
of the atmosphere and the heat of the sun.

The ordinary native barley has a close reser
composition to Californian brewing barley a
would prove a useful brewing barley. M
says that a good brewing barley should
than 8·5 per cent. of albuminoids ir
15 per cent. of water; if the na

15 per cent. of water, the albuminoids would be 8·39 per cent. For comparison we have the maximum, minimum, and average proportions given by J. Kühn, also the analyses by Pitsch and Krandauer of chevalier barley grown on unmanured land and the composition of Indian barley from Church's good grains of India.

—	Moisture.	Albuminoids Nitrogen × 6·25.	Fat.	Fibre.	Starch, &c.	Ash.	Nutrient Ratio.	Nutrient Value.	Weight of 100 corns.
BARLEY.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.			Grms.
Native	8·88	9·00	2·64	4·53	72·10	2·85	1 : 8·7	87·20	4·3646
Californian brewing	9·07	8·60	2·41	4·93	72·04	2·95	1 : 9·0	86·20	3·8495
„ chevalier	9·35	11·44	3·48	4·09	69·74	3·28	1 : 6·8	89·18	2·9474
Chili brewing	9·71	9·31	2·79	5·37	69·90	2·92	1 : 8·2	85·63	4·1127
Menemen } Smyrna	9·20	10·53	3·39	5·52	65·44	5·89	1 : 6·9	83·80	2·7533
Onshak	9·55	9·06	3·71	5·57	69·14	2·97	1 : 8·6	86·73	3·5502
Chevalier (analysed by Pitsch)	9·30	11·11	2·48	4·71	69·38	3·04	1 : 6·7	86·19	..
„ „ Krandauer	9·30	10·55	..	..	64·80	2 51	..	..	..
Indian 12·5 per cent. water	12·50	11·50	1·30	2·60	70·00	2·10	1 : 6·3	84·50	..
Indian 9·3 „ „	9·30	11·92	1·35	2·70	72·55	2·18	1 : 6·3	87·58	..
Maximum } J. Kühn	21·60	15·80	3·50	9·60	76·80	..	..	..	..
Minimum	4·50	6·40	0·80	2·26	59·20	..	..	..	..
Average	14·10	9·70	1·90	4·90	67·00	2·40	1 : 7·3	81·07	..

In Egypt both red and white wheats are grown and these differ very much in composition. The white wheat especially contains a high percentage of fat but is low in albuminoids, and as in the case of the barleys all the varieties are very dry. Generally speaking, wheats contain a considerably higher percentage of albuminoids than the barleys of the same place, but here it does not seem to be so, the white wheat containing even less than the barley. The Algerian wheat is also of a poor quality.

For comparison we have Heinzelmann's figures for 1888, Church's analysis of Indian wheat, and the maximum, minimum, and average figures given by Kühn.

—	Moisture.	Albuminoids Nitrogen × 6·25.	Fat.	Fibre.	Starch, &c.	Ash.	Nutrient Ratio.	Nutrient Value.	Weight of 100 corns.
WHEAT.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.			Grms.
Algerian	8·84	10·40	2·23	2·81	73·42	2·30	1 : 7·5	88·95	3·5016
Native red	5·25	10·63	2·25	2·19	77·21	2·47	1 : 7·7	92·01	4·4127
Native white	7·53	8·56	3 14	2·12	76·77	1·88	1 : 9·8	92·55	4·4312
Native red 1888 } Heinzelmann	7·50	10·85	..	..	68·03	..	..	..	..
Native white 1888	7·50	9·00	..	..	69·95	..	..	..	..
Indian wheat	12·50	13·50	1·20	2·70	68·40	1·70	1 : 5·3	84·66	4·102
Maximum } J. Kühn	20·00	24·20	2·70	5·50	77·70	..	..	..	..
Minimum	5·30	6·90	1·00	0·44	60·20	..	..	..	..
Average	13·40	12·00	1·80	2·39	68·70	1·80	1 : 6·1	84·90	..

Yorkshire Section.

Chairman: Sir James Kitson, Bart., M.P.
Vice-Chairman: Dr. F. H. Bowman.
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Jas. Sharp.
G. W. Slatter.
G. Ward.
T. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of members of Committee who retire at the end of the current Session.

The following have been elected to fill the vacancies and will take office in July next:—*Chairman:* A. Smithells; *Vice-Chairman:* T. Fairley; *Committee:* J. E. Bedford, F. Branson, W. Mackay, and C. Rawson.

SESSION 1892—93.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

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Meeting held Monday, May 1st, 1893.

PROFESSOR SMITHELLS IN THE CHAIR.

CONTRIBUTION TO THE ANALYSIS OF FATS. III.—THE ESTIMATION OF RESIN IN SOAPS.

BY DR. J. LEWKOWITSCH.

The qualitative detection of resin in soaps is both easy and reliable (Liebermann-Storch reaction), and affords no difficulty even in the presence of cholesterol, which gives a similar reaction; only in the latter case, the separation of the cholesterol from the resin is required as a preliminary operation. Soaps that are free from resin do not show the characteristic violet colour with acetic anhydride and sulphuric acid.

The quantitative determination of resin in soaps, on the contrary, is still an unsolved problem, and, notwithstanding numerous publications as to the reliability of the one or the other method, a completely trustworthy process is still a desideratum.

I do not intend to criticise here the earlier methods that have been recommended from time to time, as their utter failure has already been shown up by several authors.

I propose to deal in this paper with Gladding's and Twitchell's methods only. As to the former, we find in the literature more or less conflicting statements, some authors going so far as to recommend it as an absolutely reliable method, the proof for which may be given by the figures of one or two uncontrollable analyses. Twitchell's method is too new as yet to have had thrown upon it the full light of independent examination by several analysts.

I.—Gladding's Method.

This process is based on the solubility of the silver salts of the resin acids in ether; it has been used in three modifications:—

(*a.*) *Gladding's Original Method.*—Gladding proposed to dissolve the mixed fatty and resin acids, obtained by decomposing the soap, in absolute alcohol and to slightly supersaturate with concentrated alcoholic potash in presence of phenolphthaleïn. The solution is made up with dry ether to a known volume and shaken with powdered silver nitrate. A measured quantity of the ethereal solution is taken and the resin acids contained therein are weighed.

No account is taken of the volume of the precipitated silver salts, an error which causes the results to be invalidated over and above that caused by the slight solubility of the silver salts of the fatty acids in ether. True, Gladding proposes a certain correction to be made for this solubility, but as he has carried out but a small number of experiments, and as the solubility of these salts varies greatly with the composition of the fatty acid mixture, this correction is very *crux* of his process. Alder Wright and Thompson have determined the solubility in ether of silver salts of some pure fatty acids and mixtures thereof, but with very rare exceptions the nature of the fatty acids found in a soap will not be known. Even accepting their figures as correct,* the proof is still wanting that they would hold good for a mixture of these silver salts with varying percentages of silver resinates.

I have made but comparatively few experiments with Gladding's original method, as the altogether unreliable results deterred me from making any further use of it. I employed in my experiments a Muter's tube, this being the most convenient form of apparatus for avoiding losses by evaporation of the ethereal solution whilst measuring off part of it for analysis. I may say that the results were found to be by several per cents. higher than it was calculated from the *known* composition of the soaps; and yet my case represents the most favourable instance, the nature of the fatty acids being known and the solubility of their silver salts having been determined separately.

(*b.*) *Hübl's and Stadler's Modification of Gladding's Process.*—These authors recommend to exactly neutralise the mixture of fatty acids and resin acids, previously dissolved in absolute alcohol, with potash, and to precipitate all the acids as silver salts from the strongly diluted solution by silver nitrate. The silver salts are to be filtered off, protected from sunlight, dried at 100° C. in an oven, and exhausted in a Soxhlet extractor by means of dry ether. The ethereal solution should be yellow or light brown, but not dark brown; it is filtered, if necessary, the resin acids set free by hydrochloric acid, and weighed. A correction for any dissolved aliphatic silver salts is not recommended.

I have tried this method very extensively for some time, without, however, arriving at anything like satisfactory results. It was not always possible to obtain a light-coloured ethereal solution without any tangible cause for the variations being apparent. The results obtained were mostly too low, occasionally too high. The former seemed to point to the necessity of more finely dividing the cake of silver salts by grinding it up with pure sand, and therefore the greatest number of the analyses were carried out in that way;† to obviate the objection that perhaps not all the resin had been extracted, the exhaustion was repeated occasionally, without, however, yielding any better results, as will be seen from the figures below. There seemed to take place in nearly all cases a reduction of the silver salts (especially when the percentage of resin in the soap was high), which was noticeable by the filter-paper case in the Soxhlet extractor assuming a dark colour. A further confirmation of this view was afforded by the fact that in many cases—and occasionally in analyses agreeing pretty closely with the theoretical results—the ethereal solution

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* I also determined the solubility of silver oleate and stearate in ether, using Muter's tube, and found the following results, which I contrast with Wright and Thompson's figures, calculated for the free acids:—

Fatty Acid.	Solubility in 10 cc. of Ether.			
	Author.		Wright and Thompson.	
	Minimum.	Maximum.	Minimum.	Maximum.
	Grm.	Grm.	Grm.	Grm.
Oleic acid.......	0·01090	0·01094	0·0009	0·0015
Stearic acid.....	0·00054	0·00058	0·0008	0·0016

† It will be seen later on, from the results of some experiments that the sand did not affect the result.

contained resin acids only, but no silver salts, as was evidenced by the absence of a precipitate of silver chloride. The too high results, again, seemed to indicate clearly that part of the aliphatic silver salts had passed into the ether, and this led to the determination of the solubility of the silver salts of the following fatty acids under the same conditions. The little table gives the results obtained expressed in terms of the fatty acids :—

Fatty Acid.	Solubility in 10 cc. Ether.				
	I.	II.	III.	IV.	Means.
	Grm.	Grm.	Grm.	Grm.	Grm.
Stearic acid............	0·008	0·0103	0·0100	0·0121	0·0101
Oleic acid..............	0·016	0·0239	0·0166	0·0234	0·0199
Mixture of tallow and cocoanut-oil acids (about 9 : 1).	0·0140	0·0150	0·0150	0·0144	0·0146

It will be noticed that these figures are very much higher than those found in my own experiments with Muter's tube and in Wright and Thompson's experiments, which were most likely carried out in the same way.

The following table contains a number of analyses made quite recently with a number of soaps specially prepared for the purposes of this paper, so that the theoretical percentage of resin acids in the mixture of the acids should be known accurately :—

Mixed Fatty and Resin Acids.	Resin Acids.				
	Theory.	Experiment			
		I.	II.	III.	IV.
No.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	9·79	12·12	15·36	12·31	12·40
2	19·69	{ 17·24 { 15·11	15·83 14·22	16·71 16·84	16·26 } 15·78 }
3	21·45	15·93	16·07	15·14	16·19
4	24·66	16·25	17·95	17·73	15·80
5	30·31	22·79	20·95	20·90	18·72
6	39·81	{ 42·05 { 26·25	35·35 27·11	31·3 25·83	.. } 26·32 }
7	45·05	42·26	41·16	43·03	..

No correction was made for the solubility of the aliphatic silver salts, the results being mostly too low to begin with. The figures corresponding to No. 1 show that a large quantity of fatty acid has been extracted. No. 4 and No. 5, on the result of the analysis having been ascertained, were again exhausted with fresh ether and the weight of acid obtained added to that found before. This brought the values up to the following figures :—

Mixed Fatty and Resin Acids.	Resin Acids.				
	Theory.	Experiment.			
		I.	II.	III.	IV.
No.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
4	24·66	17·92	19·19	19·06	17·78
5	30·31	24·53	22·48	22·83	21·68

but it is evident that some of the aliphatic silver salts must have been extracted by the ether during the second exhaustion.

The uncertainty attending the exact correction for the solubility of the aliphatic silver salts suggests the idea of removing the bulk of the fatty acids prior to the treatment with silver nitrate. A method based on this principle has been recommended some seven years ago by Grittner and Szilazi (this Journal, 1886, 392).

(*c.*) *Grittner's and Szilazi's Modification of Gladding's Process.*—These authors dissolve the soap in 80 per cent. alcohol, neutralise, if necessary, with ammonia (of course, the same method applies to the fatty acids), and precipitate with a 10 per cent. alcoholic solution of calcium nitrate. Calcium palmitate and stearate are precipitated completely, calcium oleate to the greatest extent, whilst calcium resinate remains in solution. On adding silver nitrate to the filtrate and diluting it strongly the silver salts are precipitated ; they are filtered off and treated with ether according to Gladding's directions. The correction to be made, according to Grittner and Szilazi, is 0·016 grm. for every 10 cc. of ether used. The figures which the authors give in their original paper (Chem. Zeits. **10**, 325) speak certainly in favour of the exactness of the method, *their* differences between theory and experiment varying from −0·98 per cent. to +0·21 per cent. There is, however, no distinct statement given to the effect that the weight of the products—which are of course resin acids—have been calculated for anhydrous resin by multiplying the weights found by 0·9732. The figures, as they are given in the paper, certainly leave the impression on the reader that the actual weights obtained are considered as those of anhydrous resin and calculated as such, a procedure which is, of course, incorrect. If I look upon the weights found as those of resin acids—and the tenour of the paper undoubtedly entitles one to that opinion—and calculate from them the corresponding quantities of resin, I find a large deficit, inasmuch as only 94·3 per cent. to 97·52 per cent. of the theoretical quantity have been obtained. These large differences might be due to the correction, taken for the mixture of a large quantity of silver resinate and a small quantity of silver oleate, being such a one as if it consisted exclusively of silver oleate.

I have tried this method with the fatty acids of the abovementioned soaps, neutralising them with normal caustic potash in presence of phenolphthaleïn. Ammonia was avoided as being useless in presence of that indicator ; besides, there is no need for neutralising with ammonia. Furthermore, an excess of ammonia may easily lead to an error, as silver resinate is kept in solution by that reagent My results are given in the following tabulated form :—

Mixed Fatty and Resin Acids.	Resin Acids.				
	Theory.	Experiment			
		I.	II.	III.	IV.
No.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
3	21·45	13·25	15·78	14·96	..
4	24·66	15·77	16·41	15·27	..
5	30·31	23·96	24·11	..	..
6	39·81	35·64	36·19	*36·57	*34·97

No correction has been made for the dissolved oleate, the figures being too low already ; if the correction had been applied, the results would be still lower by several per cents. The extraction was mostly carried out in a Soxhlet tube, just like in the Hübl-Stadler process, whilst Grittner-Szilazi exhausted the silver salts in a flask. The two results marked * were obtained by that method; thus a possible objection to my figures is removed.

Another modification of Gladding's method, based on the same principle as Grittner and Szilazi's process, has been proposed by Allen, viz., to use Gladding's original method in combination with Barfoed's. The latter consists in exhausting the dried sodium salts of the mixed fatty and resin acids with ether-alcohol, whereby the resinates are dissolved easily along with part of the oleate, whilst the palmitates and stearate are left behind. The dissolved salts are transformed into the corresponding silver salts and treated with ether. Allen mentions that the combined treatment gives very satisfactory results; my experience with Grittner-Szilazi's method was not of such an encouraging nature as to induce me to try the combination of Barfoed's and Gladding's processes.

II.—Twitchell's Method.

About two years ago Twitchell (this Journal, 1891, 804) proposed a new process for the separation of resin acids from fatty acids, and the subsequent estimation of the former. His method is based on the well-known fact that aliphatic acids acted upon with hydrochloric acid gas in their alcoholic solution are transformed into their ethylic ethers, and further, on an observation made by Flückiger (Jahresberichte der Chemie, 1867, 727), that on passing hydrochloric acid gas through an alcoholic solution of colophony abietic acid is obtained. This important difference led Twitchell to the working out of a new method that gave him, to use his own words, "results" which he thinks "are impossible by any of the methods now in use." I may say *anticipando* that whilst fully concurring with that view, carefully expressed as it is, this method is not yet the final solution of the problem, and does not yet deserve the unrestricted praise which Wilson (this Journal, 1891, 952) has bestowed upon it.

In the course of a very exhaustive series of tests I have found that Twitchell's method does not give such satisfactory results as to enable one to calculate from them correctly the amount of resin used in the stock of a given soap.

I undertook therefore some experiments with a view of testing the premisses on which Twitchell's process is based. I propose to deal, under separate heads, with both the volumetric and the gravimetric methods, as recommended by their author.

(*a.*) *The Volumetric Method.*—Several brands of resin were treated according to Twitchell's directions and the resin acids estimated by titration, taking 346 as the combining equivalent of the acids which had been adopted by him. The results are tabulated below :—

Resin.	Weighed off.	Equal to Resin Acids.	Found.	Found by direct Titration without previous Treatment with HCl.
No.	Grms.	Grms.	Per Cent.	
1	2·7682	2·8444	98·39	..
1	3·7942	3·8987	94·80	..
1	3·4660	3·5614	96·65	..
1	2·5460	2·6161	100·62	..
1	3·5248	3·6219	..	86·26
2	2·7250	2·8000	92·96	..
2	2·1320	2·1907	92·40	..
2	3·0960	3·1812	87·29	..
2	2·3810	2·4466	98·42	..
2	2·1876	2·2478	..	93·93
3	2·6670	2·7405	87·09	..
3	2·1190	2·1773	95·00	..
3	3·1204	3·2063	96·96	..
4	2·8668	2·9457	98·2	..
4	2·3670	2·4322	102·3	..
4	2·8220	2·8997	95·74	..

All the titrations, I may add, were carried out with alcoholic potash.

The results suggested, in the first instance, the question whether the figure adopted for the combining weight of the resins acid, viz., 346, was correct, especially so, in view of the value of 302 given by Chenevier (this Journal, 1890, 825) and accepted by Leeds (this Journal, 1892, 308).

Adopting for abietic acid the fomula $C_{44}H_{64}O_5$, the combining equivalent for a pure resin should be $\frac{672}{2} = 336$.

I examined six different brands of American resins (as Twitchell most likely examined resins of American origin) by dissolving weighed quantities in alcohol, titrating with half-normal aqueous soda, until the end was nearly reached, and finishing with one-tenth normal alkali. The following values representing the means of several well-agreeing analyses were obtained: —

Resin.	1 gr. requires cc. 1/1 Standard KOH.	Acid Value.	Combining Equivalent.	Molecular Weight of the Anhydrous Resin.
No.				
1	2·7470	154·11	364·03	710·06
2	2·8307	159·00	352·86	687·92
3	2·8772	161·41	347·57	677·14
4	2·9119	163·30	343·42	668·84
5	2·9295	164·34	341·30	664·60
6	2·9342	164·61	340·80	663·60
		Means	348·33	

By the way, I may mention that the variations are, of course, due to varying quantities of unsaponifiable oils being contained in the resins.

It will be noticed that the average 348·33 agrees pretty closely with Twitchell's figure 346, but an easy calculation will show that for the same amount of resin used different results will be obtained according to the brand that has been worked. As a rule this will not be known, and as commercial brands vary in their composition not inconsiderably from time to time it is evident that on using the volumetric method an uncertain factor is introduced with the assumed combining weight, which may lead to an error of as much as 2 per cent. The obvious way out of this difficulty at least, viz., to separate the resin according to Twitchell from the fatty acids (*cf.* gravimetric method below) and to determine its combining equivalent, will prove of little avail.

Having obtained the above registered figures the experiments were resumed with resins No. 1 and No. 5 and a fresh brand.

Resin.	Combining Weight.	Weighed off.	Equal to Resin Acids.	Found.
No.		Grms.	Grms.	Per Cent.
1	364	2·9870	3·0693	97·85
1	364	3·4620	3·4764	94·22
2	341·3	2·4084	2·4747	95·16
2	341·3	3·5224	3·6194	99·95
3	361·6	3·2454	3·2588	99·97
3	361·6	3·0410	3·0536	102·30
3	361·6	3·0630	3·0757	102·99

In order to thoroughly test the volumetric method it was found necessary to specially prepare soaps from carefully weighed quantities of fats and resin. Average samples of the fats and resin were examined in the laboratory for the yield of fatty acids from the former and the combining weight of the latter. Without such determinations a correct calculation of the theoretical composition of the acids contained in the soap is impossible. Such an exact method was considered absolutely necessary, as variations of 2 per cent. in the result for the resin acids would indicate different qualities of soaps, when, recalculating from the analytical data, one wishes to find the amounts of fat and resin in the soap stock. Calculations of this kind are often, as I gather from published notes, carried out incorrectly.

Even in Twitchell's paper the amount of "resin"[†] contained in the acids from a soap made from 100 parts of fat and 40 parts of resin is given as 28·67 per cent. (28·57 per cent.?) instead of 30·3 per cent., which I should calculate (assuming 95 per cent. of fatty acids in the fat).

The following table contains the results of my analyses, taken at random from a larger number of tests made :—

Mixed Fatty and Resin Acids.	Resin Acids.	
	Theory.	Experiment.
No.	Per Cent.	Per Cent.
1	9·79	9·98, 9·34, *9·795, *9·91.
2	19·69	23·97, 24·55, 22·93, 23·28, 23·98, 24 08.
3	21·45	24·96, 24·78, 23·63.
4	24·66	24·89, 25·15, 25·06, 24·23.
5	30·31	29·69, 30·12, 28·18, 29·78.
6	39·81	40·24, 40·37, 41·44, 42·13, 41·8, 40·37, 42·18, 40·55, 40·07, 40·05, 43·69, 41·12, 41·81, 40·77, 44·82.
7	45·05	45·76, 46·50, 49·61, 47·66, 46·45, 47·84, 45·34, 44·24, 44·48, 44·39.

It is perhaps necessary to add that the alcohol used was absolute, as proved up the copper sulphate test; further, that the hydrochloric acid gas was dried and the temperature of the alcoholic solution kept from 55° to 60° F. For some experiments, which are marked in the table by a star, absolute alcohol, prepared from that used for the other experiments by distilling it over a little sodium, was used (although such precaution is unnecessary, seeing that water is produced by the action of the hydrochloric acid on the aliphatic acids), and the temperature was kept at 40° F. For the titrations half-normal aqueous caustic soda (finishing off with $\frac{1}{10}$ normal) was used just as by Twitchell himself. (Wilson used *alcoholic* alkali, but this is a mistake, as there may be some danger of saponifying the ethylic ethers of the fatty acids.) It is hardly necessary to lay stress on the fact that every trace of mineral acid was removed before the solution of ethylic ethers and resin acids was titrated.

It may be pointed out that the experiments agree best with the theory for a soap of very low percentage of resin, and for the soap containing 30·31. In nearly most cases the figures found are too high, and it was naturally suspected that a small quantity of the *fatty* acids might have escaped etherification which would account satisfactorily for the larger amount of standard alkali used in the titration.

I examined therefore pure stearic, pure oleic, and a mixture of tallow and cocoanut-oil acids in a similar way, with the result given in the following table :—

Fatty Acid.	Substance used.	1/1 KOH used.	The KOH calculated for Resin Acid, Combining Weight 340.
	Grms.	Cc.	Per Cent.
Stearic acid.............	2·9404	0·16	1·85
„	2·9728	0·20	2·287
„	3·2584	0·23	2·40
Oleic acid...............	3·7120	0·55	5·037
„	3·8840	0·60	5·25
Tallow and cocoanut-oil acids.	2·8935	0·54	6·35
„ „	3·0505	0·57	6·3
„ „	2·8792	0·46	5·4
„ „	3·8290	0·56	4·97
„ „	3·6914	0·54	4·9
„ „	2·7040	0·415	5·2

Here is undoubtedly a source of error, and I hasten to add that Twitchell, who has carried out *one* experiment with distilled fatty acids, found 0·97 per cent., and Wilson, who has also used distilled fatty acids, 0·7 per cent. only. But this same error will necessarily occur in the gravimetric analysis, the first stage of which is exactly the same, and as it will be seen further on that the results of the gravimetric method are *below* the theoretical ones, another explanation has to be found. It appears not unlikely—a conjecture that will be supported or rejected by further experiments—that part of the resin undergoes decomposition under the severe action of the hydrochloric acid, giving rise to the formation of acids of lower molecular weight, and perhaps also of products of condensation that are calculated as resin acids.

The experiments tabulated below for varying mixtures of oleic acid and resin will serve to support this attempt at an explanation :—

Oleic Acid.	Resin.	Equal to Resin Acids.	1/1 KOH used.	Mixture contains Resin Acids. Combining Weight 346.		Calculated for the Yield of Resin Acids only.	
				Theory.	Experiment.	Theory.	Experiment.
Grms.	Grms.	Grms.	cc.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
2·5096	0·8027	0·8248	2·4	24·736	24·90	100·0	100·60
2·3988	0·8167	0·8391	2·56	25·92	27·35	100·0	105·50
1·5638	1·5532	1·5960	4·41	50·51	48·40	100·0	95·60
1·4006	1·5202	1·5620	4·19	52·72	48·93	100·0	92·81
0·8918	2·5198	2·5892	6·68	74·38	66·397	100·0	89·47
0·8296	2·5298	2·5995	6·72	75·81	67·81	100·0	89·45

(*b.*) *The Gravimetric Method.*—The uncertainty as to which combining equivalent to use for the resin acids adheres to the volumetric method only and disappears in the gravimetric process. There the mixture of ethylic ethers and resin acids, dissolved in petroleum ether, is shaken with a very dilute solution of potash, which is supposed to dissolve only the resin acids; the resin soap thus obtained is decomposed and the separated resin acids are weighed. Before giving the results of my experiments it may be as well to point out that the separation of the soap from the petroleum ether layer (which contains the ethylic ethers) may cause a good deal of trouble, an emulsion appearing between the two layers, which refuses to disappear on shaking. Careful addition of a small quantity of alcohol helps a little, but too much of it must not be used as there is the danger of partially saponifying the ethylic ethers of the fatty acids. The higher the melting-point of the fatty acids the more persistent is the emulsion;

[†] Twitchell evidently means resin acids and not resin. But even for anhydrous resin 28·67 would not be correct, 29·49 being the theoretical value in that case.

even with resin alone such troublesome emulsions occur. Therefore repeated washings of the petroleum ether layer are required, but also here a source of error creeps in, experiments with pure ethylic stearate and ethylic oleate having shown me that on shaking them with highly diluted alkali slight but appreciable hydrolysis takes place. As a general rule it may be stated that the more troublesomely the emulsion behaved, the lower I found the results. The best way to avoid the emulsion is to use an excess of KOH, say 100 cc. instead of 50 cc., as Twitchell prescribes.

The following table corresponds to one given above, and contains the gravimetric analyses of the mixed fatty and resin acids from the soaps.

Mixed Fatty and Resin Acids.	Resin Acids.	
	Theory.	Experiment.
No.	Per Cent.	Per Cent.
1	9·79	*9·38, *9·97.
2	19·69	20·46. 20·55. †19·96, 19·99, 19·44, 19·33.
3	21·45	19·25, 18·27, 19·37, †17·83, *19·54, *18·61, *18·57. *19·16.
4	24·66	20·97, 16·65, 21·76.
5	30·31	25·76, 25·06, 23·66, 26·10.
6	39·81	35·97. 38·86, 36·44. 36·14, 35·42, 35·86, 32·51, 36·29.
7	45·05	37·58, 37·23, 37·29. 36·97. 35·32. 40·06, 36·8.

† Strong emulsion.

The experiments marked with a star were carried out at 40° F., and with absolute alcohol distilled over a little sodium.

My results do not differ from those obtained by Twitchell, for he finds instead of 30·3 per cent., 25·7 per cent., and for a mixture of 80 parts of fatty acids and 20 parts of resin (20·4 resin acids) 18·93 per cent.

The results found by the gravimetric method are, as a rule, too low, except for the smallest percentages of resin. It must, however, not be forgotten, that the fatty acids themselves contribute part of the weight found at the final stage, as a glance at the subjoined table will show. This table contains "blank" experiments with stearic, oleic, and a mixture of fatty acids; they give an indication as to the amount contributed by the fatty acids. This quantity may, however, be more than compensated by some unsaponifiable matter occurring in the resin and therefore remaining in the petroleum ether.

Fatty Acid.	Substance used.	Quantity found.	Per Cent.
	Grms.	Grms.	
Stearic acid	3·3810	0·0362	1·07
"	2·8430	0·0290	1·02
Oleic acid....................	3·8190	0·1392	3·65
"	1·6260	0·1700	3·67
Tallow and cocoanut-oil acids.	3·0676	0·0787	2·56
" "	3·7287	0·1037	2·78
" "	3·0712	0·0804	2·62

Further, some mixtures of oleic acid and resin were prepared (cf. above) and analysed with the following result. I also add three analyses carried out with resin alone:—

No.	Oleic Acid.	Resin.	Equal to Resin Acids.	Found Resin Acids.	Mixture contains Resin Acids.		Calculated for Yield of Resin Acids.	
					Theory.	Experiment.	Theory.	Experiment.
	Grms.	Grms.	Grms.	Grms.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	2·4666	0·8199	0·8425	0·7385	25·46	22·32	100	87·65
2	2·8058	0·8577	0·8812	0·7736	23·90	20·98	100	87·80
3	1·6465	1·5342	1·5765	1·3200	48·91	40·96	100	83·73
4	1·4090	1·5092	1·5508	1·3128	52·39	44·35	100	84·65
5	0·8600	2·5252	2·5948	2·0930	75·11	60·58	100	80·66
6	0·8430	2·5322	2·6019	2·1744	75·53	63·12	100	83·56
7	..	4·2524	4·2701	3·5631	..	..	100	83·44
8	..	4·6864	4·7058	3·8334	..	..	100	81·46
9	..	4·6700	4·6894	3·8979	..	..	100	83·12

The experiments under 7, 8, and 9 show a considerable deficit. Twitchell has also instituted such a crucial experiment, recovering from 5 grms. of resin 4·9382 grms. of resin acids; but it must be observed that he did not go through the whole of his gravimetric process as he should have done, but contented himself with dissolving the resin acids, immediately after their treatment with hydrochloric acid gas, in ether. This procedure may effectually mask any decomposition the resin may have undergone, as the ether is likely to extract from the acid water any substances (or any way, part thereof) that may have passed into it.

I have repeated Twitchell's experiments in his own way, and obtained, of course, the same favourable results.

No.	Resin.	Equal to Resin Acids.	After Exhaustion with Ether. Found Resin Acids.		The resulting Acids titrated with 1 1 KOH calculated for Combining Weight 361·6 corresponds to
	Grms.	Grms.	Grms.	Per Cent.	Grms.
1	4·7560	4·7757	4·7306	99·05	4·5995
2	4·6220	4·6411	4·5664	98·39	4·4187

After comparing the results obtained in the last two tables, it became necessary to look for the loss in two directions. *Firstly*, the petroleum ether might not have become completely freed from the resin acids, although a large excess of caustic alkali had been used. Therefore, the petroleum ether layer was again shaken with the dilute alkali solution and washed. The following quantities were obtained :—

No.	Grms.	Per Cent.	This brings up the Total to
			Per Cent.
7	0·0072	0·17	83·61
8	0·0154	0·33	81·79
9	0·0138	0·29	83·41

Secondly, some products of decomposition might have passed into the aqueous acid layer and not have been exhausted by the petroleum ether. Therefore that layer was shaken out with common ether, the ether evaporated, and the residue weighed. The results are tabulated below :—

No.	Extracted by Ether.		This brings up the Total to
	Grms.	Per Cent.	Per Cent.
7	0·1193	2·796	86·41
8	0·2320	4·930	86·72
9	0·1425	2·850	86·26

It is evident that not inconsiderable quantities escape the exhaustion with petroleum ether, thus vitiating the results obtained by the gravimetric process.

For the remainder of the loss I am at present unable to account in a satisfactory way.

Finally, I have repeated some of the tests tabulated above, this time, however, exhausting the acid layer with common ether and repeating the washing of the petroleum ether layer with alkali.

I may add, that on using a large excess of caustic potash in washing the petroleum ether, the formation of an emulsion was completely avoided in these experiments.

Mixed Fatty and Resin Acids.	Resin Acids.				
	Experiments.				
	Theory.	Extracted by First Alkali Wash.	Extracted by Second Alkali Wash.	Extracted by Ether.	Total.
No.		Per Cent.	Per Cent.	Per Cent.	Per Cent.
2	19·69	19·46	0·115	1·045	20·62
2	19·69	18·44	0·074	0·822	19·34
3	21·45	19·14	0·105	0·3615	19·607
3	21·45	19·19	0·061	0·2839	19·48
4	24·66	21·72	0·179	1·203	23·102
4	24·66	22·29	0·239	1·01	23·54
5	30·31	25·75	0·019	2·41	28·18
5	30·31	26·93	0·085	0·72	27·73
6	39·81	34·96	1·296	1·567	37·80
6	39·81	34·596	0·190	1·12	35·91

These last results do not differ materially from those recorded above.

Discussion.

Mr. A. H. Allen wrote that he had used for the estimation of resin in soap the combination of Barfoed's and Gladding's processes described in Vol. II. of his "Commercial Organic Analysis." Barfoed's treatment removed the greater part of the fatty acids as sodium soaps and rendered the subsequent precipitation by silver much easier and more effective. But this process had now been wholly superseded by Twitchell's method of converting the fatty acids into ethyl salts by passing HCl gas through their alcoholic solution, the resin acids not undergoing a like change. This method was much simpler than the Barfoed-Gladding process and gave as good or better results in the end.

Mr. Richardson had found, in using Gladding's method, that the results varied very much with the assumption made as to the amount of silver salt dissolved in the alcohol ether used, but that, by making a separate estimation of this amount, and introducing the corresponding correction, very fair results could be obtained. Cholesterin was sometimes present in soaps, and unless this were thoroughly removed by repeated washings with an ethereal solvent it would appear as resin.

Mr. Fairley asked if the alcohol and hydrochloric acid gas used were free from water, and

Mr. Procter remarked that water was formed, together with the ether of the fatty acid, in the same reaction.

Dr. Lewkowitsch, in reply, said that the very high percentage of fatty acids sometimes found in household soaps was due to their having dried in the shop window; it was impossible to get them in the pan with more than 63—64 per cent. For the same reason the percentages of resin given by analysts was often valueless. Alder Wright has stated that 10 cc. of alcohol ether dissolved 1·2 mgrm. of silver oleate; he had found 10 times that amount to dissolve, but had worked in a slightly different way. Resin could be detected by the acetic anhydride and sulphuric acid test; cholesterin gave the same reaction, but being unsaponifiable could be removed first. He had used at first absolute alcohol only, such as gave no blue colour with copper sulphate, but had employed for some tests some perfectly anhydrous alcohol prepared by distillation off sodium.

Obituaries.

WILLIAM FOSTER, M.A., F.C.S.

Lecturer in Chemistry in Middlesex Hospital.
Member of the Society of Chemical Industry.

Those who had heard the courteous words of Mr. W. Foster when speaking in the discussion at the very last meeting of the London Section, and had seen him in apparent full health and vigour, were scarcely prepared for the shock they received at the subsequent meeting on hearing that in the interim the speaker had been suddenly called away by death. A severe attack of double pneumonia caused the gravest apprehensions from the first, and though a strong man and in his 48th year, Mr. Foster succumbed to the severity of the attack in little more than two days.

William Foster's native place was Skipsea, near Hornsea, in Yorkshire. Besides being Lecturer in Chemistry in Middlesex Hospital, to which post he was appointed in 1876, he was for some time one of the gas examiners for the City of London. He was well-known to the gas engineering profession of the United Kingdom for the interest he took in photometry and the chemistry and technology of gas manufacture. Mr. Foster was a frequent contributor of papers to technical societies and a well-known figure at the meetings of the Gas Institute. For some years he was examiner in chemistry at the Royal College of Physicians. He received a

Telford gold medal and premium from the Institution of Civil Engineers for a detailed account, published in 1884, of researches extending over three years, "On the Composition and Destructive Distillation of Coal." This paper or report, however, was to a considerable extent founded on a paper published in the Journal of the Chemical Society in 1883, pages 105 to 110 (this Journal, 1883, 227), in which the important subject of the fate of the nitrogen during the different phases of the distillation of coal is treated in a masterly way. The important result was arrived at that of the total nitrogen in coal only about 14 per cent. are recovered as ammonia.

In collaboration with Mr. Dibdin, Gas Examiner to the London County Council, William Foster was appointed to investigate and report on the gas-lighting apparatus of the Crystal Palace International Electric and Gas Exhibition of 1882—1883.

The writer is informed that after his appointment at Middlesex Hospital in 1876, Mr. William Foster threw himself heartily into the work of his classes, and has always taken a great interest in his students generally. On Friday, the 26th of May, the day of his funeral, the Medical School of the Middlesex Hospital was closed for that day as a tribute of respect to the deceased lecturer.—W. S.

E. A. COWPER, M.Inst. C.E.

Formerly President of the Institution of Mechanical Engineers, etc.

It will be remembered as a melancholy circumstance that Mr. E. A. Cowper, who read his first and last paper before the London Section of this Society at the recent April Meeting, dealing with a subject which had formed almost a life study—just on the eve of his election, as a member of our Society—has been suddenly carried off by death. This happened on May 9th at his house at Weybridge; a cold had developed into pneumonia, and cardiac failure supervening, the end rapidly came.

But a few weeks ago, Mr. Cowper had made formal arrangements for taking his son, Mr. Charles E. Cowper, into partnership, and his friends hoped that in this way he was about to enter into a period of well-earned rest. This was the more necessary as the weight of seventy-three years of very active life had begun to press heavily upon him.

Mr. Cowper has been a Member of Council of the Institution of Civil Engineers, a member of the jury at the Inventions and the Mining and Metallurgical Exhibitions, a judge of the Royal Agricultural Society in 1868 and 1870, and one of the committee of advice at South Kensington with regard to the models.

The signal acts of Mr. Cowper's career though were those concerned with the founding of the Institution of Mechanical Engineers in 1847, the designing of the fresh exhibition buildings of 1851, the invention of the regenerative firebrick hot-blast stove in 1857, the invention of the steam-jacketed receiver for the compound engine and the writing telegraph in 1879. On the invention of the regenerative furnace by Sir (then Mr.) Wm. Siemens, Mr. Cowper traced its applicability to the purpose of heating the blast of blast-furnaces, and in 1857 he took out a patent on this subject, following it up by others, the latest of which bears the date of 1887. At the present date there are more than five hundred of the Cowper's stoves in operation.

Mr. E. A. Cowper was born in the year 1819, and was thus in his 74th year. During his long career he was not only associated in earlier life with the late Sir William Siemens, but also with the late Dr. James Young of Wemyss Bay, N.B. (this Journal, 1893, 311), in various schemes of manufacture or invention. It may be of interest to mention that the father of Mr. E. A. Cowper, Mr. Edward Cowper, was formerly Professor in the Engineering Department of King's College, and was also one of the early improvers of the printing press.—W. S.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Improvements in Apparatus for Boiling, Distilling, and Steam-raising. J. Laing, Edinburgh. Eng. Pat. 7450, April 20, 1892.

The specification describes a boiler in cross section like an upright cross. The steam is drawn off from the top portion, the heat being applied to the arms, whilst sedimentary or precipitated substances fall into the tail piece and can be drawn off.—H. K. T.

Improvements in Rotary Apparatus for Drying, Burning, and Roasting Lime, Cement, Plaster of Paris, Colours, Ores, Chemical Products, and other Materials. J. C. Fellner and C. Ziegler, Bockenheim, Germany. Eng. Pat. 7922, April 27, 1892.

The improved apparatus is intended for drying or heating substances, either by conduction or by a current of hot air or other gas. The material is passed by an elevator *a* to a rotating tube A, through which it passes. This tube has a number of trough-shaped channels fixed to its sides, which raise the material to the highest point of the tube and then allow it to fall. The inclination of the tube is capable of adjustment. Hot gases from a furnace enter at *i* into the chamber i^1, where they heat the tube A and then pass through the tubes *h* of an air-heater D to h^1, whence they pass to the chimney. Air or other gas is driven by a fan through *l*, and passes through the air-heater D to the flue *m*, which conveys it to the chamber *c* and tube A, from which it issues into the chamber *s* and escapes through *n*. The cold air before it enters *l* passes through a passage into which the hot materials from the chamber *c* are being discharged, and so becomes heated by the waste heat. In the same way the hot air issuing from B heats the cold material in the chamber *s*.

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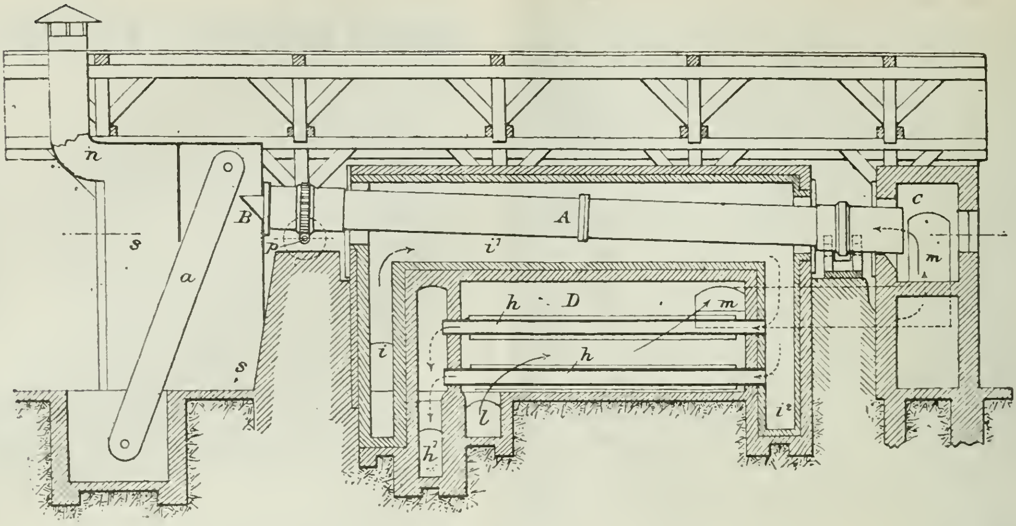
* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.



ROTATORY APPARATUS FOR DRYING, &c. —H. K. T.

An Improved Meter for Estimating the Volume and Density of Liquids. A. V. L. Bedout, Paris. Eng. Pat. 8272, May 2, 1892.

THE object of this invention is to determine automatically the total volume and average density of the alcoholic liquid issuing from or passing into a still. The apparatus employed for the purpose consists of a "Robertsval" or "Béranger" balance, each pan of which carries an open cylindrical vessel of known capacity (say 10 litres). The alcohol issuing from the still is discharged into a shallow tank (holding 50 litres) arranged above the balance, flows thence through a valve-tap into one of the abovementioned cylinders, and then by means of a horizontal overflow pipe into the second vessel. So soon as both cylinders are full the balance swings and comes to an equilibrium, and in so doing actuates a number of levers, by means of which — 1. The alcohol supply valve is closed; 2. The second cylinder is tipped over, emptied, and again righted; 3. A sample of the discharged spirit is retained in a small tube of known capacity (10 cc.); 4. The index of a dial-plate is moved on by one unit. The second cylinder being emptied, the other side of the balance again descends, reopens the alcohol tap, and at the same time allows the "sample" to flow into a gauged collecting vessel ("totaliser"). The above cycle of operations is repeated over and over again during the course of the distillation. At the finish the total volume of spirit that has passed through the apparatus is known by the state of the index, and its average strength (and volume also) by an observation of the density of the liquid collected in the "totaliser."
—H. T. P.

Improvements Relating to Filtering Apparatus for Saccharine and other Liquors. G. F. Redfern, Finsbury. From W. P. Abell, Essequebo, British Guiana. Eng. Pat. 8773, May 9, 1892.

A HERMETICALLY closed vessel of any suitable form, provided with a number of filtering plates or diaphragms wrapped in filtering cloths or other suitable medium, is employed. Through the centre of these plates passes a shaft carrying a series of arms or scrapers, one of which revolves between each pair of adjacent plates. The liquor percolates through these plates in the usual manner, but instead of the spaces becoming choked with the residue it is scraped away by means of the arms, the deposit being dropped on to a screw or other suitable conveyor, which carries it to an outlet. To operate the scrapers a ratchet wheel worked by the pump supplying the filter is employed. In some cases the scrapers are fixed and the filtering diaphragms are revolved. In the case of bag or stocking filters a ring scraper traversing the whole length is used.
—J. C. C.

Improvements in Apparatus for Evaporating, Concentrating, and Distilling Liquids. W. I. Mirrlees and D. Ballingall, Glasgow. Eng. Pat. 9499, May 19, 1892.

IN this apparatus the liquid is heated in tubes placed horizontally or at an inclination and arranged in a heating chamber. The liquid is fed into the lower tubes, and, passing with the vapour upwards from one series of tubes to the other, is at last discharged into a vessel at one end of the heating chamber, where the vapour is separated from the liquid, which latter is returned wholly or in part to the lower tubes so as to repeat the process and thus continue the evaporation. Various modifications of the plant are described.—J. C. C.

Improvements in Vessels or Bottles for Containing Gas under Pressure. C. T. Cayley, London. Eng. Pat. 9713, May 21, 1892.

THE bottoms of metal bottles for containing compressed gas are made sufficiently thick to allow of the metal being cut away so as to form a flange. This flange at first forms a continuation of the cylindrical surface of the bottle, but it is afterwards bent outwards at four equi-distant points so as to form a square base for the bottle, which consequently stands more steadily. The projections also prevent rolling when the bottle is placed on its side. The tap or valve is fitted direct into the neck of the bottle, and is protected by a cap, which is screwed on to the neck. The latter may also carry a flange having four projections.—H. K. T.

Improvements in Apparatus for Evaporating or Concentrating Alkaline or other Solutions. A. Chapman, Liverpool. Eng. Pat. 10,595, June 3, 1892.

IN evaporating or concentrating apparatus constructed and working on the multiple-effect system, an additional evaporating vessel is so connected with the last vessel of the series that the pressures in the two vessels are equal, and the liquor flows into the auxiliary from the last vessel, the drum of the former being supplied with steam direct from the steam boiler, or of higher pressure than that in the drum of the latter, whereby this latter is, as it were, "compounded."—J. C. C.

Improvements in or connected with Filters. J. G. Lorrain, London. Eng. Pat. 11,386, June 17, 1892.

This is an electrolytic filter, the improvements having reference to the electrodes, of which seven different modifications are described. In most cases, when the filtering material is a conductor, it is used as one of the electrodes.
—J. C. C.

Improvements in Filters. B. M. Santurio, Buenos Ayres, Argentine Republic. Eng. Pat. 11,816, June 24, 1892.

The permeable vessel in this filter (one of what are known as earthenware filters) is in the form of a cylinder, having hollow longitudinal webs, the filtered water percolating through the walls of the vessel into the spaces in the hollow webs, whence it is conducted to a suitable outlet. The filter is cleansed by means of sand carried up the bore of the vessel from a space near the inlet by the incoming water, the sand thus carried up falling down outside the permeable vessel into the space provided, ready to be carried up again by the incoming water, all parts of the filtering surface being thus subjected to the action of a continual stream of sand. A base or support and other accessory parts are also described and claimed.—J. C. C.

An Improved Method of and Means for Filtering Liquids. B. M. Santurio, Buenos Ayres, Argentine Republic. Eng. Pat. 12,123, June 29, 1892.

In this method the liquid to be filtered is conducted to a revolving vessel having sides of permeable earthenware, through which the liquid is urged by centrifugal force and then caught in a casing and conveyed to a suitable reservoir. The revolving vessel is mounted on a hollow shaft, which serves as the inlet. Sand or other cleansing material is placed inside the vessel. Means are also provided for washing out the receptacle.—J. C. C.

Improvements in Filtering Apparatus. H. Kohl, Euskirchen, Prussia. Eng. Pat. 18,552, October 17, 1892.

The inventor claims "a continuous working rotation mud-press with automatic mud remover, consisting of first-filters with several compartments, rotating in a tank, which conduct the pure juice through the hollow axle alternately from the right and from the left to the after-filters, which also consist of several compartments, which are disconnected and turn on the axle, while the mud, remaining in the first-filter tank, is intermittently removed by transport-spirals."
—H. K. T.

II.—FUEL, GAS, AND LIGHT.

PATENTS.

Improved Means for Obtaining Cyanides from Illuminating and Heating Gas. W. Foulis, Glasgow. Eng. Pat. 9474, May 18, 1892.

The gas, scrubbed free from ammonia, is brought into intimate contact with a solution of the carbonate of an alkaline metal, in which "carbonate of iron," or ferric oxide, is suspended, the proportions used being given. The liquid can be withdrawn from time to time from the absorbing apparatus, to be evaporated to dryness. The resulting mass is lixiviated, and the solution is concentrated to obtain sodium or potassium ferrocyanide (Na_2FeCy_3 or K_2FeCy_3) as the case may be. The "carbonate of iron" used in the process is obtained by precipitating "chloride of iron" by soda-ash, both taken in stated proportions.

Two methods are described for bringing the gas into contact with the reacting solution, so that the contained "cyanides" may produce ferrocyanides in the solution. According to one of these methods, the gas is brought into contact with "large surfaces wetted with the mixture, the carbonate or oxide of iron being kept in suspension by mechanical agitation." The other method consists in leading the scrubbed gas into the bottom compartment of a chamber having several horizontal partitions or shelves, each provided with a number of short pipes for passage upwards of the gas, each pipe having a loosely fitting hood. The top compartment has a valved opening into the "mixer," a cylindrical vessel into which the described mixture is poured, and wherein it is kept agitated by a rotating shaft carrying suitable blades. The "mixture" descends into the chamber from shelf to shelf, in a continuous or intermittent stream, and as it becomes charged with the cyanides from the gas, may be led off through a series of connected taps. The outlet for the purified gas is in the side of the highest compartment.—E. S.

Improvements relating to the Collection of Ammonia and Ammoniacal Salts from Gaseous and Liquid Mixtures. E. de Cuyper, Mons, Belgium. Eng. Pat. 13,686, July 27, 1892.

Lighting gas is purified by passing it through peat, used as a filtering medium, ammonia, ammoniacal salts, and other matters being retained. The products of distillation from ammoniacal liquors may be similarly treated. By heating the charged peat in a suitable vessel to 30°—40° C., ammonia distils off, empyreumatic products and salts remaining in the peat, provided the temperature is kept below 80° C. Peat may also be saturated directly with ammoniacal liquors, and then heated in a "water-bath" or otherwise, to distil off pure ammonia. The peat used in any of these processes, and still retaining some ammoniacal salts, is applied as a manure.—E. S.

Improvements in the Manufacture or Production of Illuminating Gas from Liquid Hydrocarbons, and Apparatus therefor. V. B. Lewes, Greenwich, London. Eng. Pat. 16,258, September 10, 1892.

A mass of coke is brought up to incandescence in a suitable furnace, and liquid hydrocarbons are then blown in by means of superheated steam, the air supply being cut off. The steam reacts with the coke in preference to the oil, producing water-gas, which dilutes and protects the vaporised oil, so that the "cracking" does not go on too far. The injection of steam and oil is continued until the temperature of the coke has fallen so low as to be no longer serviceable, when the hydrocarbon gases are swept out of the apparatus by the opening of a steam jet farther down in the furnace. Air is then admitted, with the result that the coke is again brought up to incandescence, any deposited carbon being burned away. The hydrocarbon gas on leaving the generator passes through a fixing retort maintained at a temperature of about 1000° C. The progress of the reaction is determined by allowing a small portion of the hydrocarbon gas as it leaves the generator to escape into the air through a jet. It should have a brown colour. If white, it shows that the steam is in excess, whilst if black and "sooty" too little steam has been employed. (See Eng. Pat. 21,598 of 1891; this Journal, 1893, 437.)—H. K. T.

Improved Incandescent Mediums for Purposes of Illumination. H. Hirschfeld, Berlin, Germany. Eng. Pat. 2689, February 7, 1893.

Organic or inorganic filaments or fibres are prepared with salts of lime or heavy metals capable of decomposition at an incandescent heat, "such as iron, platinum, manganese, chromium, cobalt, nickel, zinc, cadmium, tin, lead, copper, antimony, bismuth, mercury, silver, and gold," and converted by incandescence into non-combustible combinations retaining the previous solid form and shape. These, under the influence of an "opaque flame," will emit a brilliant incandescent light.—H. K. T.

Process of Manufacturing Gas. W. F. Ritchie, London. From J. B. Archer, Washington, U.S.A. Eng. Pat. 6142, March 22, 1893.

Superheated steam is mixed with oil vapour and passed through a fixing retort into a chamber filled with a chequer-work of bricks containing embedded particles of iron, where it is burnt, the products of combustion being allowed to escape. When the chamber is sufficiently hot the air supply is cut off, and the proportion of oil vapour at the same time decreased. The steam now reacts with the oil vapour and with the iron in the lower part of the chamber, producing hydrogen and iron oxide. At the middle of the chamber the hydrogen meets with a further supply of oil-gas from another retort, by which it is enriched and the two pass on over the iron in the upper part of the chamber and are purified from sulphuretted hydrogen and phosphuretted hydrogen by the iron. The gases are then scrubbed in the usual way. When the chamber has cooled, air and oil gas are again admitted at the bottom of the chamber, with the result that it is reheated and the iron oxide reduced.

—H. K. T.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Preparation and Constitution of Para-Anthracene. C. E. Linebarger. Amer. Chem. J. **14**, 597—602.

In order to ascertain the action of sunlight on anthracene dissolved in various solvents, somewhat more anthracene than could be dissolved was added to each solvent, so that as the para-anthracene separated, more anthracene would dissolve, the object being to avoid the use of a large bulk of liquid. The exposure lasted about two months, after which the precipitates were filtered off and washed with some of the pure solvent. With benzene, toluene, xylene, ethylbenzene, alcohol, glacial acetic acid, ethyl benzoate, benzene bromide and chloroform, para-anthracene was formed, generally in well-defined but varying crystals; the solvent remained colourless in the case of the first four solvents, was yellow in the case of the next four, whilst the chloroform solution was quite black. When ethylene bromide and carbon bisulphide were employed as solvents the solution became almost black and quite black respectively, but anthracene was recovered unchanged. The most suitable solvent proved to be xylene.

As regards the constitution of para-anthracene, which has a molecular mass double that of anthracene, it contains a ring of four carbon atoms occupying the γ-position with respect to the anthracene molecule. No addition- or substitution- products of this ring have as yet been obtained, but it may be possible to substitute bromine by means of the Friedel-Crafts reaction.—N. H. J. M.

The Products of Condensation of Acetone with Concentrated Sulphuric Acid. W. R. Orndorff and S. W. Young. Amer. Chem. J. **15**, 1893, 249—276.

The following is a summary of the results of the authors' researches on the products of the condensation of pure acetone with concentrated sulphuric acid:—

1. Mesitylene is formed in largest quantity, over 11·5 per cent. of the theoretical yield having been obtained. These results are not in accord with the statement of Victor Meyer, based on Bielefeldt's work, that mesitylene is not formed from pure acetone, but only from the commercial product by condensation with sulphuric acid, nor do they agree with Jacobsen's assertion that if pure acetone be used no products of higher boiling points than mesitylene are formed. The authors not only positively assert that the purest acetone does yield mesitylene, but they recommend the use of this reaction as the best method known at present for the preparation of mesitylene.

2. A not inconsiderable quantity of the hydrocarbon isodurene (unsymmetrical tetramethylbenzene) is formed in conjunction with the mesitylene.

3. A compound boiling at 185°—187° and having the formula $C_{14}H_{22}O$ is a constant product of this reaction.

4. A hydrocarbon boiling at 280°—282° and having the formula $(C_3H_4)_5$ can be isolated from the tarry products.

5. Propane is formed in small quantity.

6. Besides the five products above named, sulphurous anhydride, acetic acid, mesityl oxide, phorone, and sulphur compounds are produced. Regarding the formation of mesitylene from acetone the authors are of opinion that it resembles very closely that of ethylene as obtained from ethyl alcohol by the action of sulphuric acid.—D. B.

Methylnaphthalenes. G. Wendt. J. Prakt. Chem. **46**, 1892, 317—327.

The separation of the α- and β-methylnaphthalenes was effected by cooling the mixture obtained from coal-tar creosote oil (Schulze, this Journal, 1884, 410) until the mass solidifies. It is then heated gradually and the α-methylnaphthalene melted out. This process is repeated until the melting point of the more fusible portion no longer varies. The proportion of solid and liquid material obtained from the oil in this manner was 2:5, whilst Schulze gives the proportion of about 3:2.

α-Methylnaphthalene is a pale yellow, mobile oil, stable in air and light. It melts at − 22°, boils between 240°—243° (759 mm. mercury column in vapour). Its sp. gr. is 1·0005 at 19°. The oil dissolves readily in alcohol and ether, sparingly in water, and is volatile with steam. It is a good solvent, strongly refractive, non-fluorescent, and a bad conductor. It has an aromatic naphthalene-like odour and a burning soapy taste.

β-Methylnaphthalene crystallises from alcohol in the form of transparent laminæ. It is readily soluble in such solvents as alcohol, ether, chloroform, benzene, &c., melts at 32·5°, and boils between 241°—242° (mercury column in vapour; 759 mm.).

On sulphonation two monosulphonic acids are yielded by each compound, which may be separated by the difference in the solubility of the respective barium salts, one of which is about six times as soluble as the other. The solubility of the barium salt of β-methylnaphthalene sulphonic acid is about one-half that of the α-methylnaphthalene sulphonate.

—D. B.

A New Collidine. F. Auerbach. Ber. **25**, 1892, 3485.

Aldehydecollidine may now be produced in quantity by Dürkopf and Plath's process from aldehyde-ammonia and paraldehyde. This base was formerly viewed by Wischnegradsky as trimethylpyridine; subsequent investigations made by Dürkopf and Schlaugk have, however, shown this view to be incorrect, and the base is now generally regarded as α-methyl-β^1-ethylpyridine. On subjecting a large quantity of aldehydecollidine to the action of a 2 per cent. solution of potassium permanganate in the cold, the author obtained, besides methylnicotinic and isocinchomeronic acids, other oxidation products, the composition of which was not consonant with the constitutional formula of collidine.

By the aid of mercuric chloride the author succeeded in detecting two substances in aldehydecollidine. It was found necessary to employ an excess of reagent. A crystalline compound is then obtained, which when recrystallised from hot water yields fine rhombic tablets, melting at 168°. The pure base separated therefrom boils at 173°—174°, and has a specific gravity of 0·9369 at 0°. The new base, the mercury salt of which melts at 116°, is isomeric with collidine. It boils at 177°, does not resemble collidine in odour, but has a smell approaching more closely to that of the lower homologues, and is slightly soluble in water. The hydrochloride forms deliquescent needles, the platinochloride crystallises in pale orange-red rectangular tablets melting at 183° with violent evolution of fumes.

If the acids described are formed, then it follows that the new base must be a trimethylpyridine, and as the symmetrical compound is already known, the base in question must be unsymmetrical trimethylpyridine. (See Lunge's "Coal Tar and Ammonia," pp. 153 and 718.)—D. B.

Animal Charcoal. Zapiski. Bull. Soc. d'Encouragement, 1892, 834.

See under XVI., *page* 532.

PATENT.

An Improved Meter for Estimating the Volume and Density of Liquids. A. V. L. Bedout, Paris. Eng. Pat. 8272, May 2, 1892.

See under I., *page* 510.

IV.—COLOURING MATTERS AND DYES.

Cascarin. Leprince. Comptes rend. **115**, 286—288.

The bark of *Rhamnus Prushiana*, known in Spain as *Cascara sagrada*, contains a substance for which the name of *cascarin* is proposed. It has the same composition as rhamnetin, the colouring matter of Persian berries (from *Rhamnus infectoria*, &c.), and closely resembles it, but it has not yet been determined whether the two bodies are identical.

It is isolated in the following manner:—The crushed bark is boiled with a dilute solution of sodium carbonate, and the decoction obtained slightly acidified with sulphuric acid, a voluminous precipitate being produced, which is filtered off. The filtrate is evaporated and the extractive matters which separate as it becomes concentrated, collected, redissolved in dilute soda, and again treated with acid in slight excess. A mixture of cascarin and the compounds formed from it by oxidation and hydration, is precipitated. From this mixture, after drying at 50° C., the cascarin is extracted with acetone, the solution being treated with sulphuric acid and then poured into a large volume of hot water. After 24 hours' repose the olive deposit which has formed is collected, and the process of purification is repeated until the matter which separates ultimately consists of minute needles of an orange-yellow colour. The product has the formula $C_{12}H_{10}O_5$. It is readily soluble in alcohol, less so in chloroform, and insoluble in water. Alkalis dissolve it with a red-purple colour. When heated it darkens at 200° and decomposes at about 300° C. It yields phloroglucol when fused with potash.—E. B.

The Action of Alkalis on Indigo. K. Heumann and F. Bachofen. Ber. **26**, 225—229.

Heumann has already given it as his opinion (Jour. Prakt. Chem. 43, 111) that the brown-red mass formed on heating indigo with alkalis contains indoxyl and not leuco-indigotin as supposed by Gerhardt (Rev. scient. **10**, 371). The present research fully confirms this.

The indigotin used in the experiments was prepared by precipitating a mixture of that substance and indirubin from an indigo-vat and extracting with hot alcohol as long as the solution obtained showed traces of red colour. The residue was dried at 110°. Portions of it were mixed with 10 times their weight of finely-powdered potassium hydroxide and heated at the melting point of the latter until the mass acquired a uniform red-orange or brown colour. The product, after cooling and breaking into small pieces, was placed on a separating-funnel into which a little glass wool had been previously put. To exclude air a layer of benzene 1 cm. deep was poured into the funnel and then sufficient water to dissolve the melt, a solution of an olive-yellow colour, like that of an indigo-vat, being thus obtained. On exposure to air a bronzy pellicle of indigo formed on the surface, but when the solution was poured into dilute acid, with exclusion of air, no precipitation occurred, showing that leuco-indigotin is not present.

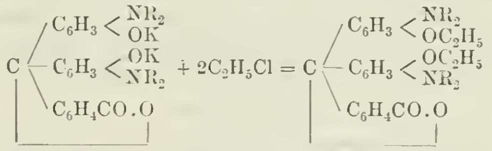
In a second series of experiments, dilute sulphuric acid, in slight excess, was employed for the solution of the melt, owing to the difficulty of preventing its oxidation in alkaline solution. The solution so produced had a pale olive-yellow colour and was unaffected by the atmospheric oxygen. On standing for some time, however, or on heating, it became turbid, a brown resinous substance eventually separating.

The formation of indoxyl was established by Baeyer's reactions for that body (Ber. **16**, 2188 *et seq.*). On the addition, for instance, of diazobenzene chloride to the acid solution of the melt, a flocculent, red precipitate of phenyl-azo-indoxyl was obtained. Similarly, a soluble azo-compound was prepared by the action of diazobenzene sulphonic acid. In consequence of the presence of a considerable quantity of potassium sulphate in the indoxyl solution, this was obtained in the form of its potassium salt. It dissolves sparingly in water and cold alcohol with a brown colour, in cold ammonia and sodium hydroxide solutions with a dark purple-red, and dyes animal fibres orange from a dilute acid solution. Its alkaline solution is rapidly decolourised by zinc dust, a slight precipitation of indigo taking place on standing. The presence of indoxyl in the alkali-melt was further confirmed by the preparation of indirubin from it by Forrer's method (Ber. **17**, 976).

Indoxyl was also found to be produced by heating indigo with a solution of potassium hydroxide of sp. gr. 1·45, in this case again no leuco-indigotin being formed.—E. B.

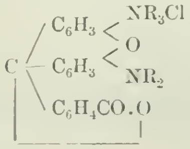
The Constitution of the Rhodamines and Eosines. A. Bernthsen. Proceedings of the Chemical Society of Heidelberg. Chem. Zeit. 1892, 16, 1956—1957.

According to Monnet (Bull. Soc. Chim. 1892, 523; this Journal, 1892, 677) the tetra-alkylated rhodamines of the phthaleïn and succineïn series, in the form of "alkali salts," interact with alkyl halides, yielding dyes of bluer shades (anisolines). This action is explained by Monnet as due in the first instance to a rupture by the alkali of the pyrone-ring (the oxygen ring structure) in the rhodamine molecule, the two atoms of metal in the dialkali phenolate thus formed, on heating with the alkyl halide, becoming replaced by alkyl groups, thus:—

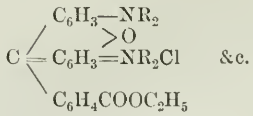

C
$C_6H_3 < \begin{smallmatrix}NR_2\\OK\end{smallmatrix}$
$C_6H_3 < \begin{smallmatrix}OK\\NR_2\end{smallmatrix}$
$C_6H_4CO.O$
$+ 2C_2H_5Cl =$
C
$C_6H_3 < \begin{smallmatrix}NR_2\\OC_2H_5\end{smallmatrix}$
$C_6H_3 < \begin{smallmatrix}OC_2H_5\\NR_2\end{smallmatrix}$
$C_6H_4CO.O$

This view, however, is incorrect. The hypothetical alkali salts are simply the free colour bases. Moreover, cognizance is not taken of the great difference, on the one hand, between the anisolines and the colourless dialkylaniline-phthaleïns of which they are assumed to be alkoxy-derivatives, and, on the other hand, of the close resemblance between the anisolines and rhodamines.

In reality a direct combination of the alkyl halide takes place, the pyrone-ring remaining intact. The new dyes might hence be looked upon as quaternary ammonium compounds of tertiary rhodamines of the general type—



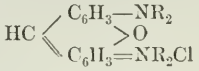
did not another method of formation lead to a different conclusion. They are obtained, namely, by the action on the rhodamines of mild esterifying agents, which are incapable of converting amines into ammonium compounds; by treating, for instance, a solution of a rhodamine in alcohol with hydrochloric acid gas. They also possess a well-defined estereal character, being, for instance, saponified by heating with alkalis. In accordance with these facts their constitution must be expressed thus :—



$$C\left\{\begin{array}{l} C_6H_3-NR_2 \\ \quad\;\; >O \\ C_6H_3=NR_2Cl \qquad \&c. \\ C_6H_4COOC_2H_5\end{array}\right.$$

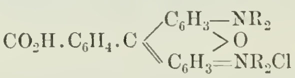
This formula finds confirmation in the behaviour of the dialkylrhodamines, which, when heated with alkyl haiides, yield, instead of the more stable trialkylrhodamines, readily saponifiable dialkylrhodamine esters. These are valuable new dyes of yellowish-pink shades and of a brilliancy not hitherto attained.

Conformably to this theory of the quinonoid structure of the rhodamine molecule, the constitution of the analogous formorhodamines (pyronines) will be represented by the formula—



$$HC\left\{\begin{array}{l} C_6H_3-NR_2 \\ \quad\;\; >O \\ C_6H_3=NR_2Cl\end{array}\right.$$

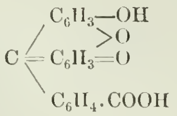
The other rhodamines are derivatives of dyes of this type containing organic radicles in place of the methane hydrogen atom, the rhodamines *par excellence* having the formula—



$$CO_2H.C_6H_4.C\left\{\begin{array}{l} C_6H_3-NR_2 \\ \quad\;\; >O \\ C_6H_3=NR_2Cl\end{array}\right.$$

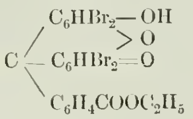
and thus containing a carboxyl group, which, as already mentioned, is readily esterifiable. This explains why the formorhodamines, which do not contain any acid group, cannot be similarly alkylated. The generally inactive character of the carboxyl group in the benzo-rhodamines is due to its being combined with an NR_2 group, an intra-molecular salt-formation between it and the latter taking place, similar to that which occurs in glycocol and taurin, for example.

The hydroxy-analogues of the rhodamines in their salts, have a similar constitution, that of fluoresceïn, which gives an easily saponifiable ethyl ester, being, for example—



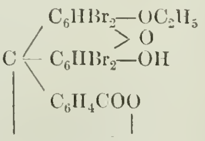
$$C\left\{\begin{array}{l} C_6H_3-OH \\ \quad\;\; >O \\ C_6H_3=O \\ C_6H_4.COOH\end{array}\right.$$

(Free fluoresceïn, however, yielding as it does a diacetyl derivative, must be represented by the usual lactone formula.) The formula of ethyleosin (eosin S) must also be (I.) and not (II.)—



$$C\left\{\begin{array}{l} C_6HBr_2-OH \\ \qquad\;\; >O \\ C_6HBr_2=O \\ C_6H_4COOC_2H_5\end{array}\right.$$

I.

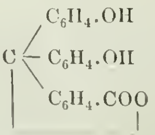


$$C\left\{\begin{array}{l} C_6HBr_2-OC_2H_5 \\ \qquad\;\; >O \\ C_6HBr_2-OH \\ C_6H_4COO\end{array}\right.$$

II.

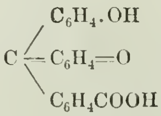
as it has hitherto been represented.

The striking production of colour by the action of alkalis on phenolphthaleïn is, again, most probably referable to a change of constitution from (I.) to (II.)—



$$C\left\{\begin{array}{l} C_6H_4.OH \\ C_6H_4.OH \\ C_6H_4.COO\end{array}\right.$$

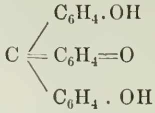
I.



$$C\left\{\begin{array}{l} C_6H_4.OH \\ C_6H_4=O \\ C_6H_4COOH\end{array}\right.$$

II.

the latter formula being analogous to that of aurin—



$$C\left\{\begin{array}{l} C_6H_4.OH \\ C_6H_4=O \\ C_6H_4\,.\,OH\end{array}\right.$$

This desmotropic change in the phenolphthaleïn molecule finds a parallel in the case of the benzo-rhodamine bases. Thus, these are intensely coloured in a hydrated state $(+\ 5H_2O)$, but, when anhydrous, are colourless and dissolve in benzene without colour. For the bases in the latter condition, therefore, the lactone formula must be retained.

The quinonoid character is obviously possible only in dyes which contain salt-forming groups (NH_2; OH, &c.). Fluoresceïn chloride, for instance, cannot possess it. It is interesting, however, that this compound on treatment with potash forms an alkaline salt, the lactone group in it evidently being hydrolysed in a manner similar to that of diphenylphthalide under the same circumstances.—E. B.

The Increasing Application of Substantive Dyes for Wool.
H. Falke. Färber-Zeit. 1892—93, **13**, 193—194.

To produce the most brilliant shades on wool, which are at the same time resistant to the milling process, the wool may be mordanted with chromium, alumina, or tin, and dyed in a second bath with logwood, fustic, or alizarin colours. This process, however, not only necessitates a considerable expenditure of time and labour, but exerts a not inconsiderable influence on the fibre in regard to its fitness for spinning. The avoidance of this last-mentioned evil by the use of substantive dyes, has quite removed the difficulty of their high price, and their use in wool-dyeing is consequently increasing.

The dyeing of cotton with benzidine and diamine colouring matters requires, as a rule, an alkaline bath; such a bath cannot, however, be used for wool, except with such dyes as Congo-red and Benzopurpurin 4 B, which are sensitive to acids, and a bath rendered faintly alkaline with borax or sodium phosphate is therefore preferable. There are, however, a number of dyes on the market which are less sensitive to acids; among them are included Deltapurpurin, Erika, Diamine-scarlet, Diamine fast red, Sulphone-azurine, Brilliant-Congo, and Brilliant-azurine. The bath may be prepared with these dyes by the simple addition of sodium sulphate, and, in the case of calcareous waters, of acetic acid. Indeed, in single instances, such as Diamine-scarlet, Diamine fast red, and Sulphone-azurine, tartrates or sodium sulphate and sulphuric acid may be used, but the avoidance of baths too strongly acid is a matter of great importance. For, not only does the fibre remain softer thereby—in the loose condition, better adapted for spinning, and in the woven material less felted—but the dye is not taken up as rapidly, and it is more equally distributed. The whole of the colouring matter is, however, extracted from the bath whether it be acid or neutral.

Bright-red shades are produced with Brilliant-Congo, Deltapurpurin, and Diamine-scarlet B; bluer tones with Benzopurpurin 10 B; pink with Erika; Bordeaux with Diamine fast red, Congo-Corinth, and Hessian-purple; yellow with Chrysamine, Diamine golden-yellow, Chrysophenine, and Oxyphenine; yellowish-red with Congo-orange and Mikado-orange; and blue with Sulphone-azurine, Brilliant-azurine, and the more recent product Chicago-blue.

The resistance to milling of these dyes is by no means absolute, but far exceeds that of ordinary azo-dyes. When alkaline earths, alumina, or neutral soap is made use of they remain unaltered, and no influence is exerted on the interwoven white or brighter colours; but in the presence of soda they are less stable. Diamine fast red exhibits a characteristic fastness towards light and towards the milling process as compared with other substantive dyes, and these properties are considerably enhanced by boiling with "Fluorchrome," which is a convenient substance for the production of a chrome-lake; it has the advantage over potassium chromate in that the chromium oxide is deposited on the fibre after at most half an hour's boiling, and it may be added to the dye-bath itself. It does not attack copper vessels. Diamine fast red when treated with "Fluorchrome" gives shades on wool so resistant to the milling process that they are superior to alizarin-reds, and it ought only to be a question of time to completely replace the latter by Diamine fast red for military cloth. No such favourable action of "Fluorchrome" on other dyes has been observed.

The resistance of the benzidine dyes towards gaseous sulphurous acid renders possible the bleaching of fabrics having coloured devices on a white ground. Hitherto it has been the practice to interweave bleached yarn; but independent of the fact that bleached yarn cannot be woven as well as unbleached, the brightness of the shades is impaired by the large number of operations. By treatment of substantive, dyed, unbleached fabrics with sulphurous acid, the colours are raised to the brightness they would possess if dyed on bleached material.

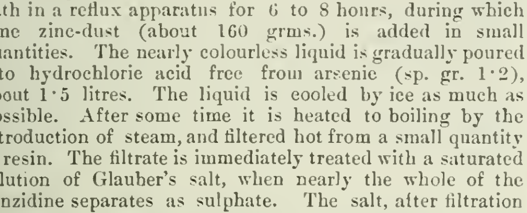
The fastness towards light of many of these dyes when applied to wool is superior than when applied to cotton, and even those which are somewhat fugitive on cotton are often very stable on wool. The best, according to the author's experience, are Diamine fast red, Deltapurpurin, Brilliant-azurine, Oxyphenine, and Chrysamine.—A. R. L.

Preparation of Benzidine Sulphate. H. Teichmann. Zeit. ang. Chem. 1893, 67.

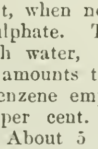
Nitrobenzene, 100 grms., caustic soda solution (sp. gr. 1·4), 80 grms., and water, 500 cc., are heated on the water-bath in a reflux apparatus for 6 to 8 hours, during which time zinc-dust (about 160 grms.) is added in small quantities. The nearly colourless liquid is gradually poured into hydrochloric acid free from arsenic (sp. gr. 1·2), about 1·5 litres. The liquid is cooled by ice as much as possible. After some time it is heated to boiling by the introduction of steam, and filtered hot from a small quantity of resin. The filtrate is immediately treated with a saturated solution of Glauber's salt, when nearly the whole of the benzidine separates as sulphate. The salt, after filtration by suction, washing with water, and drying, forms a greyish-blue powder, and amounts to about 90 per cent. of the weight of the nitrobenzene employed. It contains an average amount of 2·5 per cent. of ash, an immaterial quantity in most cases. About 5 grms. of aniline and a small quantity of diphenyline are formed.—N. H. J. M.

Note on a Meta-Azo-Compound. R. Meldola and F. B. Burls. Proc. Chem. Soc. 1893 [12].

While azo-compounds of the ortho- and para-series can be represented either as hydrazones or as true azo-compounds by the formulæ—



the azo-derivatives of the meta-series—



cannot be formulated as hydrazones. The authors prepared certain members of the meta-series in order to institute a comparison between their properties and those of the ortho- and para-series. It is obvious that a comparative study such as that proposed is calculated to throw light on the question of the constitution of organic colouring matters, as the "quinonoid" bonds are not present in the meta-compounds according to the present method of formulation.

The first compound experimented on did not give a decisive result. The only satisfactory compounds which are worth studying from the present point of view are evidently those of the type $C_6H_4.OH.N_2X$ [$OH:N_2X = 1:3$], in which X is an *unsubstituted* hydrocarbon radicle. Metamidophenol was diazotised in presence of hydrochloric acid in the usual way and combined with α-naphthylamine, also dissolved in hydrochloric acid. The mixture of the two solutions gradually became of a deep violet-red colour. The azo-compound was finally precipitated by the addition of sodium acetate. The precipitate was collected, washed with water, and purified by dissolving it in cold dilute caustic soda, filtering and reprecipitating by acetic acid; it was then digested with dilute ammonia, washed with water, and crystallised alternately from dilute alcohol and benzene.

The substance thus obtained is *metaphenolazo-α-naphthylamine*, $HO.C_6H_4.N_2.C_{10}H_6.NH_2$ It crystallises in dull, orange-coloured needles fusing at 196°. Its solution in all solvents is orange-coloured, and it possesses strong tinctorial power as an orange dyestuff. It is both acid and basic in properties, readily dissolving in cold aqueous solutions of alkalis, forming orange-coloured liquids, and also forming well-defined salts with acids. The solutions of its salts are of a magnificent violet colour. It dissolves in strong sulphuric acid, forming a dull, magenta-red coloured solution, becoming violet on dilution, and on the further addition of water the sulphate separates out in bronzy crystals.

In order to further characterise the azo-compound, the acetyl derivative was prepared by boiling a solution of the substance in glacial acetic acid with acetic anhydride till the original violet colour of the solution had changed into orange. Beautiful golden scales were at length obtained melting at 232°—235°, and proved to consist of a monoacetyl derivative.

As this compound is phenolic, it is clear that the acetyl displaces amidic hydrogen, and, therefore, that the product has the formula $HO.C_6H_4.N_2.C_{10}H_6.NH.C_2H_3O$. It dissolves in alkali, forming an orange-coloured solution and possesses strong tinctorial properties. *A non-phenolic derivative*, formed simultaneously, was not formed in sufficient quantity for complete examination. The melting point, after several crystallisations from dilute alcohol and benzene, was about 226°, and the nitrogen approximated in quantity to that required by the diacetyl derivative. The substance forms flat needles of a golden colour, and is also an orange colouring matter. As it is non-phenolic, the hydroxylic hydrogen is probably displaced as represented by the formula $C_2H_3O.O.C_6H_4.N_2.C_{10}H_6.NH.C_2H_3O$.
—W. S.

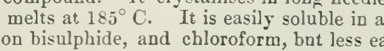
PATENTS.

Manufacture of Novel Azo-colouring Matters Dyeing Directly on Cotton. C. D. Abel, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 10,667, June 4, 1892.

These colouring matters are derivatives of an anhydro base derived from benzanilide. This substance when treated with nitrosulphuric acid yields trinitrobenzanilide, to which the following formula is given—

$$(1.3.4)\ NO_2.NO_2.C_6H_3.NH.CO.C_6H_4.NO_2\ (1.3)$$

On reduction this forms the corresponding triamine, which is a stable compound. It crystallises in long needles from water, and melts at 185° C. It is easily soluble in alcohol, ether, carbon bisulphide, and chloroform, but less easily in hydrocarbons. When heated to higher degrees of temperature it is said to separate the elements of water, forming a diamido anhydro base—



$$NH_2.C_6H_3\left\langle\begin{matrix} NH \\ N \end{matrix}\right\rangle C.C_6H_4.NH_2$$

This compound, which is sparingly soluble in water, but easily in other solvents, melts at above 250° C. Its hydrochloride and sulphate are easily soluble in water. When treated with hydrochloric acid and sodium nitrite in proper proportions it yields a tetrazo compound, which combines with phenols and amines and their derivatives to form cotton-colouring matters. These dyestuffs have an advantage over the "Congo" colouring matters in that they are less easily affected by acids. They are also stated to be fast to soap. The combinations of the new base can be produced in the well-known manner.—T. A. L.

Improvements in the Manufacture of Azo-colouring Matters. Brooke, Simpson, and Spiller, Lim., A. G. Green, and T. A. Lawson, London. Eng. Pat. 10,915, June 9, 1892.

A red colouring matter dyeing wool from an acid bath, the dyed fabric resisting the processes of milling and scouring to a remarkable extent, is obtained by combining diazotised, azoxytoluidine, melting at 168° C., with one molecular proportion of α-naphthol-*p*-sulphonic acid and one molecular proportion of β-naphthol disulphonic acid R. The tetrazo solution from 25·5 lb. of azoxytoluidine, 14 lb. of sodium nitrite, and 4·5 gals. of 31 per cent. hydrochloric acid in 120 gals. of water, is added to a solution containing 25 lb. of sodium α-naphthol-*p*-sulphonate and 20 lb. of crystallised sodium acetate in 100 gals. of water. When the combination is complete, a solution of 35 lb. of R salt and 24 lb. of anhydrous sodium carbonate in 100 gals. of water is run in. After the solution has become quite clear, salt is added and the precipitated colouring matter is filtered, pressed, and dried. It forms a dark red powder easily soluble in water, but insoluble in alcohol. The red colour of the aqueous solution is changed to orange-red by caustic soda. Dilute acids do not precipitate the solution. Concentrated sulphuric acid dissolves the dyestuff with a bluish-red colour. Goods dyed with it are not affected by acids.—T. A. L.

Manufacture of Colouring Matters capable of Dyeing Cotton Direct. C. D. Abel, London. From Kern and Sandoz, Bâle, Switzerland. Eng. Pat. 3737, February 20, 1893.

The specification refers to the production of red azo colouring matters for unmordanted cotton. They are obtained by combining *m*-ethyl- or *m*-diethyl-aniline sulphonic acid with tetrazo-diphenyl or tetrazo-ditolyl in equimolecular proportions in an alkaline or acetic acid solution and combining the intermediate compound so obtained with 1·4 (Piria) or 1·5 (Laurent) α-naphthylamine sulphonic acid. By employing *m*-diethyl-*o*-toluidine sulphonic acid browner shades are produced. The following quantities are given for the manufacture of one of the above-mentioned dyestuffs. The solution of tetrazo-diphenyl chloride from 14·2 kilos. of benzidine sulphate, 15 kilos. of 30 per cent. hydrochloric acid, and 7·2 kilos. of 96 per cent. sodium nitrite is combined with an aqueous solution of 13 kilos. of diethylaniline sodium sulphonate and 16 kilos. of sodium acetate. In about two hours a solution of 18 kilos. of 70 per cent. sodium naphthionate is added, and the whole is then allowed to stand two days, after which it is made alkaline with soda, heated to boiling, and the colouring matter precipitated with salt, filter-pressed, and dried. The dyestuff dissolves easily in cold water and in concentrated sulphuric acid to a blue solution, from which it is precipitated in reddish-violet flakes on dilution. It dyes cotton a ponceau-red, which turns violet with acids.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

A Study of Oxycellulose. A. Nastjukoff. Bull. Soc. Ind. Mulhouse, 1892, 493—510.

The oxycellulose of Witz (this Journal, 1884, 207, 254, 292, and 1885, 9) is not a uniform substance but a mixture of cellulose and oxycellulose proper, which possesses the properties ascribed to the mixture. For the determination of the percentage composition of the true oxycellulose, a mixture of it and of cellulose was prepared by soaking filter-paper in a solution of bleaching-powder at 4° B., exposing to the air for four hours, then washing in succession with dilute ammonia solution and water, and drying over sulphuric acid. Analyses of the product, made before and after the removal of the oxycellulose from it by treatment with caustic soda (as described by Lange, Zeits. f. physiol. Chem. 1889, 283), then showed the empirical formula of the oxycellulose to be $C_6H_{10}O_6$. Attempts to isolate it were unsuccessful.—E. B.

Report presented to the Industrial Society of Mulhouse on the preceding Memoir. A. Scheurer and E. Nölting. Bull. Soc. Ind. Mulhouse, 1892, 492—493.

The chemical nature of oxycellulose still remains undefined. From its properties it would seem to be a phenolic compound, while the cellulose from which it is derived appears rather to be a complex alcohol. In respect to composition, it has been found to contain less carbon and more oxygen than cellulose.

Nastjukoff has not determined the constitution of the body in question. He has, however, succeeded in showing that it yields a hydrazone or osazone when treated with phenylhydrazine, thus indicating the probable presence in it of aldehydic or ketonic groups. (See also this Journal, 1885, 10.)—E. B.

Making Silk from Wood. Rep. Consuls of the United States, No. 150. March 1893, 402.

The United States Consul at St. Etienne gives the following particulars of the well-known Chardonnet process (this Journal 1891, 359). The raw material is wood-pulp, nitrated and made into collodion in the usual way. The collodion is enclosed in a solid receptacle, into which an air-pump sends compressed air, which forces it through a filter into a horizontal tube armed with 300 cocks, of which the spouts are made of glass tubes drawn out to the diameter of the thread of a cocoon. On the opening of the cocks the collodion issues in a thread of extreme delicacy, six of which go to make a thread of sufficient consistency for weaving. In that state, however, it is unfit to be rolled on the spools, and requires hardening. For this purpose the glass tube is surrounded by a small reservoir, also of glass, filled with water. The thread, on traversing the water, parts with its alcohol and ether, and becomes solid and elastic, and as resisting and brilliant as ordinary silk. The spun thread is highly inflammable, but it may be rendered "as slow of combustion as any other material by treatment with a solution of ammonia." Another practical difficulty is the frequent snapping of the slender thread owing to unequal pressure, 5lb. of excellent silk being frequently followed by 5 lb. of a comparatively worthless quality. Up to the present time none of the important silk-men have invested in the enterprise, and the disposition on the part of capitalists is to await developments.—Ed. T.

PATENTS.

Improvements in Dissolving Cellulose and Allied Compounds. C. F. Cross, E. J. Bevan, and C. Beadle, London. Eng. Pat. 8700, May 7, 1892.

Bleached cotton or any form of cellulose, such as that obtained from flax, rhea, hemp, wood, is first "mercerised," *i.e.*, impregnated with a solution of caustic soda of 15 per cent. strength, containing therefore about 12 per cent. by weight of Na_2O, and the excess of solution having been removed by squeezing, so as to leave in the material from 3—4 times its weight of the solution or from 40—50 per cent. of its weight of the alkali, the mercerised cellulose is exposed to the action of carbon bisulphide in a closed vessel, 30—40 per cent. of the bisulphide being employed on the weight of the cellulose. In from 3—5 hours at the ordinary temperature the reaction is complete and the product ready for solution in water. By-products of the interaction of the alkali and bisulphide are produced, but their presence for many applications is unobjectionable. They may, however, be to a great extent removed by precipitation with brine or alcohol and redissolution in water of the soluble cellulose, or they may be converted into colourless compounds by the addition of sulphurous acid or an alkaline bisulphite. The soluble derivative of cellulose has the property of becoming reconverted into cellulose (1) spontaneously on long standing, (2) on being heated to 80—100 C., (3) by treatment with oxidising agents. Thus if the solution be poured on any surface and evaporated to dryness at 100° C., a transparent film is obtained, from which the alkaline salts may be removed by washing, &c. The final product has all the characteristics of cellulose, more especially as regards resistance to solvents, alkaline solutions, and oxidising agents. By similar methods the soluble compound may be deposited upon textile fabrics, yarn, or cloth, and may be employed for coating metal gauze, &c. (see this Journal, 1893, 499).—Ed. T.

Improvements in the Method of and Apparatus for Removing Fatty Matters and other Impurities from Wool and similar Textile Materials. W. E. Heys, Manchester. From E. F. Dramez, H. P. J. Vassart, and J. H. S. M. Delattre, Paris. Eng. Pat. 11,581, June 21, 1892.

Suitable solvents are employed, such as carbon bisulphide or volatile hydrocarbons for the fatty matters, and water for the matters soluble in water. This, the inventors state is not new, but so far no such process has been carried out on a working scale. The apparatus now patented is composed of a series of closed becs or chambers, each provided at its exit with a pair of mangle rollers. The first contains the volatile solvent for dissolving out the fatty matters, the second contains cold water for the removal of potash salts, &c., and a third may contain hot water, for driving off any remaining solvent and dissolving any matters not removed by the cold water. The volatile vapours are carried off through a collecting tube and condensed by suitable apparatus. The material is delivered into the first bec in a thin layer through a narrow opening by two endless travelling aprons working face to face and having the material between them. In the bec the material is received between two other travelling aprons, by which it is delivered to the first pair of mangle rolls, after which it is received by the travelling aprons of the second bec, and so on to the third. Each bec is divided into two V-shaped sections, and the travelling aprons are carried below rollers in the lower part of each section. By this means a double submergence of the material is obtained and a minimum quantity of solvent used. The solvents in the becs may be drawn off and the matters contained therein recovered by known means.—Ed. T.

An Improved Process for the Recovery of the Cloth from Damaged Waterproofed Fabrics. T. J. Hutchinson and R. Hardman, Bury. Eng. Pat. 11,994, June 28, 1892.

When the india-rubber of waterproofed textile fabrics has become deteriorated the fabrics are usually destroyed and the cloth is lost, a loss which, in the case of silk and woollen goods, is very serious. The inventors' object is to recover the cloths by an economical process, which also renders them more suitable for proofing than in their original condition. The fabrics are treated in a bath of warm oil or fatty matter until the proofing is decomposed or dissolved. The excess of fatty matter is then expressed by rollers, and the cloth treated with a suitable volatile solvent. The inventors prefer, however, for the removal of the fatty matters, a method described in T. J. Hutchinson's patent, 10,285, July 3, 1890 (this Journal, 1891, 918). Suitable oils are olive, rape, and cotton-seed oils, and a suitable solvent is naphtha from coal-tar, shale, or petroleum.

—Ed. T.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

The Increasing Application of Substantive Dyes for Wool. H. Falke. Färber Zeit. 1892—1893, **13**, 193—194.

See under IV., *page* 514.

PATENTS.

Improvements in Machines for Printing Fabrics. F. S. Schwabe, Middleton, W. Pickup and W. Knowles, Pendleton. Eng. Pat. 7288, April 16, 1892.

This invention relates to apparatus employed for the intermittent printing of fabrics by means of engraved rollers. There are three claims. The first of these is for an improvement in the cams used, which are to be constructed in three parallel parts, of which the middle one can be turned on its axis and then fixed in any required position by bolts passing laterally through perforations in all the parts, the raised portions or working surfaces of the cams being thus rendered variable in extent. The second claim relates to the employment on the cam-shafts of "box" wheels of appropriate size, instead of ordinary spur-wheels, to enable the relative positions of the shafts and cams to be readily altered when necessary. The third is for the formation of slots either in the links holding the rods carried by the cam anti-friction rollers; or, if the latter carry levers, in the levers; or, again, in the rods themselves, whereby an instantaneous fall of the printing rollers is obtained when the raised surfaces of the cams have passed under the anti-friction rollers, accurate completion of the printing being thus assured.—E. B.

A New or Improved Means or Process of Producing Coloured Patterns or Designs upon Silk Plushes, or upon Wool or Velvet Plushes. R. Dewhurst and Co., Lim., and A. Stockdale, Birstall. Eng. Pat. 10,642, June 4, 1892.

Attempts to print coloured patterns on wool or cotton plushes have hitherto failed, owing to the use of starch or other paste, which it is difficult to remove, and to the pressure exerted, which is requisite for laying down the pile. The inventors trust to the capillarity of the fibres for the absorption of the solutions which they employ, and they select a material dyed with an azo or basic dye susceptible of being discharged with stannous chloride. They then spread a solution of the latter upon the raised portions of a wooden printing block or copper roller, which they cause to rest for a few moments upon a piece (say) of olive-coloured silk plush previously warmed. On removal of the block the liquid will be found to have been absorbed by the fibres. The fabric is then steamed, the colour is decomposed, and a light green pattern appears standing out clear on the olive ground. By the use of sufficiently strong tin chloride the colour will entirely disappear from the affected parts, leaving the fibre white. Excellent results are also obtained with tin acetate. In order to ensure a more equal absorption of the liquid into the pile, the raised parts of the printing block or roller are covered with pieces of felt corresponding with the figures of the pattern, and this felt is saturated with the reducing solution.—Ed. T.

VII.—ACIDS, ALKALIS, AND SALTS.

Commercial Potassium Cyanide. R. Kayser. Chem. Zeit. 1892, **16**, 1148.

The commercial article usually consists of a mixture of potassium and sodium cyanides. Account must be taken of this fact in stating results of analyses, since a sample containing much of the sodium salt might, even in presence of 15 per cent. of impurities, be returned as 100 per cent. potassium cyanide. The presence of sodium cyanide is in some cases objectionable. For instance, the preparation of a gold-plating bath by dissolving gold by aid of the electric current becomes impracticable, because the difficultly soluble sodium aurous cyanide formed, is immediately deposited on the anode. Fresenius confirms the occurrence of sodium ferrocyanide in commercial potassium ferrocyanide.—H. T. P.

PATENTS.

Improvements in the Art of Producing Insoluble Chlorides Direct from the Metals. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 212, January 5, 1892.

See under XI., *page* 526.

Improved Means for obtaining Cyanides from Illuminating and Heating Gas. W. Foulis, Glasgow. Eng. Pat. 9474. May 18, 1892.

See under II., *page* 511.

Improvements relating to the Collection of Ammonia and Ammoniacal Salts from Gaseous and Liquid Mixtures. E. de Cuyper, Mons, Belgium. Eng. Pat. 13,686, July 27, 1892.

See under II., *page* 511.

Improvements in the Manufacture of Caustic Alkalis or Carbonated Alkalis. J. Lederer, Prague, Austria. Eng. Pat. 4767, March 4, 1893.

This invention is effected by means of the following processes:—

i. Potassium chloride and ammonium sulphate are mixed with sufficient water to form a thick pulpy mass, the ammonium chloride being subsequently separated by sublimation.

ii. The potassium sulphate formed is then decomposed by strontium hydroxide, yielding caustic potash and strontium sulphate.

iii. The strontium sulphate is reconverted into hydroxide by treating it with ammonium or sodium carbonate, the carbonate of strontium thus obtained being afterwards converted into oxide in "strontium-furnaces," as used in the manufacture of strontium-sugar.

The caustic alkali obtained (see ii.) may be carbonated, if desired, in a suitable manner.—J. C. C.

Improvements in the Process of obtaining Chlorates of the Alkalis or of the Alkaline Earth Metals by Electrolysis. W. T. Gibbs and S. P. Franchot, Buckingham, Canada. Eng. Pat. 4869, March 7, 1893.

See under XI., *page* 527.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Improvements in Appliances employed in the Glazing of Earthenware Pipes and Analogous Articles. T. H. Hunt, Darwen. Eng. Pat. 8896, May 11, 1892.

This invention relates to that class of glazing in which the article is dipped in a solution of clay-wash or "slip." The article is placed on a perforated tray, which is connected by chains to a balance weight. When a coating is required both externally and internally the tray is lowered into a bath containing the "slip," after which the articles are removed and dried. When the internal surface only is to be glazed, use is made of the device of having the reservoir made of compressible material. The sides of the reservoir being compressed, the "slip" is forced up the interior of the article to the required height, after which it is allowed to subside back into the reservoir.—V. C.

Improvements in the Manufacture of Terra-cotta and like Materials, and in Apparatus therefor. H. L. Doulton and S. L. Leach, Lambeth. Eng. Pat. 10,123, May 27, 1892.

In order to obtain true surfaces in terra-cotta, the patentees mould and dry the blocks to be treated and dress the surfaces to restore them to truth, afterwards firing and salt-glazing them. The working of the surfaces may be repeated after a preliminary firing and the final firing and glazing are then proceeded with. The perforated ends of the blocks described in Eng. Pat. 5205 of 1889 (this Journal, 1890, 393) may be used for external surfaces by the application of the re-dressing process mentioned above, the holes being closed with pegs of clay having flat heads and tapered shanks so as to fit firmly into the holes. The firing of the goods mentioned is effected in a special box kiln with flues so arranged that not only the sides, top, and bottom are heated, but also the greater part of the doorway, so that an even temperature is maintained, warping lessened, and the cost of re-dressing largely avoided.—B. B.

Improvements in the Manufacture of Ceramic or Pottery-ware Crucibles, Cisterns, Sinks, Flags, and Cements; also applicable for Paving Footpaths, Roads, and as a Filtering Medium. J. Davies, London. Eng. Pat. 823, January 13, 1893.

This invention, which is an improvement on the process patented October 1, 1891, Eng. Pat. 16,692 relates to the employment of materials for the purposes mentioned in the title, which consist of a basis of powdered slate, hitherto a waste material, mixed with silica, manganese, iron, granite, or asphalt according to the purpose for which it is required. The employment of the material for purposes of filtration is based upon the power which, the inventor has found from experiments, the slate possesses "of removing from the water deleterious materials, such as carbonate of lime."—V. C.

Improvements in Glass Pipes, Tubes, and Gutters, and in the Means for and Method of Manufacturing the same. P. Sievert, Döhlen, Saxony. Eng. Pat. 2260, February 1, 1893.

In this process the pipe or tube is produced by rolling down molten glass in grooves or flutes and using a core to complete the formation of the pipe or tube. Molten glass is poured from a reservoir or hopper into the bite of two rollers. The rollers are placed horizontally, each being provided with grooves. A core of suitable dimensions is placed in the grooves. When the core is moved downwards the molten glass follows the movement and forms a tube the dimensions of which are determined by those of the ring-shaped space between the contours of the grooves and the core. The speed at which the core is lowered is regulated according to the circumferential velocity of the rollers. When the downward movement of the core is completed, and the reservoir is nearly emptied, the core is removed, when the tube may be subjected to the rolling process or may be annealed without rolling.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Tests of Artificial Sandstones. Böhme. Mitt. König. tech. Versuchs. 1892, **4**, 169—185.

Five samples were tested, four being of "hydraulic sandstone" manufactured according to Cressy's Ger. Pat. 20,890, and the fifth being an artificial sandstone made by Zernikow (Ger. Pat. 34,862). The chief results are given in the following tables:—

"Hydraulic Sandstone."

Condition of Test Piece.	Tensile Strength.	Compressive Strength.
	Kilos. per Sq. Cm.	
Air-dried	47	314
Saturated with water	40	285
Saturated and frozen for 25 hours— (1.) In air	44	288
(2.) Under water	43	286

The specific gravity of the stone was 2·189, the amount of water necessary to saturate it varied from 6 to 8 per cent., and the volume of material removed by abrasion by the standard grinding test (v.i.) was 36·9 cc. This test of the power of the stone to resist attrition is carried out by subjecting a surface of the stone having an area of 50 sq. cm. to an iron disc bearing upon it with a pressure of 30 kilos. and making 22 revolutions per minute, the effective radius of the disc being 22 cm., and the disc being fed with 20 grms. of No. 3 emery per minute. The trial is continued until 450 revolutions have been made.

Artificial Sandstone (Zernikow).

Condition of Test Piece.	Tensile Strength.	Compressive Strength.
	Kilos. per Sq. Cm.	
Air-dried	26	356
Saturated with water	25	350
Saturated and frozen for 25 hours— (1.) In air	22	335
(2.) Under water	22	334

Sp. gr. 1·837; abrasion test 28·4 cc.—B. B.

Tests of Mixtures for Artificial Sandstone. Böhme. Mitt. König. tech. Versuchs. 1892, **4**, 180—182.

The material is put on the market by a firm of cement makers for making ornaments for building purposes, and is prepared in various colours. Three samples (red, grey, and yellow) were examined at the testing station. When gauged with water they took up about equal amounts, 33—35 per cent. when the resulting mortar was of syrupy consistency, and 26—27 per cent. when it was made somewhat stiffer. When gauged in this manner the red set in $9\frac{1}{2}$ hours, the grey in $7\frac{1}{2}$ hours, and the yellow in $5\frac{2}{3}$ hours. Their fineness is shown by the following table:—

——	Residue. Per Cent.		
	Red.	Grey.	Yellow.
5,000 meshes per sq. cm.	38	54	52
900 " " "	12	20	17
600 " " "	6	8	8
324 " " "	1	1·5	3
180 " " "	0	0	0

Test pats of all three materials were found to be free from tendency to crack or "blow." The following results were obtained by gauging with 14 per cent. of water and allowing the test pieces to harden (1) for one day in air and the remaining time under water, and (2) in air only:—

——	Tensile Strength. Kilos. per Sq. Cm.	
	Under Water.	In Air.
7 days	25·45	31·65
28 "	32·10	37·45
60 "	38·20	45·85
90 "	42·70	61·50

——	Compressive Strength. Kilos. per Sq. Cm.	
7 days	254·9	261·4
28 "	313·8	361·4
60 "	378·0	406·0
90 "	418·2	437·0

—B. B.

Imitation Terra Cotta. Böhme. Mitt. König. tech. Versuchs. 1892 **4**, 183—185.

The material consists of a mixture of gypsum, brick-dust, and slaked lime, and is used for ornamental relief work and the like. The tests were carried out in the manner adopted at the testing station for artificial stones:—

——	Tensile Strength.	Compressive Strength.
Air-dried	10·85	46·1
Saturated with water	8·68	33·3
Saturated with water and frozen— (1.) In air	10·60	38·8
(2.) Under water	10·75	35·1

The specific gravity was 1·111 and the abrasion test 52·8 cc.—B. B.

On Magnesia Bricks. C. Bischof. Oesterr. Zeits. fur Berg- und Hüttenwesen, 1893, 27; Proc. Inst. Civil Eng. Abs. 1893, 5.

For the manufacture of magnesia bricks, the material most in favour at present is the magnesite of the Veitschthal, in Styria, which, although less pure considered as a source of magnesia than the same mineral from the island of Eubœa, in the Greek Archipelago, has nevertheless the property of fritting at a high temperature without melting. This is due to the presence of iron and, probably, alumina in small quantity. The composition of the two substances, both in the natural and burnt states, is as follows:—

Magnesite.

——	Styrian.	Greek.
	Per Cent.	Per Cent.
Carbonate of magnesia	90·0 to 96·0	94·46
„ lime	0·5 „ 2·0	4·40
„ iron	3·0 „ 6·0	FeO 0·08
Silica	1·0	0·52
Manganous oxide	0·5	Water 0·54
Calcined Magnesite.		
Magnesia	77·6	82·46—95·36
Lime	7·3	0·83—10·92
Alumina and ferric oxide	13·0	0·56— 3·54
Silica	1·2	0·73— 7·98

The calcination is effected in cupolas with a silicious lining, in reverberatory furnaces, or, best, in highly-heated gas-kilns, the nature of the product varying with the amount of heat to which it is subjected. At a red-heat magnesium carbonate is decomposed into carbonic acid and caustic magnesia, which resembles lime in becoming hydrated and recarbonated when exposed to the air, and possesses a certain plasticity, so that it can be moulded when subjected to a heavy pressure. By long-continued or stronger heating the material becomes dead burnt, giving a form of magnesia of high density, sp. gr. 3·8, as compared with 3·0 in the plastic form, which is perfectly unalterable in the air but entirely devoid of plasticity. According to Schlossing, a mixture of two volumes of dead-burnt with one of plastic magnesia can be moulded into bricks which contract but little in firing. Other binding materials that have been used are clay up to 10 or 15 per cent., gas-tar, perfectly freed from water, soda, silica, vinegar as a solution of magnesium acetate which is readily decomposed by heat, and carbonates of alkalis or lime. Among magnesium compounds a weak solution of magnesium chloride may also be used. For setting the bricks lightly-burnt, caustic magnesia, with a small proportion of silica to render it less refractory, is recommended. The strength of the bricks may be increased by adding iron, either as oxide or silicate. If a porous product is required, sawdust or starch may be added to the mixture. When dead-burnt magnesia is used alone, soda is said to be the best binding material. According to Lezius the average composition of magnesia bricks in use is about—magnesia, 80·9; silica, 4·8; alumina, 1·6, ferric oxide, 6·8; lime, 6·5 per cent. When a magnesia brick is laid upon a fire-brick bed, no action takes place below about 1,600° C., but above that point combination takes place with the formation of a fluid grey slag, which rapidly perforates the fire-brick. When a bed of pure alumina is used the resistance is somewhat greater but not much. The resistance to slagging from the ash of fuel is only about one-half that of a good fire-clay brick. Upon a coke or gas-carbon bed, pure magnesia may be heated higher than the melting-point of platinum without showing the slightest sign of fusion, but in the presence of other substances, fusible combinations are more or less readily formed. The fluxing power of these substances is as follows in ascending order: alumina, lime, ferric oxide, silica, and phosphoric acid, the latter substance being far more corrosive in effect than silica. A mixture of pure alumina and magnesia in equal parts is infusible at the welding point of malleable iron, but the combination is rendered easy by the presence of a third oxide.

In addition to their principal application in the basic open-hearth furnace and converter, magnesia bricks have been successfully used for lining kilns for cement-making and in burning strontia for sugar works, and also in lead and antimony smelting works, as they remain perfectly tight when exposed to molten lead, which readily permeates ordinary fire-bricks.

PATENTS.

Improved Methods of Utilising Slag made in connection with Iron and Steel Furnaces. C. H. Aston, Middlesbrough. Eng. Pat. 7473, April 20, 1892.

The methods patented included the production of slag bricks with interlocking projections and depressions, of slag bricks with a glazed surface, of blocks and supports for railway sleepers, and of slag sand by granulation with the water from the tuyeres of the blast furnace. The heat of molten blast-furnace slag is also proposed to be used for steam raising and like purposes. Other products claimed are a polishing powder from slag and a cement to be called "Chastonian cement" from calcareous slags mixed with magnesian lime and hot-blast stove flue dust with or without a little plaster of Paris."—B. B.

Improved Manufacture of Material suitable for Building and Architectural Purposes and for Ceramic and similar Works. M. Laffont, Paris, France. Eng. Pat. 10,532, June 2, 1892.

Pure plastic fireclay is mixed with "a fusible clay (not a marl), slate, sand, or such rocks as obsidian, syenite, basalt, &c., in proportion to be determined by preliminary experiment with the material chosen. The raw materials are finely powdered, moistened, and thoroughly mixed and used for the production of pipes, bricks, slabs, &c., which are moulded in the usual way. The goods are dried and heated gradually to a temperature of 1400° C., when a semi-fused crystalline product is obtained, corresponding in appearance with natural igneous rocks. When the mixture is not made homogeneous, a variegated product results.—B. B.

A Process for Hardening and Preserving Natural and Artificial Stone and other like Building Material. W. H. Talbot, Merton, and C. H. Venning, Shortlands. Eng. Pat. 11,766, June 23, 1892.

The stone is thoroughly dried and heated to a temperature not exceeding 250° F., and, after cooling, immersed in a solution of an alkaline silicate, preferably silicate of potash, (sp. gr. 1·3), then in one of alum or aluminium sulphate (1 lb. per gallon) and heated to 350° F. for several hours with subsequent gradual cooling.—B. B.

An Artificial Stone Composition. J. E. Keseling and C. Fuchs, jun., New York, U.S.A. Eng. Pat. 14,336, August 9, 1892.

Calcined magnesia fairly free from lime is ground and dissolved in hydrochloric acid (sp. gr. 1·16) until a neutral solution of magnesium chloride (34° B.) is obtained. A mixture is then made of 30 lb. of magnesia, 20 lb. of magnesium chloride, 70 lb. dry sharp sand, and 2 lb. of asphaltum dissolved in oil of turpentine. The sand may be replaced by ground slate or similar siliceous material. The proportion of asphaltum varies according to the nature of the articles to be made, rising to a maximum in the case of such things as wash-tubs, which "are subjected to extreme changes of temperature." The mixture can be moulded and dried and the excess of magnesium chloride may be eliminated by treatment in a bath of hot water or in a steam bath at 8—10 atmospheres pressure.—B. B.

An Artificial Stone Composition. J. E. Keseling and C. Fuchs, Jun., New York, U.S.A. Eng. Pat. 16,354, September 13, 1892.

Seventy pounds of sand, 30 lb. of magnesia, 20 lb. of magnesium chloride solution (32°—34° B.), 2 lb. of asphaltum solution (½ lb. asphaltum in 1 gallon of oil of turpentine), and 5 lb. of a mixed solution of albumin and casein are mixed and used in the formations of artificial stone. The albumin solution is "made by dissolving ½ oz. yellow egg albumin in 24 lb. pure water at a temperature of 145° F." and the casein solution "by dissolving ½ oz. casein and ⅛ oz. caustic soda in 24 lb. pure water at a temperature of 145° F., and the two solutions are used in proportions varying from 3·2 to 4·1.—B. B.

Improvements in the Manufacture of Artificial Stone and Apparatus in connection therewith. C. George, Berlin, Germany. Eng. Pat. 3338, February 15, 1893.

The stone is made on a frame or skeleton of ropes or coils of jute, hemp, flax, Indian grass, and the like, tarred or otherwise, with or without a core of "spring steel or other metal," woven, laced, or plaited together. The rope network is wound from a coil on to a cylindrical drum serving as the mould of the finished article (*e.g.*, a drain pipe) and any suitable plastic cementitious material applied to fill up its intestices, the outer surface being trimmed with a scraper.—B. B.

X.—METALLURGY.

Notes on Sampling. H. R. Wood. School of Mines Quarterly, 1892, **13**, 364.

See under XXIII., *page* 547.

On Combustion in the Hearth of the Blast-Furnace. W. Van Floten. Stahl und Eisen, 1893, 26. Proc. Inst. Civil Eng. Abs. 1893, 62.

The experiments recorded in this paper were undertaken with a view of determining whether it was possible, as had been supposed by some smelters, that with a large volume of blast, free oxygen might pass unchanged into the higher regions of the furnace, and so become a source of waste by the premature combustion of the fuel. For this purpose samples of gas were collected from numerous points between the centre and the circumference of the hearth of a blast-furnace, at the level of tuyère centres, and in planes 25 in. above, and 7 to 8 in. below them, and the proportion of oxygen, carbonic acid, carbonic oxide and hydrogen in each was determined by an analysis in Thörner's gas apparatus. The collecting apparatus, which was somewhat similar to that used by Deville in his experiments on dissociation, was a copper tube of 4 mm. bore, with a double water-jacket formed by two concentric gas-pipes of ¾ and 1¾-in. diameter, the cooling-water flowing in through the smaller tube and out through the larger one, the collecting end of the copper tube being turned at right-angles to and brought flush with the surface of the outer jacket. The length of the tube is 2,200 mm.; the outer end is provided with a strong flanged cover, so that it can be driven in to any point up to the centre of the hearth, either through the centre of a tuyère, or the embrasure of the bronze water-casing surrounding it.

The furnace, 65 ft. high, 19½ ft. wide in the boshes, and 9¾ ft. in the hearth, is blown by five twyers of 4·8 in., with blast at 5 lb. pressure, heated to 650° or 750° C. when making white basic iron from a mixture of two parts of ore and 1 part of mill cinder, yielding 42 per cent., with 12·4 cwt. of flux, at the rate of 130 tons daily, and consuming coke, with 9 to 10 per cent. of ash, at the rate of 19·4 to 19·6 cwts. per ton of metal.

When a greyer pig with 2 per cent. of silicon is made, the tuyères are reduced to 4·4 in., and the make to a little over 100 tons, while the coke is increased to about 20 cwt. Occasionally a white steel iron or semi-spiegel with 5 per cent. of manganese is produced.

In all 46 analyses have been made of gas taken with the apparatus during a period of 7 months, under varying conditions of working, and the results are given in a tabular form, which cannot, however, be usefully reproduced without the figures showing the locality of the sample. The following table contains some of the extremes of composition:—

No.	O	CO_2	CO	H	N	O : N	Locality.
						Per Mille.	
2	13·0	6·0	0·0	0·75	80·5	236	Middle of tuyere-eye.
11	0·0	0·0	37·0	3·00	60·0	308	Centre point of hearth.
16	0·0	13·5	6·0	0·25	80·25	205	Near edge of tuyère-eye.
31	0·0	0·0	33·75	1·75	64·5	262	Midway between two tuyères.
33	0·0	0·0	45·25	2·00	52·75	421	Close to wall of hearth.
42	0·0	11·0	11·75	2·00	75·25	224	25 in. above No. 2.

The results of the analyses show that intense combustion takes place at the point of admission of the air; but that it is restricted to a very small space, as although the blast is supplied at a speed of about 800 ft. per second, the extreme limits at which free oxygen is found are contained within an approximately spherical space, which does not extend more than 24 in. from the tuyère centre line, or 25 in. above it. It is clear, therefore, that waste of coke by combustion in the upper part of the furnace by excess of blast passing the tuyères unchanged is not possible under the ordinary condition of hot-blast coke or charcoal smelting, whatever the case may be with cold-blast.

It also appears that the first use of the blast is in the maximum oxidation of carbon, *i.e.*, to carbon dioxide, the oxygen being entirely consumed before there is any production of carbonic oxide. This is shown by the circumstance that oxygen or carbonic oxide are only found together in the gas under exceptional conditions, which may be accounted for by irregularity in the pressure of the air, due to the pulsating action of the blowing engine.

Hydrogen appears to be universally present in the gas in the proportion of 0·5 to 4 or 5 volumes, even when there is a notable excess of free oxygen. This, probably, results from the decomposition of water vapour in the blast, and, together with that derived from the moisture in the coke, it passes through the charge, remaining unchanged, like nitrogen, as it is ultimately found in full in the waste gases of the furnace top.

The proportion of oxygen to nitrogen in the gases which, under normal conditions should be 265 to 1,000, is in most of the samples taken from the hearth, considerably lower, being in one instance as low as 205, showing that some of the air is consumed for other purposes than the oxidation of coke, that is in the fining of cast-iron by the oxidation of carbon, silicon, manganese, iron, and phosphorus. There must, therefore, be both oxidizing and reducing regions in the hearth at the same level, oxygen and carbonic acid prevailing in the former, and carbonic oxide in the latter. The extent of such oxidizing areas will depend upon intensity of combustion and volume of blast supplied, diminution of the latter, and increase of its temperature, tending to diminish their size.

To show that oxidation does take place to some extent in the cast-iron passing the tuyères, the author points out that the bears of blast-furnaces are not imperfectly carburized masses of iron, but that they have been actually decarburized and come down melted as they send out branches, filling the openings between the hearth bottom bricks, showing that the metal has been perfectly liquid. A plate of such metal 4 mm. thick was found to contain—carbon, 0·04; silicon, 0·10; manganese, 0·41; phosphorus, 0·33 per cwt. Such a material, when melted at a high temperature, takes up carbon very rapidly, and, therefore, would be very destructive upon a carbon-lined hearth-bottom; but with grey cast-iron, high in silicon, the oxidizing action is mainly confined to that element, and the effect upon such a lining would be less, as the product would contain more carbon.

From the results obtained in those experiments, the author has modified the opinions that he formerly expressed upon the subject of scaffolding in blast-furnaces, as it is clear that the descent of the charge cannot be assumed to take place uniformly over the whole section of the furnace.

From a consideration of the facts, it is easy to see that very wide furnaces have a greater tendency to scaffold than narrow ones, and also that when it is necessary to diminish the working power of the furnace it is better to stop up one or more tuyères, continuing to blow with the full size of the reduced number rather than to reduce the pressure of blast uniformly over the full number. In the first case there will be fewer funnels formed in the furnace, but they will be of their normal size, and therefore less liable to disturb the working of the furnace by angular fall of the materials than the larger number of smaller ones.

On the Hardening of Steel. W. Metcalf and J. W. Langley. Trans. of the Amer. Soc. of Civil Eng., vol. xxvii. 1892, 382. Proc. Inst. Civil Eng. Abs. 1893, 69.

As a result of observations and experiments described, the following working hypothesis is offered by Mr. Metcalf, with which both authors are in accord.

The solution of carbon in steel above the point of recalescence is practically perfect, unless the dose of carbon is very large. At and below that point the excess of carbon tends to crystallise out, and therefore very rapid cooling of the steel is necessary to keep it in solution. Also the formation of large crystals is prevented, and only small ones, corresponding to the refining grain, are produced. This disturbance of the crystalline force results in violent molecular stresses, which produce hardness in a manner analogous to cold-rolling or hammering. The function of the carbon is so to alter the ordinary molecular aggregation of the iron that this strained grouping can be brought about within easily managed temperature limits. Similarly, annealing is a partial throwing out of solution of previously dissolved carbon.

The hardening or chilling of cast iron follows the same general law, only, owing to the greater amount of carbon and silicon present, the cooling must take place from the temperature of fusion.

The relation of carbon to melted iron is one which lies very near the border line, separating typical chemical combination from typical solution, if indeed any such separation exists. Hence the customary terms framed to denote one or other of these states do not adequately express the shades of difference between the actual phenomena to which they are applied.

The Precipitation of Tin by Zinc. A. Harpf. Oesterr. Zeits. für Berg- und Hüttenw., 1892, 635. Proc. Inst. Civil Eng. Abs. 1893, 79.

A SUBSTANCE known as argentine has been introduced in Germany for making the so-called silver paper, which is used instead of tin foil as a packing material. It is a finely-divided form of metallic tin, also known as tin dust, of such a texture as to become an extremely fine powder, which must be perfectly uniform in grain, of a bright metallic grey tint, and entirely free from crystalline particles. The author was for some time in charge of a manufactory of this article, and introduced some modifications in the process, which are described. The raw materials of the manufacture are tin, hydrochloric acid, and zinc. The first may be used in the form of block or grain tin, but generally waste materials, such as bearing-metal turnings, which are obtained from railway repairing shops in large quantity, are preferred. These are very variable in composition, including both white and red metal, with the proportion of tin varying from 27·6 to 74·5 per cent. The solution is effected by boiling the alloys with hydrochloric acid in large copper vessels, taking care to keep the stanniferous material in large excess, under which condition the copper is not attacked, while the greater part of the tin dissolves, lead, copper, and antimony remaining wholly or partially undissolved. The solution is filtered through a layer of sand in a hard-wood tub with a double bottom, where the lead chloride contained in the hot liquor crystallises out on cooling. The residues are passed on to another establishment to be used in making copper and antimony preparations. The purified solution, consisting essentially of stannous chloride, with traces of antimony, lead, and iron, having an average density of 40° B., corresponding to about 23·5 per cent. of tin, is diluted from one to two hundred times its volume of water, and transferred to large vats in which plates of zinc are suspended, when, if all conditions are right, the tin precipitates as a uniform grey mass, rendered spongy by the simultaneous evolution of hydrogen, falling, when dried and rubbed through a sieve, to a fine dust. The precipitate is removed every day, fresh liquor is added, and the process is renewed until the zinc chloride solution remaining has reached a strength of 20° to 25° B., when it is removed and concentrated to 50°, corresponding to a strength of 52 per cent. of chloride of zinc. This is readily sold, as it is extensively used for preserving railway sleepers. The finished product should be as nearly as possible pure tin. An average sample analysed by the author contained—hygroscopic water, 0·83 per cent.; lead, 0·60 per cent.; zinc, 0·83 per cent., the remainder being tin, with small traces of iron, chlorine, and antimony.

As the silver paper is used in wrapping up provisions, the tin dust used in its preparation must not, according to the sanitary laws of the German Empire, contain more than 1 per cent. of lead.

In the year 1890 the price realised varied from *7l.* to *7l. 10s.* per cwt.

Formerly silver paper was made by covering ordinary white paper with a priming of white lead and size, upon which either silver leaf or tin foil was cemented. At present this has been almost entirely replaced by argentine, which is made to adhere to the paper by the use of so-called wax solutions, prepared by methods which are kept secret. According to the author the methods are as follows:—

In the first, 4 kilos. of wax and $\frac{3}{4}$ kilo. of potash are boiled with 50 kilos. of water, and the melting fluid so produced is stiffened to a thick paste by stirring the tin precipitate into it.

In the second, 75 litres of freshly made 4 per cent. starch solution are mixed with 750 grms. of a wax solution prepared from 5 lb. of wax and $1\frac{1}{2}$ lb. of potash dissolved in hot water, and 25 kilos. of argentine are added.

The paste so obtained is printed by rolls on to paper, which dries to a dull grey tone, but becomes bright when burnished by passing through hot calender rollers, when it exactly resembles tin foil.

PATENTS.

Improved Methods of Utilising Slag made in connection with Iron and Steel Furnaces. C. H. Aston, Middlesbrough. Eng. Pat. 7473, April 20, 1892

See under IX., *page* 520.

Improvements in or relating to the Treatment of Silver Ores containing Zinc, and Gold Ores containing Zinc. H. A. Penrose, Swansea. Eng. Pat. 7832, April 26, 1892.

ONE part of powdered anthracite is mixed with four parts of the ore containing about 25 per cent. of zinc and the mixture roasted on the bed of a reverberatory furnace, having an iron bottom, for about 12 hours, beginning with a low temperature and finishing at bright redness. The ore is then treated by any of the usual methods for the extraction of gold, silver, and zinc. By this method of roasting there is less loss of gold and silver than in the ordinary roasting.—H. K. T.

Improvements in or relating to Aluminium Solder. A. F. Boult, London. From C. Sauer, Berlin, Germany. Eng. Pat. 8551, May 5, 1892.

This is an alloy consisting of 9 parts of aluminium, 1 to 3 (or even 4) of silver, and 2 to 4 (or even 5) of copper. A silver-copper-zinc-aluminium alloy and a silver-brass-aluminium alloy are also described; moreover, the zinc may be replaced by cadmium or bismuth or a fusible alloy such as "Wood's metal." A small proportion of gold may also be added. In making the alloys the copper and silver are first melted together, molten aluminium added, and solid zinc then dropped in. To use the alloy it is broken up and spread between the surfaces of the articles to be soldered, previously heated; these are then pressed together with the soldering-iron. No flux is required. Directions are also given for soldering aluminium to aluminium, bronze, iron, or platinum.—H. K. T.

An Improved Metallic Alloy. C. F. Hengst, Plumstead. Eng. Pat. 8861, May 10, 1892.

This is an alloy containing 60 per cent. of copper, 38 per cent. of zinc, and 2 per cent. of aluminium. These metals are melted together and sodium or other metallic flux capable of oxidation at the temperature of the mixture is stirred in. The quantity used should be sufficient to flood the surface of the mixed metals. The sodium increases the tenacity of the alloy and prevents deterioration by exposure to air or sea-water. The degree of hardness may be varied by varying the proportions of the ingredients. The alloy is termed "promethium" or "titanic metal."—H. K. T.

Improvements in and relating to Baths for Coating Metallic Plates. W. H. Luther, Glasgow. Eng. Pat. 8932, May 11, 1892.

This bath consists of one U-shaped vessel placed within another so that a U-shaped space is left between the two, in which the metal is melted. The bath is heated by the products of combustion from a fire or an oil-spray burner, which pass through flues surrounding the outer vessel to the inside of the inner vessel, and thence to the chimney. The metal sheets, which may be 30 ft. in length, are drawn into the bath by a pair of rollers and are guided through it by curved guide-pieces. The bath may contain two metals such as lead and spelter floating one on the other and covered with sal-ammoniac. The area of molten metal exposed to the air is small.—H. K. T.

Improvements in Coating Iron and other Metals with Lead, and in the Alloying or Treating of Lead to render it suitable for this purpose. F. G. Bates, Philadelphia, U.S.A., and W. R. Renshaw, Stoke-on-Trent. Eng. Pat. 10,459, June 1, 1892.

To 100 lb. of lead are added 5 lb. of aluminium, 2 oz. sal-ammoniac, ½ oz. arsenic, ½ oz. of borax or 1 lb. of alum, and 1 lb. of cryolite. The alloy of lead, aluminium, and arsenic gives a harder and more firmly-adhering coat than is obtained in the ordinary process. The plates to be coated are cleaned and passed through the bath in the usual way.—H. K. T.

Improvements in the Manufacture of Wrought Iron. J. Lakin, Wolverhampton. Eng. Pat. 10,756, June 7, 1892.

Three cwt. of cast-iron swarf, 4 cwt. of iron scale, such as that from ironworks, forges, tube-works, &c., and 1 cwt. of coke-dust are intimately mixed and introduced into a puddling furnace. As the surface cakes it is removed to one side until the whole charge has become caked into a mass resembling coke. It is then balled up and rolled into bars. The advantage of the process is that a larger yield of iron is obtained from a mixture of cast-iron swarf and scale oxide than from iron swarf alone, there being in the former case a gain, in the latter a loss, of 25 per cent. The charge is best worked in a furnace having two doors. The cinder produced is suitable for fettling puddling furnaces.
—H. K. T.

Improvements in Extracting Silver and certain Base Metals from Ores or Compounds containing the same. J. David, Llwyndu. Eng. Pat. 12,492, July 6, 1892.

Ores containing silver, copper, zinc, and lead combined with sulphur are heated in a closed vessel whereby scintillation in the subsequent calcining is avoided. After calcining they are extracted first with dilute sulphuric acid and then with calcium acetate. On mixing the two extracts silver and lead are precipitated and are recovered in the usual way. Copper is then precipitated in the metallic state with zinc, after which the solution is neutralised with ammoniacal liquor from gasworks, and the zinc precipitated with sulphuretted hydrogen, the sulphide of zinc being collected for the production of spelter. Finally the solution of ammonium sulphate is evaporated to the crystallising point, the sulphuric acid used and that produced in the calcination being in this way recovered. The residue left from the ore after extraction can be smelted in the usual way.—H. K. T.

Process for Production of Metallic Antimony. C. D. Abel, London. From R. Koepp and Co., Oestrich, Germany. Eng. Pat. 12,733, July 11, 1892.

Antimony ores in a sufficiently pulverised condition are treated with a solution of a ferric salt, whereby the antimony is dissolved out in accordance with the equation—

$$6FeCl_3 + Sb_2S_3 = 6FeCl_2 + 2SbCl_3 + 3S$$

Some hydrochloric acid, or better, sodium chloride, is then added and the liquor electrolysed. Metallic antimony is deposited on the cathode whilst the ferrous chloride passes to the anode, where it is oxidised and becomes ready for use over again. The anodes and cathodes may be composed of lead. The bath is heated to 50° C., and is kept in motion by suitable agitation. If the metal be required in a coherent form a current of about 40 ampères per square metre may be employed (this Journal, 1893, 273).
—H. K. T.

Improved Construction of Converters for Smelting Copper. C. Vattier, Santiago, Chili. Eng. Pat. 3107, February 11, 1893.

This is a device for protecting the linings of converters used in the treating of copper, and consists in the employment of a water-jacket in the neighbourhood of the tuyères and the ends of the cylindrical converter. In this way undue cooling of the mass is avoided, whilst the only repairs required are those which can be carried out whilst the apparatus is in operation. The water-jacketing consists of copper tubes conveying water embedded in the lining of the converter, one set of horizontal tubes covering a space extending 0·4 metre above and below the tuyères, another set of nearly circular tubes being placed in each end.
—H. K. T.

Improvements in Compounds for Converting Iron or Low-grade Steel into High-grade Steel by the Cementation Process. F. G. Bates, Philadelphia, U.S.A. Eng. Pat. 3586, February 17, 1893.

This invention is an improvement on a previous one (Eng. Pat. 7820 of 1890; this Journal, 1890, 811) and consists in the addition of manganese or nickel oxide to the previously patented mixture for converting iron into steel by the cementation process. The mixture for converting Bessemer billets into high-grade steel now stands as follows:—90 parts of carbon, 10 of cryolite, 20 of black oxide of manganese, 2 of salt or saltpetre, 10 of hydrated lime, and 10 of ground alum. When a nickel steel is required the manganese may be wholly or partly replaced by nickel oxide. The operation is carried out in the usual way. The nickel steel produced from Bessemer and open-hearth steel is suitable for armour plates and projectiles.—H. K. T.

A Process for Freeing Copper from Arsenic. F. B. Stone, Belvedere. Eng. Pat. 4251, February 27, 1893.

Copper containing arsenic is melted in a reverberatory furnace and is freed from iron, lead, and zinc in the usual way, if necessary. It is then allowed to oxidise until it is brittle and gives a dull red fracture, when sodium or potassium carbonate, hydrate, or nitrate is added in amount equal to 10 times the weight of the arsenic. The metal is kept molten and in contact with the flux for 20 or 30 minutes, and is then cast into pigs, care being taken that the slag does not run with the metal, as the arsenic in the slag would be reduced in the subsequent refining process. The copper is afterwards refined or poled in the usual way. When the percentage of arsenic is less than 1 per cent. the amount of alkaline salt added is the same as if 1 per cent. were present. —H. K. T.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Voltaic Cells with Fused Electrolytes. J. Brown. Proc. Royal Soc. **52**, 75—91.

Considerable discrepancies exist between the observed values of the electromotive forces of ordinary forms of voltaic cells and the theoretical values as computed by Thomson's law. The author attributes this, to some extent, to a possible action of the solvent itself as an electrolyte, to the formation of insoluble films (*e.g.*, oxides or hydrogen), and to the uncertainty of calculations involving heats of solution of the products of the voltaic action. He was, therefore, led to the consideration of a simple form of cell in which the liquidity of the electrolyte was produced by fusion. The possible number of such cells is limited by the fact that the electrolytes must be fusible at reasonable temperatures, and that the boiling point of any component must not be below the fusing point of the electrolyte in contact with it. The author decided to begin with chlorides as the most convenient.

The cells were of the two-fluid type, the outer cell consisting of a V-tube of hard glass, one limb of which was longer than the other and by which the cell was supported. This tube contained one of the chlorides into which dipped the appropriate metal; the bend of the tube could be heated as desired by Bunsen burners. The second cell consisted of another tube the lower end of which was plugged with asbestos to act as a porous partition. In this tube was placed the second chloride and its appropriate metal, and the tube was then placed in the shorter limb of the V-tube. In making the observations the metals were first connected up to the electrometer and then inserted into their respective chlorides, and the deflexion was noted. The deflexion was again noted after about five minutes. The metals were then taken out and cleaned for a fresh set of observations, and the mean of a number of such observations was taken as the true value. The author gives several tables showing his results, which are nearer to the theoretical values than those of the same combinations in aqueous solutions. As a comparison he takes the following numbers (in volts) for metals in aqueous solutions of their chlorides, from Wright and Thompson.

—	Wright and Thompson. Metals in Aqueous Solutions of their Chlorides.			Metals in fused Chlorides.		
	Calculations.	Observations.	Difference.	Calculations.	Observations.	Difference.
Magnesium | zinc	1·634	0·702	0·932	1·07	0·87	0·20
Magnesium | cadmium	2·000	1·030	0·970	1·15	1·17	− 0·03
Aluminium | zinc	1·008	− 0·280	1·288	0·20	0·17	0·03
Aluminium | cadmium	1·374	0·05	1·324	0·28	0·44	− 0·16

The author finds that the electromotive forces of cells containing pairs of the metals, tin, lead, and zinc, come out nearest to the theoretical values. The values obtained for other metals did not agree so closely, but can be brought into agreement by applying constant corrections, one for each metal, and the author attributes these corrections to the high temperatures of the cells as compared with the temperatures for which the recognised heats of combination are true.

Four of the cells were tested by passing currents through them in both directions alternately and noting the electromotive force after each current. It was found that polarisation was practically absent except in the case of the zinc-silver element.—D. E. J.

Electro-Chemical Effects on Magnetising Iron. Part IV. T. Andrews. Proc. R. Soc. **52**, 114—117. (See this Journal 1892, 527 and 609.)

Influence of Magnetisation on Corrosion of Steel.—During the progress of the electrical portion of the author's research, described in previous papers, numerous gravimetric experiments were carried out with the object of determining the influence of magnetisation on the corrosion of iron and steel, the corrosive fluid being a solution of cupric chloride. The following was the method of investigation:—Pairs of steel bars were cut adjacently from a long, highly polished steel rod, so as to be as nearly as practicable alike in structure and composition, one of the bars being magnetised and the other remaining unmagnetised. Each bar was accurately weighed and they were then placed in equal quantities of cupric chloride solution contained in beakers of the same diameter and cubic capacity, the beakers being a considerable distance apart. On the completion of the period of immersion each bar was taken out of the solution, and the deposited copper, which was generally found surrounding the bar in the form of a compact hollow cylinder, was drawn off. The remains of the steel bar were then carefully washed, dried, and weighed. A fresh pair of polished steel bars, one magnetised and one unmagnetised, were prepared for each experiment. The table below shows some of the results.

The cupric chloride solution was prepared by dissolving 4 ounces of crystallised cupric chloride in 20 fluid ounces of water, each steel bar being immersed in the same quantity of solution. The steel bars were not highly magnetised, and the period of immersion was purposely made somewhat long with the object of studying the effect of magnetisation on general corrosion, the immediate effect having been noticed in previous experiments. The results indicate that magnetisation exerts a small but noticeable effect (about 3 per cent.) on the corrosive action of copper salts on iron and steel, probably due, in the author's opinion, to local currents set up by magnetisation between the central and polar portions of the bars, giving rise to greater chemical activity.

Influence of Magnetisation on Corrosion of Steel.

Size of Bars.		Time of Exposure.		Quantity of Solution.	Loss in Weight, Unmagnetised Bar.	Loss in Weight, Magnetised Bar.	Increased Loss in Weight of the Magnetised Bar.
Length.	Diameter.						
Inch.	Inch.	Hours.	Minutes.	Oz.	Grains.	Grains.	Per Cent.
1½	0·296	19	30	10	217·00	260·00	5·27
3	0·295	24	0	10	153·00	167·40	9·11
3	0·296	24	0	10	241·30	247·90	2·73
3	0·296	12	0	10	112·91	122·85	8·80
3	0·296	24	0	Grs. 4000	179·80	187·34	4·19
3	0·293	24	0	4000	206·38	206·85	0·23
3	0·295	24	0	4000	189·03	190·54	0·80
4	0·250	24	0	Oz. 10	221·25	227·46	2·80
4	0·250	24	0	10	219·53	222·14	1·19
4	0·250	24	0	10	229·10	230·22	0·36
1½	0·301	24	0	10	236·74	237·19	0·19
4	0·260	13	0	Grs. 1200	216·62	217·08	0·21
					Average of 29 experiments............		3·05

—D. E. J.

PATENTS.

Improvements in the Method and Process for the Recovery of Tin from Tinned Plate and other Sources. M. Ramos-Garcia, Greenwich. Eng. Pat. 18,726, November 19, 1890. Second Edition.

The improvements relate to the chemical treatment applied to the cuttings in order to clean them and separate the tin, to the electrical treatment of the liquids containing tin in solution, and to the preparation which the iron undergoes on leaving the baths. The tins and cuttings are first subjected to a roasting process to free them from grease, and are then treated in vats with a solution of ferric chloride at a boiling temperature to dissolve off the tin. This ferric chloride is preferably prepared by electrolysis. When the vats contain at least 10 per cent. of their weight in tin the liquid is filtered either through fine sand or through bags of felt, and ordinary crystallised carbolic ("phenic") acid is added in the proportion of 500 grms. to each 1,000 kilos. of the liquid, and sulphuric acid (sp. gr. 1·84) in the proportion of 1,000 grms. to 1,000 kilos. The liquid is now transferred to the depositing baths, and electrolysed until the amount of tin in solution has fallen to 4 per cent., when the process is stopped, the liquid run off, and the recovered tin washed and cast into ingots. The iron from which the tin has been removed is packed ready for transport after it has been washed and dipped in caustic soda or similar solution.

—G. H. R.

Improvements in and relating to the Manufacture or Production of Chlorine and Sodium Amalgam. J. Greenwood, London. Eng. Pat. 5999, April 7, 1891.

The cylindrical containing-vessel of iron forms the cathode of an electrolytic cell, a central insulated rod of carbon with a copper core (as described in Eng. Pat. 18,990 of 1890; this Journal, 1891, 642) being used as the anode. A porous partition, of the same character as that described in the above-mentioned patent divides the cell into two compartments. Both compartments are sealed, but have pipes entering them; those in the anode compartment serving to convey a constant stream of sodium chloride through it, and those in the cathode compartment supplying it with mercury.—E. T.

An Improvement in the Manufacture of Tubes by Electrolysis. F. E. and A. S. Elmore, Leeds. Eng. Pat. 5167, March 23, 1891.

The inventors claim three methods of loosening tubes electrolytically deposited on mandrils (this Journal, 1887, 833).

i. By subjecting the thin shell first deposited to the pressure of a roller, thus stretching all of it except a part at the end, so that after depositing to the required thickness and "parting off" the unstretched portion, the tube can be removed.

ii. By exhausting the air from a thin hollow mandril, thus causing it to shrink from the tube deposited upon it.

iii. By subjecting the mandril to internal pressure before depositing upon it, and after deposit relieving the pressure within so that it shrinks from the tube.—J. C. C.

Method of and Means for Renewing or Repairing the Filaments of Incandescent Electric Lamps. H. Chapman, Morley. Eng. Pat. 5947, April 7, 1891.

The lamp is opened at the bottom (uncapped end) and a little joint-making paste of the usual character introduced to cement the broken parts together. The joint is then carbonised by "arcing" on to it from an electrode introduced from the bottom of the lamp. If desired the old filament may be removed, the bulb cleaned out, and a new filament introduced and attached by the above process. The opening at the bottom is drawn out again and the lamp exhausted and sealed in the usual way. Special tools for the above processes are illustrated in the specification.—E. T.

Improvements in Electro-depositing Copper, Brass, and Bronze, parts of which Improvements are also applicable to other Electrolytic Purposes. W. H. Walenn and J. A. Timmis, London. Eng. Pat. 6029, April 8, 1891.

A bath suitable for the deposition of the above-named materials on iron or similar metals is prepared by the use of potassium cyanide containing only 40 per cent. of real cyanide—this particular strength being specified as an essential to the invention—and mixed with stated proportions of ammonium tartrate and ammonio-cupric oxide, all specially prepared. The ammonium tartrate is made by the addition of ammonia water to tartaric acid until the precipitate at first formed is re-dissolved and the solution has become slightly alkaline. The ammonio-cupric oxide is prepared from hydrated copper oxide freshly precipitated by a slight excess of caustic potash. The whole preparation of the bath is made with the ingredients cold, but the electrolyte, charged with copper to the extent of two or three ounces per gallon, is used at a temperature of about 130° F. See the following abstract.—E. T.

Improvements in Electro-depositing Copper, Brass, and Bronze. W. H. Walenn and J. A. Timmis, London. Eng. Pat. 6030, April 8, 1891.

The bath is made up as in Eng. Pat. 6029 of 1891—abstracted above—but by the addition of ammonia can be worked *cold*. The proportions for copper are, per gallon, 2 lb. of 40 per cent. cyanide, 1 oz. of tartrate and 5 oz. ammonio-cupric oxide. The bath is to be charged with copper electrically by the use of a large anode and a small cathode, and more ammonio-cupric oxide added till the solution becomes of a clear sea-green colour; 6 oz. of ammonia water are then added and the solution used in a closed bath. The deposit is said to be tough, homogeneous, non-porous, bright, and adhesive.—E. T.

Improvements in the Process of Coating or Cleaning Metals. R. Heathfield, Darlaston. Eng. Pat. 9757, June 9, 1891.

Supplementary to Eng. Pat. 500 of 1891 (this Journal, 1892, 443). Plates requiring to be cleaned for galvanising or otherwise coating, are made anodes in a suitable solution. To keep this solution acid, supplementary anodes of carbon or other insoluble material are employed. These cause more iron to be deposited on the cathodes than is dissolved from the anodes, and the solution therefore becomes more acid. Such anodes are not of course used if the solution is already sufficiently acid.—E. T.

A Machine for Separating Magnetic Iron Sand from Gold, Titanium, and other Foreign Matter, for the purpose of Obtaining these for Use. W. C. Alexander, Barnstaple. Eng. Pat. 10,338, June 18, 1891.

The material to be operated upon is introduced with plenty of water into a vertical revolving cylinder in which are placed any convenient number of electro-magnets. In the wash of the material the magnetic particles are thrown outwards by centrifugal force and coming in contact with the poles of the magnet adhere firmly thereto, while the non-magnetic matter is not of course attracted. Various devices are described for making the apparatus self-acting. The magnets, having collected a certain quantity of matter, overbalance a counterpoise, and, descending, open a series of valves for the admission, &c. of more matter; and, finally, their own circuit being automatically broken, release the magnetic matter clinging to them and allow it to fall into a hopper below, while they themselves ascend to their original position for the whole series of operations to start anew.—E. T.

Improvements in the Art of Producing Insoluble Chlorides Direct from the Metals. S. C. C. Currie, Philadelphia, U.S.A. Eng. Pat. 212, January 5, 1892.

The metal, the chloride of which is to be obtained, is made the anode in a cell containing a suitable neutral electrolyte. Thus calomel may be produced by using mercury as anode in a neutral solution of zinc chloride, to which may be added a little sodium or potassium chloride to increase the conductivity of the solution, using a zinc plate as cathode. The chlorine, which is produced by electrolysis is not liberated, but combines with the mercury.—E. T.

Improvements relating to the Coating of Articles with a New Metallic Alloy by Electro-Deposition. The London Metallurgical Company, Limited, and S. O. Cowper-Coles, London. Eng. Pat. 1391, January 23, 1892.

The metal plate is an alloy of zinc, cadmium, and silver, or simply of cadmium and silver. The cadmium, if present to the extent of 25 to 35 per cent., prevents the silver from tarnishing so rapidly as is usual. For a cheaper metal as much as 90 per cent. of the baser metals may be employed.

The electrolyte is cadmium cyanide dissolved in a slight excess of potassium cyanide and mixed with a small quantity of a solution of silver cyanide in potassium cyanide. The anode is an alloy of approximately the same proportions as are desired in the deposited metal.—E. T.

Improvements in or relating to the Electric Treatment of Metal or other Bodies. C. H. Hoho and E. A. C. Lagrange, Brussels, Belgium. Eng. Pat. 7226, April 14, 1892.

According to this invention the heat generated at the point of contact between a solid and liquid conductor, or two solids and a liquid, is applied to the treatment of metals in certain operations such as soldering, forging, hammering, and the like, in which it is required that a high temperature should be attained at certain points. One electrode is large and fixed; the other, which is movable, is the body to be heated, and only such portion of it as it is desired to heat is immersed, and generally speaking it is preferable that the body to be heated should constitute the negative electrode. Any suitable liquid may be employed.—G. H. R.

Improvements in Apparatus or Means for Hardening and Tempering Metals. W. Holland, Birmingham. Eng. Pat. 8393, May 4, 1892.

This invention relates to apparatus for hardening and tempering steel and iron articles such as umbrella ribs, knitting pins, cycle spokes, &c., electrically, the current passing through the article or articles under treatment, and the conducting parts of the machine either in series or in parallel, and these articles themselves form the contacts. The machine or apparatus consists essentially of three parallel discs, disposed at suitable distances apart, and collectively made fast to a turning axis, which is driven from any source of power. The discs are insulated from metallic contact with the gripping and other appliances carried by them, whilst one of the three forms a carrier for resistance coils, which keep the current constant in the event of a wire or other article being omitted in the feed. The lower portions of the discs and the gripping levers carried by them are immersed within a tank of oil or other cooling liquid, which reduces the wires from a maximum to a minimum temperature, and the wires, on their recedence, are again heated to a known temperature, according to that required, and are then allowed to fall out of position or are ejected.—G. H. R.

Improvements in Secondary Batteries. E. Freund and L. Bristol, London. Eng. Pat. 10,388, May 31, 1892.

The principal objects of this invention are to provide means for exerting a uniform resistance to the expansion of battery plates, the formation of a neutral space at the bottom of each cell by constructing the positive and negative plates of unequal depths, the employment of an improved intermediate cover for preventing the escape of the acid, and an improved joint between the cells and the outer casing. The improvements refer more particularly to the portable secondary batteries described in the specifications, Eng. Pat. 9854, 1888 (this Journal, 1889, 622); Eng. Pat. 8456, 1889; and Eng. Pat. 5329, 1891.

In constructing the improved batteries the positive and negative plates in each cell are slightly inclined towards each other, the top edges being further apart than the bottom edges; and between the plates are inserted a series of tapered staves, having the same degree of taper as the space between the plates, their distance apart being preferably about equal to the distance between the plates. The expansion of the plates during formation causes these staves to exert a gentle and uniformly distributed pressure over their surfaces. The staves may be constructed of wood or glass or other suitable material.—G. H. R.

Electrical Insulating Sheet. A. H. S. Dyer, Schenectady, U.S.A. Eng. Pat. 10,521, June 2, 1892.

This invention relates to means for insulating electrical conductors, commutator segments, and the like, and consists in building up an insulating plate from a series of scales of non-comminuted mica of various sizes and shapes, which are held together with their edges overlapping by a cement. Any convenient number of layers so composed are superposed upon one another and cemented together, and are then finished by heating, rolling, and pressing, and are finally for certain purposes, furnished with a layer of a larger scale applied on one or both sides of the sheet and cemented thereto, and if desired heated, rolled, and pressed as before. The sheet may be obtained curved, by heating it and clamping it rigidly in curved shape before cooling, and then chilling it rapidly.—G. H. R.

Improvements in Galvanic Batteries. W. L. Wise, London. From T. Rosati, E. Righetti, and G. O'Connell, Florence, Italy. Eng. Pat. 11,087, June 13, 1892.

In this battery the positive element consists of pure lead, or lead alloyed with another metal—for example, tin—in order that the acid may act upon it; carbon or some similar substance is used for the negative plate, and the exciting liquid contains sulphuric acid, or consists of a dilute mixture of sulphuric and nitric acids.—G. H. R.

Improvements in Secondary or Storage Batteries. W. A. Boese, Berlin, Germany. Eng. Pat. 11,532, June 20, 1892.

The improvements consist in constructing the plates of a mixture of metallic lead, or oxide or peroxide of lead, in a finely-divided state, with an alcoholic solution of anthracene or similar residues from the distillation of coal-tar, subjecting the same to heat not exceeding 35° C., and subsequently forming them by electrolysis in a sulphuric acid bath. —G. H. R.

Improvements in Secondary or Storage Batteries. H. H. Lloyd, Philadelphia, U.S.A. Eng. Pat. 1229, January 19, 1893.

In this battery the supports are cast under pressure round pellets of chloride of lead or other substance which is capable of furnishing the active material for a battery, and the pellets are so shaped that a rabbet joint is formed between them and the plate. Insulating separators provided with apertures corresponding to the active material keep the plates apart, and the latter are provided with longitudinal grooves to allow of the circulation of the acid. The positive plates are wrapped in a textile fabric such as woven asbestos, to prevent short circuits arising from the dislodgement of active material.—G. H. R.

Improvements in the Process of obtaining Chlorates of the Alkalis or of the Alkaline Earth Metals by Electrolysis. W. T. Gibbs and S. P. Franchot, Buckingham, Canada. Eng. Pat. 4869, March 7, 1893.

This process consists in subjecting a solution of chloride of potassium to electrolysis in a cell having an oxide of copper cathode until about one-half of the potassium chloride has been decomposed and converted into potassium chlorate. The solution is then drawn off into crystallising tanks, allowed to cool and crystallise; the cathode is removed from the cell, washed, dried, reoxidised in a current of air at a dull red heat, and then replaced in the cell. The liquor remaining in the crystallising tank is made up to strength with fresh chloride, and returned to the cell to be re-subjected to electrolysis.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Analysis of Washing Powders. W. J. Kinney, W. H. Wenger, and F. P. D. Amer. Chem. J. **14**, 623—624.

The following analyses have been made of four samples of powders used for washing clothes, &c., and largely sold in Virginia.

——	A.	B.	C.	D.
Sodium carbonate	45·2	26·9	19·2	46·6
Fatty acids	26·4	44·0	25·6	25·7
Combined soda	3·1	3·4	3·5	2·6
Fine sand	—	16·3	—	—
Water	23·7	8·8	19·1	21·9

The powders are, therefore, mixtures of soap and dried washing soda, and may be used in conjunction with soap to remove the hardness of water; but when used alone must be injurious to cotton, linen, or woollen goods. It is suggested that borax might be employed with great advantage in the place of soda, as it removes all hardness from water, is an excellent detergent, and at the same time is without corrosive action.—N. H. J. M.

Olive Oil in Southern Sicily. Reports from Consuls of the United States. No. 150, 1893, 406.

According to the United States Consul at Catania, the average season is from the end of September to the end of November, but extends sometimes into January. Lowland olives are considered the richer, and oil made from them remains good longer than that yielded by olives grown on the heights. The olives are ground on a circular platform of solid masonry, about 1 meter high and 2 meters broad. The surface inclines towards the centre, in which stands a stout upright piece of wood. Parallel to this and at right angles with the platform is affixed a millstone some 30 centimeters broad and weighing about 800 kilos. Into this wheel is fastened a heavy pole to which a donkey or mule is hitched. The stone revolves very slowly and a man with a shovel turns the pulp constantly. About 100 kilos. are crushed in half-an-hour, and the mass is then carried to the press in soft rush baskets, which are piled up symmetrically. Several pieces of wood are placed on the top of the pile, and a beam is let down on the whole. A large wooden screw above the middle of the beam is turned by a lever worked by 6—8 men. The oil runs into a hogshead underneath, filled four-fifths with water through which the impurities fall to the bottom. After pressing, the olives are returned to the mill to be ground again for half-an-hour, and again pressed. The double operation is repeated a third time, and the pulp is then taken to a dark room, banked up 40 cm. high, and left for three days, by which time it has attained a high temperature. After being ground it is pressed a fourth time. The remaining pulp, which, out of every 100 kilos. of olives averages 70 kilos., is sold and taken out of Sicily to be worked again by stronger machinery. The fresh green oil is transferred to red unglazed earthen jars in which it is allowed to stand for eight days to clarify. A temperature approximating 70° F. is the best adapted to the clarifying and preservation of the oil.—Ed. T.

Solid Lubricants. Holde. Mitt. Königl. Versuchs. 1892, **4**, 186.

A uniform method for the qualitative examination of solid lubricants can generally be adopted, as they are usually found to consist of lime soap, fatty oil, and mineral oils. Differences in the character of the constituents and in the mode of mixing adopted, account for variations in the quality of the product. The nature of the fat used was ascertained by saponifying the ether extract, removing the mineral oil and precipitating and examining the fatty acids. The residue from the original ether extract (usually a soap) can be decomposed by a mineral acid and the resulting fatty acids also examined. The following table gives the results obtained with various commercial lubricants.

Name.	Appearance.	Specific Gravity.	Acidity (Per Cent. SO_3)	Method of Examination.	Constituents found.	Remarks.
Solid grease.0.	Yellow-brown: consistency of lard; faint smell.	0·926 at 20° C.	Per Cent. 0·03	Extracted C_6H_6 Extract examined for fatty oil, rosin oil, resin, and mineral oil. Residue treated with HCl and fatty acids separated.	Palm oil, mineral oil, lime soap. No resin oil nor "weighting" substances. Fe trace.	..
Solid machine grease.	Yellow; consistency of lard; soapy smell.	0·896 at 18·7° C.	0·06	Extracted CS_2; remainder of examination as above.	Fatty oil, mineral oil, lime soap. No rosin, rosin oil, nor "weighting" substances.	..
	Yellow-brown: consistency of lard: slight smell.	..	..	As above.	Fatty oil, mineral oil, strongly fluorescent and containing much paraffin (behaving like brown coal tar oil); lime soap $Fe_2O_3+Al_2O_3$ trace.	Iodine number of fatty acids separated from soap=72.
Wagon grease.	Deep brown; consistency of lard; smelt of rosin oil.	1·095	0·158	Extracted $C_2H_5(OH)$; residue $BaSO_4$ HCl removed CaO from alcoholic extract. The residual oil yielded resin acids by washing with Na_2CO_3 and precipitating the solution with HCl.	Rosin oil, rosin, lime soap: $BaSO_4$ Fe trace. No mineral nor fatty oil.	The high specific gravity is due to the $BaSO_4$
Leather belt dressing.	Brown: consistency of lard; smelt of bitter almond oil.	..	1·69	Soluble in much ether. Alcohol removed a red-brown fish oil. Residue more solid than soluble portion. Nitrobenzene recognised by reduction to aniline which was detected by chloride of lime.	Is a mixture of solid and liquid fats perfumed with nitrobenzene soap, mineral, tar, and rosin oil. and "weighting" agents absent. Ash 0·4 per cent.	..

—B. B.

Researches on Turkey-red Oil. P. Juillard. Bull. Soc. Ind. Mulhouse, 1892, 415–491.

An account of the author's conclusions as to the nature of the Turkey-red oil prepared from castor oil has already appeared (this Journal, 1892, 355).

With respect to the product from olive oil, it is considered that at temperatures of from 0° to 5° the initial action of sulphuric acid on this oil is to form direct addition compounds, namely, dioleïnhydroxystearinmonosulphuric and monoleïndihydroxystearindisulphuric esters—

$$\left.\begin{array}{r}HSO_4.C_{17}H_{34}COO.\\(C_{17}H_{33}COO.)_2\end{array}\right\}C_3H_5$$

and—

$$\left.\begin{array}{r}(HSO_4.C_{17}H_{34}COO\ )_2\\C_{17}H_{33}COO.\end{array}\right\}C_3H_5$$

These by further action of the acid are respectively resolved into—

$$\left.\begin{array}{r}C_{17}H_{33}COO.C_{17}H_{34}COO.\\C_{17}H_{33}COO.\end{array}\right\}C_3H_5.SO_4H$$

and—

$$\left.\begin{array}{r}C_{17}H_{33}COO.C_{17}H_{34}COO.\\H\ SO_4.C_{17}H_{34}COO\end{array}\right\}C_3H_5\cdot SO_4H$$

The sodium salts of the latter compounds together with their derivatives and products of decomposition, namely, oleic, hydroxystearic, oleostearic, and possibly oleohydroxyoleic acids, constitute the oil-magma which is produced by the prolonged action of sulphuric acid on olive oil, after it has been freed from uncombined sulphuric acid by washing successively with sodium sulphate and sodium chloride solutions, the glycerin-sulphuric esters decomposing the alkaline salts and thus becoming neutralised. When boiled with dilute hydrochloric or sulphuric acid, the sulphuric acid is completely eliminated from this magma, and a mixture of oleic, oleostearic, hydroxystearic, and perhaps oleohydroxyoleic acids is produced.

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—E. B.

Remarks on the Preceding Paper. Scheurer-Kestner and Binder. Bull. Soc. Ind. Mulhouse, 1892, 409–415.

The research on the composition of Turkey-red oil carried out by Juillard (this Journal, 1892, 355, and preceding abstract), is the most exhaustive yet made on the subject. The problem of the nature of this product may now be considered solved.—E. B.

Estimation of Ash in Mineral Lubricating Oils. A. Stepanow. Chem. Zeit. Rep. 1892, **31**, 348.

See under XXIII., *page* 552.

Manufacture of Hard Soap. C. D. Abel, London. From N. Osuchowski, Varsovia, Poland, and A. S. Zivierzchowski, Paris, France. Eng. Pat. 10,784, June 7, 1892.

This invention relates to the manufacture of hard soaps without "unsalting," by first slowly boiling without water fatty acids or neutral fats or resins, or mixtures of these, with a caustic alkaline lye or alkaline carbonate lye, then adding successive small quantities of pure water until frothing ceases and the mass becomes uniform and transparent, and finally drying and pressing in moulds. By this process rapid saponification is effected.—J. L.

Improvements in the Process of and Apparatus for Thickening Linseed Oil. R. Haddan, London. From E. Schaal, Feuerbach-Stuttgart, Germany. Eng. Pat. 4935, March 7, 1893.

The inventor thickens linseed oil by heating it to a temperature of 330°—345° C. To prevent the oil from catching fire, an indifferent gas, or steam, is allowed to pass over the oil so as to exclude atmospheric air. A special apparatus has been designed for carrying out the process. Should, by inadvertence, the oil have been heated to a higher temperature than specified above, a stream of cold oil can be introduced into the lower portion of the apparatus whilst the thickened oil runs off through an overflow pipe. —J. L.

Solubility of Rosin Oil and Mineral Oil in Acetone. E. Wiederhold. J. Prakt. Chem. **47**, 1893, 394.

See under XXIII., *page* 551.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Notes on Oxycellulose and Bornesite. E. R. Flint and B. Tollens. Annalen. **272**, 288.

See under XIX., *page* 540.

The India-Rubber of the Upper Orinoco. Dr. Lucien Morisse. Annales Télégraphiques, 1892, 355. Proc. Inst. Civil Eng. 1893, 110.

In 1888 and 1889, the author undertook a journey to the basin of the Orinoco and Rio Negro, in the course of which a detailed study was made of the methods in use for the extraction of india-rubber. The india-rubber obtained on the Orinoco is identical with that from the Amazon, the latter being known as Para rubber. The trees in both districts are varieties of Hevea, belonging to the Euphorbia family. When the trees are cut down, the roots send up fresh branches, which attain maturity in about five years. It is, however, forbidden by the Venezuelan Government to cut down the trees, and the sap is extracted by tapping them. In Columbia, felling the trees is permitted. The work is chiefly carried on by Indians, and is at present confined to the banks of the rivers, although the whole of the forest region is said to be equally rich in rubber trees. The work is commenced by clearing a path through the forest with short pathways leading to the trees. The trees are then scraped to remove moss and other loose substances, and a liana is bent round the trunk at a height of an inch or two above the ground. The liana is placed in a slanting position, so that the juice runs towards one side. The ends of the liana are tied together by means of smaller creepers, and the space between the bark and the loop is smeared with clay. At the lower end of the liana a small cup made of leaves is fixed in such a position that it receives the sap. The trees are tapped every second day, the number of holes made in the bark varying from eight to sixteen. After tapping, the sap continues to run for about three hours. The milk having been collected, a fire is made with resinous wood, in the smoke of which a piece of wood is rotated. The milk being poured over this piece of wood at regular intervals, is coagulated, and when the mass of india-rubber thus formed is sufficiently thick, it is removed by making an incision in one side. The Indians adulterate the india-rubber both with inert substances, such as sand, stones, wood, &c., as well as with the milky juice of other trees, chiefly of the Balata family. The tests used to detect admixtures of the latter kind are based upon the diminution of elasticity which results from the presence of balata. The chief action which the smoke has upon the india-rubber is to coagulate it; but the cake is also saturated with antiseptic substances; these prevent subsequent fermentation, which would be detrimental to the quality of the product. The method of smoking being very slow, the author undertook a number of experiments in order to discover a more rapid method of coagulating the sap. The action of a number of chemical re-agents upon the sap was tested, and several were found to coagulate the india-rubber satisfactorily. The most economical substance for this purpose was found to be ordinary sulphuric acid, one part of which will coagulate about 500 parts of sap. It was found, however, that india-rubber which had been treated by sulphuric acid alone, soon began to decompose, and was covered with fungoid growth. A small proportion of carbolic acid was therefore added as an antiseptic, and with this addition the process gave good results. The india-rubber extracted by this method is white and of great purity. It may be coloured dark, like the variety known as Para, by adding a small quantity of lampblack to the milk before coagulation. The author considers this unnecessary, and regards the carbon as an impurity. It is estimated that a European workman could produce by this process about 50 kilos. (1 cwt.) of pure india-rubber daily. The author gives a number of particulars with reference to the occurrence of the Hevea trees in the various river basins, and also describes the system of exploitation which prevails at present.

PATENTS.

Improved Manufacture of Vermilion. H. W. Picton, London, and S. E. Linder, Oakfield. Eng. Pat. 5120, March 15, 1892.

This invention is one in which the manufacture of vermilion is effected by a wet process in which black sulphide of mercury is treated with solutions of alkaline sulphides, whereby great difficulty is experienced in getting rid of the last traces of the latter. To avoid this difficulty the inventors suspend the black sulphide in water which is saturated with sulphuretted hydrogen. The black sulphide in this course of treatment dissolves, and on keeping the solution heated, preferably at a temperature of about 160° C., it slowly and spontaneously changes into vermilion.—C. O. W.

Improvements in or relating to Colour Washes. W. H. Bodin, Wednesbury. Eng. Pat. 9812, May 24, 1892.

This invention refers to colour-washes for coating walls, ceilings, paper hangings, and other surfaces so as to enable the colour-washed surface to be washable with water without removing or damaging the colour. The surfaces to be treated are prepared in the usual manner with alum or size soap and alum. To one gallon of the vehicle to be used for colour-washing are added the following ingredients:—

Borate of manganese	1½ lb.
Ground sugar of lead	1½ „
Alum	1½ „

or—

Phosphate of zinc	1½ lb.
Phosphate of soda	1½ „
Sulphate of iron	1½ „

or—

Strong spirit of ammonia	1 oz.
Ground sugar of lead	1½ lb.
Alum	1½ „

or—

Resin	1 lb.
Caustic soda	1 oz.

When made up in the form of a powder, either of the above mixtures is ground up with such a quantity of glue as there would be in the amount of size used.—C. O. W.

Preparation or Material for Lacquering or Covering Surfaces. D. Marcus, London. From The Japan Curio Co., Yokohama, Japan. Eng. Pat. 11,029, June 11, 1892.

The sap or juice procurable from *Rhus vernicifera*, tapped about May 15th to June 10th, is called in Japanese Hatsugama, and consists of about 75 per cent. of resin and 25 per cent. of water. The lac tapped from about June 10th to August 31st is called Natsumono or Sakarimono and contains about 80 per cent. of resin and 20 per cent. of water, while the lac tapped in September is named Doyo Sugi or Osohen. The raw lac is a thick resinous fluid of little or no value for lacquering purposes. Different qualities have to be mixed together and other ingredients added to make it fit for use.

To make a lac called Roiro from 80 to 85 per cent. of the natsumono, 10 to 15 per cent. Togishiru, and about 5 per cent. of Yenabura are well churned together. Togishiru is the sediment remaining from the grinding of steel or iron articles, Yenabura is an oil extracted from a seed called Hengoma resembling coriander seed in appearance. The above mixture is heated in a pan over a charcoal fire for about 8 hours until the colour changes from dark cream to deep black. It is absolutely necessary to expel from the mixture all traces of water and then to filter it.

When applied, the mixture is glutinous and sticky, and must be dried in a damp atmosphere at about 70° F. A polish or lustre can be given to the dried surface by rubbing down all inequalities with charcoal or whetstone and then coating the surface with a very thin coat of raw lacquer. The raw lacquer should be immediately wiped with soft paper. A second coating of raw lacquer should then be added, and this new surface allowed to dry. The lustre can be improved by polishing with the hand, using a soft powder or oil; Tsunoko or buck's horn powder is suitable for the purpose. If very high quality of lacquer is desired the lacquering process can be repeated as often as 20 times, each coating being rubbed and polished before the application of the next coating. The Nashiji or gold-dust ground, is obtained by scattering gold-dust on the lacquered surface before the lacquer is dry and pressing it with paper.

Inferior qualities of Roiro lacquer are obtained by altering the quantities of ingredients or using lac of different qualities. Vermilion or other coloured lacquers are obtained by mixing 6 lb. of Natsumono, $2\frac{2}{10}$ lb. of Osohan, $2\frac{2}{10}$ lb. of Yenabura, $\frac{2}{10}$th of a lb. of the skin of dried plums, and about 20 lb. of vermilion or some other pigment. This mixture is prepared and used in the same manner as the Roiro lacquer.—C. O. W.

Improvements in Varnishes. A. M. Dumoulin, Asnières, France. Eng. Pat. 3034, February 11, 1893.

The approximate proportions of the ingredients of this varnish are:—

Fat	40
Oil of turpentine	350
Lamp black	9
Plumbago	600
Scent	1

The fat is dissolved in the moderately warm oil of turpentine. Subsequently the lamp black and plumbago are incorporated, and finally a scent, such as essence of bitter almonds, is added to mask the disagreeable odour of the plumbago.—C. O. W.

An Improved Liquid Bronzing Composition. J. Perl, Berlin. Eng. Pat. 3557, February 12, 1893.

This is a non-oxidising liquid bronzing composition consisting of a mixture of—

	Parts.
Pyroxylin	45
Aceto-acetic ether	855
Damar Resin	25
Amyl-acetate	75
Bronze powder	225

—C. O. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Chemistry of the Grainer Pit. T. Palmer and P. G. Sanford. J. Anal. and Appl. Chem. 1893, 7, 87—95.

In the following analyses liquor A is an infusion of 6·187 lb. of air-dried pigeon's dung per gall.; liquor B is the same liquor after it has been mended with an infusion of 1·058 lb. of air-dried pigeons' dung per gall.; liquor C is residual liquor, *i.e.*, such as has ceased to bring out goods:—

——	A.	B.	C.
Specific Gravity	1001·2	1001·6	1001·4
	Per Cent.	Per Cent.	Per Cent.
Alkalinity (NH_3)	0·102	0·102	0·085
Total ammonia	0·034	0·056	0·025
Total solid matter	0·210	0·350	0·330
Containing organic matter	0·074	0·186	0·162
„ ash*	0·136	0·164	0·168
*Containing:—			
Silica	0·004	0·003	0·003
Calcium carbonate	0·026	0·054	0·062
Magnesia	0·008	0·007	0·004
Potassium carbonate	0·033	0·033	0·016
Sodium chloride	0·065	0·067	0·083
Total	0·136	0·164	0·168

No uric acid, tyrosine, &c. were found. It was noted that the liquors contain much less soluble total solid matter and more ammonia than the original dung paste; this is attributed to the loss of organic matter and production of ammonia during the fermentation to which the paste is subjected.

Their study of the grainer vat leads the authors to conclude that (1) the quantity of active substances actually required is very small; and (2) the waste of material is mainly due to the introduction of organisms which have no part in the graining process, but break down both pelt and graining material.

Experiments in which artificial liquors, graining liquors, and bran drenches were confined in Pasteur flasks, sterilised, and inoculated with bacilli, are detailed. They show that contact with air is not an essential condition for the graining process, which is a species of lactic, and "hence of butyric, fermentation," and depends upon the presence of decomposing nitrogenous albuminoid matter. It is also demonstrated that the deleterious growths are in great measure prevented, and material thus saved, by covering in the pit with inclined match-boarding which prevents access of air and confines the anti-aërobic gases evolved during the process. The revolving drum or paddles should in this case be wholly submerged in the liquor.—A. G. B.

PATENTS.

Improvements in the Process and Apparatus for Tanning Hides and Skins with Electrolytic Action. E. J. Finot, Paris. Eng. Pat. 11,835, June 24, 1892.

The hides or skins are suspended in the tan pit so as to be completely immersed in the liquor, and are connected with the negative pole of a dynamo. The positive pole is a sheet of lead or other suitable metal attached to the bottom or side of the pit. A current of carbonic acid gas is introduced into the liquor "for the purpose of keeping open the pores of the hides by causing them to resist the contraction due to the action of the tannin." At the same time the liquor is kept in constant circulation to hasten the process, by means of a rotary pump or a screw propeller. Care is taken to graduate the increase in "the percentage of alkalis, acids, and tannin of the bath, whereby the strength of the bath can be proportioned according to the progress of the tanning process." Steam is introduced to maintain the proper temperature.—A. G. B.

A New or Improved Putty or Marine Glue. C. A. Jensen, London. From W. M. Walters, Liverpool. Eng. Pat. 18,443, October 14, 1892.

This consists of a new kind of putty or marine glue such as is used in filling the seams of ships' decks, coating bilges and ships' bottoms, in place of Portland cement. The putty is prepared by melting about 50 parts of resin at from 200° to 300° F., adding 6 parts of oil, raising the temperature to 350° F., and adding 56 parts of whiting or equivalent material. The proportions may be altered according to the consistency required.—C. O. W.

XV.—MANURES, Etc.

On the Occurrence of Phosphates in Nebraska. E. Fulmer. J. Anal. and App. Chem. 1893, 7, 95—98.

On the banks of a small tributary of the Republican river an excavation shows the decomposed shale which underlies that region, and a close examination of this shale reveals the presence of blue nodules varying from one-sixteenth to one-fourth of an inch in diameter. They are are of all shapes, and are easily crushed between the fingers; when powdered they dissolve easily in acids, and an analysis of this solution shows that they consist of ferrous and ferric phosphates, evidently being the earthy variety of *Vivianite*. The following is an analysis of the mineral:—

	Per Cent.
Phosphoric acid	25·62
Ferric oxide	15·67
Ferrous oxide	28·23
Water	23·95
Insoluble residue	4·77

Lime, magnesia, and alumina were not determined.

Deducting the insoluble residue, this analysis corresponds with the formula—

$$2(4FeO.P_2O_5) + 2Fe_2O_3.2P_2O_5 + 29H_2O$$

In the same neighbourhood another excavation reveals the shale in a further stage of decomposition, and containing yellow nodules of about the size of a chestnut. They are less easily soluble than the blue nodules, and are evidently mainly ferric phosphate, for the following is an analysis of the sample:—

	Per Cent.
Phosphoric acid	27·94
Ferric oxide	42·74
Ferrous oxide	0·32
Water	23·12
Insoluble residue	5·32

Alumina, lime, and magnesia were not determined.

This analysis approximates to the formula—

$$4Fe_2O_3.3P_2O_5 + 20H_2O$$

The shale itself in this district contains varying amounts of iron, and from 1 to 3 per cent. of phosphoric acid.

Inasmuch as the yellow nodules are blue or green in the interior, and occur at points where the rocks have a scoriaceous appearance, the author concludes that the yellow nodules are produced by the oxidation of the blue at a high temperature. Both forms become dark-reddish brown when ignited.—A. G. B.

Examination of Bone Meal, Meat Meal, and Similar Phosphatic and Nitrogenous Manures. W. Hess. Zeits. ang. Chem. 1893, 74.

See under XXIII., *page* 551.

PATENTS.

Improvements in Compositions for Tillage or Fertilising, Polishing, and like Purposes. G. Norman, jun., Sheffield. Eng. Pat. 7677, April 23, 1892.

Oyster and other shells are calcined, powdered, and mixed with 10 per cent. of powdered coprolites and a small proportion of dried and ground horns or hoofs of animals, to which mixture 5 per cent. of basic slag, charcoal, and "other materials, according to the required nature of the tillage," may be added. When the mixture is intended for polishing purposes calcined oyster shells may be mixed with 10 per cent. of Trent sand, and the whole ground to "an impalpable powder."—B. B.

Improvements relating to the Collection of Ammonia and Ammoniacal Salts from Gaseous and Liquid Mixtures. E. D. Cuyper, Mons, Belgium. Eng. Pat. 13,686, July 27, 1892.

See under II., *page* 511.

XVI.—SUGAR, STARCH, GUM, Etc.

Animal Charcoal. Zapiski. Bull. Soc. d' Encouragement, 1892, 7, 834—851.

The absorbent properties of animal charcoal were discovered by a pharmacist named Fiquier in 1811, and in the following year Derosne employed this substance for the treatment of beet juice in the place of wood charcoal, which had been used for the same purpose since the commencement of the beetroot sugar industry in France. Animal charcoal was, however, at that time a costly material, and its manufacture as a separate industry can only be regarded as established after Charmes in 1822 and Dumont in 1828 commenced to revivify it; they employed the substance in the form of lumps.

The author then describes the various forms of furnaces which have been used for burning bones. The present processes largely depend upon the requirements of manufacturers, which differ in various countries. In Austria animal charcoal in lumps of the size of a walnut is used, in Germany the size of the lumps is at most that of a hazel nut, in France the form is that of granules of the size of linseed, and in England and America that of millet seed. Certain definite conditions as to the colour, coarseness, form, and porosity of the pieces or granules are also always insisted upon.

When the fatty matter in bones is extracted with ether and the mineral matter with hydrochloric acid, there remains a semi-transparent substance—osseïn—of somewhat variable composition, which, when treated with hot water, is converted into gelatin.

In the manufacture of animal charcoal, it is a matter of extreme importance to ascertain the relative amounts of mineral and organic matters in a sample of bones. The mean values of the analyses of all the bones comprising an ox skeleton are osseïn 34 per cent., and ash 66 per cent. The crude bones contain about 15 per cent. of fat and 25 per cent. of water, together with foreign impurities such as sand. The large bones such as the femur are on account of their greater richness in osseïn the most servicable for the manufacture of animal charcoal. In order to obtain a homogeneous product, it is necessary to reduce the percentage of sand in the crude material to a fixed amount. Bones which have been exposed to the atmosphere or to moisture lose their osseïn and yield a charcoal of little value; it may be recognised by its grey colour.

The bones should be reduced to pieces the size of a walnut and the fat extracted by means of light petroleum naphtha, after which only 1—2 per cent. of fat remains. This treatment with petroleum naphtha is indeed so important that it is only since the year 1879, when the process was first adopted, that a really good sample of animal charcoal has been obtainable. The bones are dried at a temperature not exceeding 70° C. — a higher temperature renders them brittle—and are crushed by means of fluted cylinders, disintegrators, mills, or mill stones. The production of spheroidal fragments is sometimes effected by softening the fragments of bone with steam and subsequently treating them in specially constructed apparatus; this process, however, destroys a portion of the osseïn, and gives rise to a charcoal of inferior quality. Wendel, of Vienna, patented, in the year 1887, an apparatus for rounding the fragments of bone and freeing them from adherent extraneous matters.

The gaseous products which are given off during the carbonisation of bones comprise a mixture of hydrocarbons, amines, carbonic oxide, carbonic anhydride, ammonium cyanide, and cyanogen; they burn with a bright flame. The condensed liquid is of two kinds, viz., an oily liquid of sp. gr. 0·97, which on rectification yields the well-known Dippel's oil, and an aqueous liquid of sp. gr. 1·05 — 1·1 containing principally ammonium salts, but in addition more or less of the oily product in solution. According to the author, bone oil may perhaps serve for the manufacture of Prussian-blue, whilst the aqueous distillate yields on neutralisation with sulphuric acid, a suitable material for the ammonia-soda process.

The temperature at which the bones are carbonised exerts a great influence on the various products, thus:—The higher the temperature the more volatile products and less charcoal are obtained, but the composition of the former is simpler than that of those obtained at a low temperature. In practice it is found that to produce a charcoal completely black, a cherry-red heat is the most convenient temperature, whilst at a lower temperature the osseïn is not completely decomposed and the product has a characteristic reddish-brown reflection. Too high a temperature gives rise to the production of a vitreous charcoal, which has generally a bluish reflection. It is important that the temperature should be kept low in the initial stage of the process, that is, until all the water has been driven off, after which it is gradually raised to a cherry-red glow.

Experiments on the decolourising power of animal charcoal, carried out with numerous samples and dark beetroot juice, lead the author to the view that the principal factor in the decolorising power of this substance, is its porosity, but besides this the percentage of carbon plays a not inconsiderable part. (This Journal, 1888, 419).—A. R. L.

Melassigenic Action and Influence of Salts on the Crystallisation of Sugar. A. Nugues. Bull. de l'Assoc. des Chim. 10, 22.

The author's *modus operandi* is as follows:—A concentrated syrup containing sugar (300 parts) and water (100 parts) was prepared; it was kept cool and agitated for four days, when the massecuite was drained from the sugar crystals by vacuum, on a perforated copper plate, covered with a disc of filter-paper. The filtered liquid was found to contain 204 grms. of sugar to 100 grms. of water. In 304 grms. of this syrup there was dissolved at 80° C. 100 grms. of sugar and 7 grms. of potassium chloride. This syrup is designated first product; after keeping it cool and agitating it for

Name of Salt.	Syrup from First Product.		Syrup from Second Product.	
	Co-efficient.		Co-efficient.	
	Melassigenic.	Crystallisation.	Melassigenic.	Crystallisation.
Calcium chloride	..	7·666	.	3·693
„ acetate	..	2·244	..	1·868
„ "gluconate"...	..	1·789	..	1·466
„ lactate	..	1·525	..	0·616
„ nitrate.........	..	1·349	..	1·687
Sodium acetate	..	1·272	..	1·264
„ "gluconate"....	..	1·161	..	1·241
„ sulphate	..	1·580	..	1·580
„ lactate..........	..	1·050	..	0·726
Potassium gluconate....	..	0·941	..	1·112
Sodium chloride	..	0·840	..	0·513
Potassium lactate.......	..	0·733	..	0·515
Sodium nitrate	..	0·653	..	0·624
Potassium sulphate.....	..	0·455	..	1·040
„ acetate.......	..	0·410	..	0·386
„ chloride	..	0·280	..	0·200
„ nitrate.......	0·072	..	0·060	..
Sodium carbonate	0·738	..	0·182	..
Potassium carbonate....	1·273	..	0·861	..
„ hydroxide....	6·120	..	5·666	..
Sodium hydroxide	7·404	..	8·140	..

four days, the sugar crystals were filtered off as before. The filtrate contained 202 grms. of sugar to 100 grms. of water, so that the weight of crystals on the filter was 102 grms.—2 grms. more than the weight of the second addition of sugar. It is therefore evident that the effect of the salt is the opposite to melassigenic. The co-efficient expressing the retarding effect exerted by the salt on the formation of molasses, or in other words its assistance to the crystallisation of sugar, is thus calculated $\frac{2 \times 1}{7} = 0\cdot28$.

To prepare the second product, half the water was evaporated from the last syrup; it then contained 202 grms. of sugar, 7 grms. of potassium chloride, and 100 grms. of water. The syrup which drained from the resulting massecuite, treated precisely as in the other cases, contained 100·6 grms. of sugar to 100 grms. of water, so that the weight of sugar left on the filter was 101·4 grms. instead of 100 grms., which would have been obtained had no salt been present. The crystallisation co-efficient is therefore in this case $\frac{1\cdot4 \times 1}{7} = 0\cdot2$.

The whole of the added salt was found in the syrups in every other case but those of potassium sulphate and calcium lactate, which salts crystallise out with the sugar.

The table on previous page gives the melassigenic and crystallisation co-efficients of the salts experimented with.

—A. R. L.

Digest of the Studies Made on the Nature of the "Organic Non-Sugar" in Saccharine Products. J. A. Deghuée. School of Mines Quarterly, 1892, **13**, 312—333.

The author states that he has compiled the index to the literature of the organic non-sugar constituents of saccharine products, of which the following is an abstract, preparatory to an investigation of the organic constituents of cane-juices. The compounds are arranged in three sections, namely, organic acids, nitrogenous bases, non-nitrogenous substances.

Acetic Acid.—Identified in the liquid from the save-all of the vacuum-pans. Prepared by extracting with ether, forming the ethylic ether and then fractionating (Birnbaum and Koken, Ber. 1875, **8**, 83. Not present in the untreated beet-juice; is a product of fermentation (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Method of determination (Teixeira Mendes, Zeits. Ver. 1885, **35**, 250). Found in cane-molasses (Winter, Untersuchungen über das Zucker Rohr, 1891, p. 18).

Aconitic Acid, $C_6H_6O_6$—Discovered in cane-juice. Method of preparation (Behr, Zeits. Ver. Rübenzucker Ind. 1877, **26**, 738). Found both in cane and beet juices (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Found in the pan incrustations of sorghum sugar-works (Parsons, Neue Zeits. Rübenzucker Ind. 1882, **9**, 87; this Journal, 1883, 189).

Adipic Acid, $C_6H_{10}O_4$—Found in the calcium precipitate which is produced during the treatment of beet-juice (von Lippmann, Ber. 1891, **24**, 3299; this Journal, 1892, 50).

Apoglucic Acid, $C_{18}H_{10}O_9$—Produced by the action of alkali on glucose (Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Found in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780; this Journal, 1888, 761).

Arabic Acid, $C_8H_{10}O_7$—Discovered by Scheibler to be identical with metapectic acid (Zeits. Ver. Rübenzucker Ind. 1873, **23**, 179). Preparation and properties (Wachtel, Neue Zeits. Rübenzucker Ind. 1879, **3**, 367; von Lippmann Die Zuckerarten und ihreDerivate, 1882, p. 185). Usually found as calcium salt (von Lippmann, Zeits. Ver. Rübenzucker Ind. 1880, **30**, 342).

Aspartic Acid, $C_4H_7NO_4$—Preparation and properties (Scheibler, Zeits. Ver. Rübenzucker Ind. 1866, **16**, 222).

Butyric Acid.—Identified in the liquid from the save-all of the vacuum pans (Birnbaum and Koken, Ber. 1875, **8**, 83). A product of fermentation; not present in untreated beet-juice (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Method of determination (Teixeira Mendes, Zeits. Ver. Rübenzucker Ind. 1885, **35**, 250). Found in cane molasses (Winter, Unters. über das Zucker Rohr, 1891, p. 18).

"Canna Acid," $C_{14}H_{16}O_{13}$—Discovered by Winter (Unters. über das Zucker Rohr, 1891, p. 18).

Citric Acid.—Said to be present in beets prior to 1849 (Michaelis, Zeits. Ver. Rübenzucker Ind. 1852, **2**, 64). Found in beets as a salt (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Thought not to be present in cane juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780; this Journal, 1888, 761). Not found in cane molasses (Winter, Unters. über das Zucker Rohr, 1891, p. 18).

Formic Acid.—Identified in the liquid from the save-all of the vacuum pans (Birnbaum and Koken, Ber. 1875, **8**, 83). Product of fermentation not present in untreated beet-juice (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Method of determination (Teixeira Mendes, Zeits. Ver. Rübenzucker Ind. 1885, **35**, 250). Not found in cane molasses, Winter, Unters. über das Zucker Rohr, 1891, p. 18).

Glucic Acid, $C_{12}H_{18}O_9$ (Reichardt, Zeits. Ver. Rübenzucker Ind. 1870, **20**, 529).—Violet colour of beetroot juice due to iron glucate (Teixeira Mendes, Zeits. Ver. Rübenzucker Ind. 1874, **24**, 420; also Bodenbender, Zeits. Ver. Rübenzucker Ind. 1875, **25**, 122). Produced by action of alkali on glucose (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Found in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 772; this Journal, 1888, 761).

Glutamic Acid, $C_5H_9NO_4$ (Scheibler, Zeits. Ver. Rübenzucker Ind. 1869, **19**, 553).—Presence in beetroot juice confirmed (Bodenbender and Pauli, Zeits. Ver. Rübenzucker Ind. 1877, **27**, 965). Properties (Scheibler, Neue Zeits. 1884, **13**, 101).

Glutaric Acid, $C_5H_8O_4$—Discovered in the calcium precipitate which is formed during the treatment of beetroot juice (von Lippmann, Ber. 1891, **24**, 3299; this Journal, 1892, 50).

Glutimic Acid, $C_5H_7NO_3$ (Lippmann, Chem. Zeit. 1884, **8**, 385).

Glycollic Acid, $C_2H_4O_3$—Found in the calcium precipitate formed by the treatment of beetroot-juice (Ber. 1891, **24**, 3299; this Journal, 1892, 50).

Glyoxylic Acid, $C_2H_2O_3$—Found in very young beetroots (von Lippmann, Neue Zeits. Rübenzucker Ind. 1891, **27**, 194).

Humic Acid, $C_{24}H_{10}O_{10}$—An oxidation product of a colourless substance present in beetroots (Sostmann, Zeits. Ver. **17**, 56).

Lactic Acid, $C_3H_6O_3$—Not present in untreated beet-juice; product of fermentation (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Not found in cane molasses (Winter, Unters. über das Zucker Rohr, 1891, p. 18).

Malic Acid, $C_4H_6O_5$—Doubtful if the compounds prepared by Payen and Braconnot were really malic acid (Siekel, Zeits. Ver. Rübenzucker Ind. 1877, **27**, 780; Lippmann, Ber. 1891, **24**, 3299; this Journal, 1892, 50). Found in the beetroot as a salt (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Identified in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780; this Journal, 1888, 761). Known to exist in beetroot 40 years ago (Lippmann, Zeits. Ver. Rübenzucker Ind. 1890, **40**, 424). Found in the calcium precipitate formed during the treatment of beet-juice. Lævo-modification only found (Lippmann, Ber. 1891, **24**, 3299: this Journal, 1892, 50).

Malonic Acid, $C_3H_4O_4$—Discovered in incrustation of the vacuum pans (Lippmann, Neue Zeits. 1881, **6**, 299). Found in the juice of unripe or decomposed beetroots (Lippmann, Zeits. Ver. Rübenzucker Ind. 1883, **33**, 715).

Melassic Acid, $C_6H_6O_3$ (?).—Product of action of alkali on glucose (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882).

Metapectic Acid, $C_8H_{10}O_7$, $2H_2O$—Found in beetroot prior to 1849 (Michaelis, Zeits. Ver. Rübenzucker Ind. 1852, **2**, 64). Scheibler (Zeits. Ver. Rübenzucker Ind. 1868, **18**, 159 and 294). Fremy (Comptes rend. **48**, 202). Identical with arabic acid (Scheibler, Zeits. Ver. Rübenzucker Ind. 1873, **23**, 288). Lævo-rotatory when produced by action of alkali on pectose; dextro-rotatory when produced by the action of hydrochloric acid. In the latter case it reduces Fehling's solution (Battut, Sucrerie Ind. 1888, **32**, 285, 311, and 357). Sulphuric acid converts it into arabinose (Chem. Zeit. 1889, **13**, 2; this Journal, 1889, 206). See also Herzfeld (Zeits. Ver. Rübenzucker Ind. 1891, **41**, 667).

Oxalic Acid, $C_2H_2O_4$—Scheibler (Zeits. Ver. Rübenzucker Ind. 1866, **16**, 515). Found in beetroots as a salt (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Seems not to be present in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780; this Journal, 1888, 761).

Hydroxy-citric Acid, $C_6H_8O_8$—Found in juice of unripe beetroots. Optically inactive (Lippmann, Zeits. Ver. Rübenzucker Ind. 1883, **33**, 715).

Hydroxyglutaric Acid, $C_5H_8O_5$ (Lippmann, Zeits. Ver. Rübenzucker Ind. 1882, **32**, 895).—Dextro-modification said to exist in beetroot-juice (Lippmann, Ber. 1891, **24**, 3299; this Journal, 1892, 50).

Parapectic Acid, $C_{24}H_{30}O_{21} + 2H_2O$—Found in beetroots prior to 1849 (Michaelis, Zeits. Ver. Rübenzucker Ind. 1852, **2**, 64). A transformation product of pectose (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). See also Herzfeld (Zeits. Ver. Rübenzucker Ind. 1890, 40, 687).

Pectic Acid, $C_{16}H_{18}O_{13} + 2H_2O$—Conversion product of pectose (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882). Formed by action of alkali on pectin; converted into parapectic acid by heat or acids (Sidersky).

Propionic Acid, $C_3H_6O_2$—Not present in untreated beetroot-juice (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882).

Succinic Acid, $C_4H_6O_4$—Not normally present in beetroot-juice (Bittmann, *loc. cit.*) Found in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780; this Journal, 1888, 761). Found in the calcium precipitate formed during the treatment of beetroot-juice (Lippmann, Ber. 1891, **24**, 3299; this Journal, 1892, 50).

Succulmic Acid, $C_{44}H_{40}O_{16}$—Discovered by Sestini. Found in molasses by Diguet (Neue Zeits. Rübenzucker Ind. 1888, **21**, 212).

Tartaric Acid, $C_4H_6O_6$—Believed not to exist in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780). Found in calcium precipitate formed during the treatment of beetroot-juice. Only dextro-modification found (Lippmann, Ber. 1891, **24**, 3299; this Journal, 1892, 50).

Tricarballylic Acid, $C_6H_8O_6$—May be a product of the decomposition of citric acid (Lippmann, Zeits. Ver. Rübenzucker Ind. 1878, **28**, 365; Wehr, *ibid.* 1879, **29**, 879).

Ulmic Acid, $C_{20}H_{14}O_6$—Constituent of red colouring matter of beetroot-juice (Sostmann, Zeits. Ver. Rübenzucker Ind. 1867, **17**, 56. Produced by action of alkali on glucose (Bittmann, *ibid.* 1879, **29**, 882). Found in cane-juice (Winter, *ibid.* 1888, **38**, 780; this Journal, 1888, 761).

Albumin.—Michaelis (Zeits. Ver. Rübenzucker Ind. 1852, **2**, 64) lævo-rotatory. Found in beetroot-juice (Bittmann, *ibid.* 1879, **24**, 882).

Asparagin, $C_4H_8N_2O_3$—Discovery attributed to Rossigon. First mentioned by Dubrunfaut (Scheibler, Zeits. Ver. Rübenzucker Ind. 1866, **16**, 222). Proposal to estimate it by ascertaining the amount of ammonia yielded by its decomposition (Sachsse, *ibid.* 1873, **23**, 55). Not found in cane-juice (Bittmann, *ibid.* 1879, **29**, 882). Optical properties (Becker, Neue Zeits. Rübenzucker Ind. 1881, **6**, 304 and 317). General properties and constitution. Not precipitated by basic lead acetate. Lævo-rotatory in alkaline solutions, dextro-rotatory in acid solutions (Sidersky, 1890).

Betaïne, $C_5H_{11}NO_2$—Discovered by Scheibler (1866). Extracted by means of sodium phosphomolybdate. Boiled with alkali, trimethylamine is formed (Scheibler, Zeits. Ver. Rübenzucker Ind. 1869, **19**, 549). Ripe beetroots contain less than unripe. Identical with hydroxyneurine (Scheibler, *ibid.* 1870, **20**, 20). New method of preparation (Frühling and Schulz, *ibid.* 1877, **27**, 469). Not found in cane-juice. Optically inactive (Bittmann, *ibid.* 1879, **29**, 882).

Choline, $C_5H_{15}NO_2$—Discovery (in beetroots?) (Lippmann, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 68).

Glutamine, $C_5H_{10}N_2O_3$ (Schulze and Uriche, Zeits. Ver. Rübenzucker Ind. 1877, **27**, 321). Precipitated by mercuric nitrate (Schulze and Bosshard, Ber. 1883, **16**, 312). Optical activity (Schulze and Bosshard, Zeits. Ver. Rübenzucker Ind. 1885, **35**, 319). Decomposes into ammonia and glutamic acid when heated with lime (Sidersky, 1890).

Legumine.—Found in untreated beetroot-juice. Is not coagulated on boiling (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882).

Leucine, $C_6H_{13}NO_2$—Presence in beetroot-juice (Lippmann, Zeits. Ver. Rübenzucker Ind. 1885, **35**, 156).

Protagon (*Lecithine*).—Jubert states (Zeits. Ver. Rübenzucker Ind. 1875, **25**, 105) that the substance discovered by Scheibler (*ibid.* 1874, **24**, 309) is a vegetable ferment. Both theories refuted (Borschtschoff, *ibid.* 1876, **26**, 738). Ferment theory supported (Cienkowski, *ibid.* 1878, **28**, 1017).

Tyrosine, $C_9H_{11}NO_3$ (Lippmann, Zeits. Ver. Rübenzucker Ind. 1885, **35**, 156).

Arabinose, $C_5H_{10}O_5$—Discovered by Scheibler, and called by him "pectinose" or "pectin sugar" (Zeits. Ver. Rübenzucker Ind. 1868, **18**, 159 and 164). Formed by action of sulphuric acid on arabic acid (Lippmann, *ibid.* 1880, **30**, 342; Sidersky, 1890). Properties, &c. (Lippmann, *ibid.* 1884, **34**, 1383). Elementary composition (Kiliani, Ber. 1887, **20**, 282 and 339). Method of extraction from beetroot (Wohl and Niessen, Zeits. Ver. Rübenzucker Ind. 1889, **39**, 929). Colour reactions (Tollens, *ibid.* 1891, **41**, 907).

Cholesterin, $C_{26}H_{44}O$—Found in an alcoholic extract of gelatinised beetroot-juice (Scheibler, Zeits. Ver. Rübenzucker Ind. 1874, **24**, 309). Detected in the precipitate form by the action of lime on beetroot-juice (Kollrepp, *ibid.* 1888, 38, 772; this Journal, 1888, 856).

Isocholesterin.—Discovered by Kollrepp in 1888.

Colouring Matter.—Zier, 1839; Sostman (Zeits. Ver. Rübenzucker Ind. 1867, **17**, 56); Wachtel (Neue Zeits. Rübenzucker Ind. 1879, **2**, 421, and **3**, 366). The colouring matter "Beta-red," produced by the oxidation of Reinke's so-called "Rhodogen," probably belongs to the aromatic series (Strohmer, Zeits. Ver. Rübenzucker Ind. **32**, 879).

Coniferin, $C_{16}H_{22}O_8$—Found in the insoluble portion of the beetroot. Gives vanillin on oxidation (Lippmann, Zeits. Ver. Rübenzucker Ind. 1883, **33**, 316; this Journal, 1883, 184 and 387). Sidersky (1890). Gives a blue colour with phenol.

Dextran, $C_6H_{10}O_5$—Anhydride of glucose; sometimes found in beetroot-juice as a product of the life of schizomycetes, Leuconostoc Mesenteroides Cienk (Scheibler, Zeits. Ver. Rübenzucker Ind. 1874, **24**, 309). Main constituent of gums of beet-juice. Resembles pectin rather than a carbohydrate (Borschtschoff, *ibid.* 1876, **26**, 738). Origin and nature (Bauer, Neue Zeits. Rübenzucker Ind. 1882, **8**, 258). Extraction (Weissberg, *ibid.* 1888, **19**, 301). Sometimes formed in cane-juice (Winter, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 780; this Journal, 1888, 761).

Extractive Matter.—Michaelis (Zeits. Ver. Rübenzucker Ind. 1852, **2**. 64). Not completely precipitated by basic lead acetate (*ibid.* 1857, **7**, 39).

Fats and Oils.—Present in beetroot-juice in very small quantity only (Bittmann, Zeits. Ver. Rübenzucker Ind. 1879, **29**, 882).

Gummy Matter.—Not found in juice of uninjured beetroots (Michaelis, Zeits. Ver. Rübenzucker Ind. 1855, **7**, 209). See also Borschtschoff (*ibid.* 1876, **26**, 738); Bittmann (*ibid.* 1879, **29**, 882); Lippmann (Ber. 1890, **23**, 3564; this Journal, 1891, 375).

Parapectin, $C_{32}H_{46}O_{31}$—Formed by heating pectin with water (Sidersky, 1891).

Pararubin, $C_{12}H_{22}O_{11}$—Reichardt (Zeits. Ver. Rübenzucker Ind. 1875, **25**, 803).

Pectin, $C_{32}H_{48}O_{32}$—Michaelis (Zeits. Ver. Rübenzucker Ind. 1852, **2**, 64). Not found in juice of uninjured beetroots (*ibid.* 1855, **7**, 209). Found in cane-juice (*ibid.* 1888, **38**, 780; this Journal, 1888, 761). Chevron (Neue Zeits. Rübenzucker Ind. 1888, **20**, 169). Does not reduce Fehling's solution, is dextro-rotatory, and is converted into pectic acid by alkali (Battut, Sucrerie Indig. 1888, **32**, 285, 311, and 357). Formation (Beaudet, Neue Zeits. Rübenzucker Ind. 1889, **22**, 245). Influence on the analysis of beetroot-juice (Weisberg, *ibid.* 1889, **23**, 9). Said to be a mixture of several compounds (Herzfeld, Zeits. Ver. Rübenzucker Ind. 1891, **41**, 667). Forms a gelatinous mass with water; acids convert it into metapectic acid (Sidersky, 1891).

Pectose.—Michaelis (Zeits. Ver. Rübenzucker Ind. 1852, **2**, 64) Bittmann (*ibid.* 1879, **29**, 882). General properties (Battut, Sucrerie Indig., 1888, **32**, 285, 311, and 357). Converted into pectin as the beetroot ripens; perhaps by the action of pectase (Sidersky, 1890).

Phytosterin, $C_{26}H_{44}O$ (?).—Lippmann (Zeits. Ver. Rübenzucker, 1888, **38**, 68; this Journal, 1888, 223).

Catechol, $C_6H_6O_2$—Discovery in beetroots (Lippmann, Ber. 1887, **20**, 3298; this Journal, 1888, 128). Reduces Fehling's solution (Wohl, Zeits. Ver. Rübenzucker Ind. 1888, **38**, 458; this Journal, 1888, 459).

Vanillin, $C_8H_8O_3$—Scheibler (Ber. 1880, **13**, 335). First aromatic compound found in sugar (Lippmann, Zeits. Ver. Rübenzucker Ind. 1880, **30**, 134). *See under coniferin.*

Viscose, $C_6H_{10}O_5$—Discovery by Béchamp (Neue Zeits. Rübenzucker Ind. 1881, **7**, 214). Identical with dextran (Scheibler, *ibid.* 1881, **7**, 216).—A. R. L.

An Improved Method for the Gravimetric Estimation of Furfurol Hydrazone. W. H. Krug. J. Anal. and Appl. Chem. 1893, **7**, 68.

See under XXIII., *page* 551.

The Electrolytic Estimation of Copper as applied to Invert Sugar Determinations. B. B. Ross. J. Anal. and Appl. Chem. 1893, **7**, 83.

See under XXIII., *page* 551.

PATENT.

Improvements in Filtering Apparatus. H. Kohl, Euskirchen, Prussia. Eng. Pat. 18,552, October 17, 1892.

See under I., *page* 511.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Occurrence of Boric Acid in Beer and Hops. J. Brand. Zeits. ges. Brauw. 1892, **15**, 427; and Chem. Zeit. Rep. 1892, **31**, 350.

According to the author, boric acid is an invariable constituent of beer, and may be readily detected by its action on turmeric paper. The test is best applied as follows:—The beer is rendered slightly alkaline, evaporated to dryness, ignited, and the ash extracted with water. The solution is evaporated to a small bulk, acidified with hydrochloric acid, and tested with turmeric paper in the usual way. In all cases a slight brown coloration, changed by alkalis to a greenish-blue, was obtained. In each case the presence of boric acid was confirmed by Gooch's method of converting it into methyl borate, and separating the latter by distillation. Further experiments proved that the boric acid was exclusively derived from the hops employed. A number of hop samples were examined, fresh as well as dried, and relatively large amounts of boric acid were found in all parts (leaves, twigs, and flowers) of the plant. The stalks of wild hops also contained the acid, but no trace could be detected in barley and malt.—H. T. P.

PATENTS.

An Improved Meter for Estimating the Volume and Density of Liquids. A. V. L. Bedout, Paris. Eng. Pat. 8272, May 2, 1892.

See under I., *page* 510.

Improvements connected with Apparatus for Aërating Malt—and other Liquors and Liquids. D. Wickham, Ware, Herts. Eng. Pat. 10,126, May 27, 1892.

The apparatus, details and drawings of which are given, is manipulated as follows:—The beer or other liquid to be aërated is drawn from the cask, &c. by means of a pump and forced into a globular receiver provided with baffling-plates (perforated or not), in which it is impregnated with carbonic acid gas. The latter is drawn from a liquid gas cylinder fitted with a reducing valve, and is passed through a water-jacketed attemperating coil, heated by a small gas flame, before it enters the aërating vessel. After aëration the liquid passes through another pipe, either back to the original containing-vessel or to a bottling machine. —H. T. P.

Improvements in the Manufacture of Yeast. H. Myers. Salroyd Low Moor, Yorks. Eng. Pat. 10,078, May 27, 1892.

The object of this process is the production of yeast possessing good keeping qualities, and suitable alike for bread baking and for use in distilleries. To this end 80 lb. of ground rye and 10 lb. each of ground malted wheat and malted rye are mixed with 75 galls. of water at 165°—170° F. One thirty-second per cent. each of sulphuric acid and of Epsom salts are then added, the whole kept at the above temperature for 8—10 hours, cooled to 80° F., and thoroughly mixed with 5 cwt. of pressed brewers' yeast. Fermentation is allowed to proceed at 80° F., and may be assisted by forcing compressed air through the mass. The head of yeast which rises is skimmed off from time to time, washed with ice-cold water, allowed to settle, and finally pressed for use.—H. T. P.

Improvements in Treating or Ageing Spirit. R. C. Scott, Liverpool. Eng. Pat. 11,638, June 21, 1892.

The spirit, previously cooled to about 32° F., is brought into contact—preferably in the form of fine spray—with a current of cooled air. It is claimed that a loss of ethers and alcohol is thus avoided, whilst objectionable bodies (fusel oil) are rendered harmless.—H. T. P.

Improvements in the Preparation or Treatment of Beer, and of an Extract of Malt to be used therefor. W. P. Thompson, Liverpool. From J. Uhlmann, Fuerth, Bavaria. Eng. Pat. 4927, March 7, 1893.

According to recent observations highly-coloured malts (especially "amber" and "caramel" malts) contain notable quantities of "malto-dextrin" or "iso-maltose," which body imparts to beer a particularly good flavour, condition, and stability. In the usual mashing process, owing to the excess of diastase always present, the malto-dextrin is converted into maltose, which does not possess the above favourable properties in nearly so great a degree. In order to obtain an extract rich in malto-dextrin, the inventor mashes the coloured malt separately with a small quantity of ordinary malt at a suitable temperature (49°—52° R.). The wort obtained is added to beer or finished wort (*i.e.*, boiled) produced in the usual way; or the extract may be condensed and used in this condition.—H. T. P.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

Report on Foods, &c. from the Analytical Station at Breslau. B. Fischer, A. Sartori, G. Runschke, and F. Butter. Chem. Zeit. Rep. 1892, **31**, 349—350.

Beer.—The authors have found the copper occasionally occurring in beer to be derived from the defectively tinned copper conducting tubes of the beer-engines employed.

Bread.—It has been found impracticable to fix a maximum percentage of water allowable in bread. In several instances bread, otherwise normal, contained over 40 per cent. of water (the standard suggested). The amount of water present appears to depend, not only on the age of the bread and the conditions of baking, but also on the nature of the flour used, and on the size and form of the loaves. Generally speaking, the larger the loaves and the more nearly globular in shape, the higher is the amount of water found.

Honey.—According to Haenle, the rotatory power of honey solutions on protracted dialysis eventually falls to zero, whilst in presence of glucose syrup a dextro-rotatory solution remains. The authors fail to confirm this observation, but hesitate to condemn this method of detecting the adulteration of honey, because Haenle's conditions of dialysis differed from their own.

Milk.—For approximately estimating the fat in milk the authors have discarded Marchand's process in favour of Soxhlet's volumetric method, although the latter presents some difficulties. In many cases the ethereal layer separates either not at all or in insufficient quantity. The trouble is, however, completely overcome by using a centrifugal machine. Another difficulty is that the scale of the spindle is not sufficiently extended for milk rich in fat.

Lard.—The adulteration of lard with cotton-seed oil seems to have been practically abandoned. For the detection of such addition the authors still recommend Bechi's reaction, and the determination of the iodine number.—H. T. P.

Proteïds of the Flax-Seed. T. B. Osborne. Amer. Chem. J. **14**, 629—661.

The importance of linseed-meal, which is flax seed more or less freed from oil, as a cattle food makes it desirable that the composition of the seed, especially as regards the proteïds, its most valuable constituents, should be investigated. The results now described show that the seeds contain a globulin precipitable by dialysis, a proteïd precipitable by prolonged heating and by sodium chloride and acid, proteose and peptone-like bodies, and a proteïd soluble in dilute aqueous potash. Attempts to determine the amounts of these substances failed.

As regards the factor for calculating the proportion of proteïds from the amount of nitrogen in flax-seed, it is impossible to say exactly what it should be, but a pretty close approximation can be made. The results show that the proteïds contain collectively an average of 18·00 per cent. of nitrogen. The factor for flax-seed would thus be 5·55 instead of 6·25 in the case of a meal containing 7 per cent. of nitrogen; this would give a percentage of protein 38·85 instead of 43·75.—N. H. J. M.

Crystallised Vegetable Proteids. T. B. Osborne, Amer. Chem. J. **14**, 662—689.

The crystallised globulins of the Brazil-nut and the oat-kernel are distinct substances, although they agree closely in percentage composition, except as regards nitrogen and sulphur. Oat-kernel globulin is soluble in water at 60°, Brazil-nut globulin insoluble. By saturating a 10 per cent. sodium chloride solution of these two substances the proteid of the oat-kernel is almost completely precipitated whilst that of the Brazil-nut remains unaffected. Similar solutions when saturated with magnesium sulphate retain nearly all of the Brazil-nut but none of the oat-globulin. Finally, when the sodium chloride solutions are heated, the Brazil-nut globulin begins to separate at 70° and is largely, but not wholly precipitated, at 100°; oat-globulin does not coagulate at all when boiled.

The crystalline globulins of hemp seed, castor bean, squash seed and flax seed are almost identical in composition and behave very similarly towards reagents and solvents. The four globulins are probably identical.

—N. H. J. M.

Some Products of Cassava. E. E. Ewell and H. W. Wiley. Amer. Chem. J. **15**, 1893, 285—289.

From some analyses made about four years ago of the roots and bark of the sweet cassava (*Jatropha Manihot*) grown in Florida, it was concluded that the plant was valuable for feeding purposes, being very rich in carbohydrates, though rather poor in albuminoids. The authors have recently obtained a large quantity of the root and after separating the bark from some of the roots, each was subjected to analysis with the following results:—

—	Peeled Root.		Fibre after removal of Starch.	Bark of Root.	
	Fresh.	Dry.	Dry.	Fresh.	Dry.
Moisture	61·30	..	..	61·30	..
Ethereal extract	0·17	0·44	0·30	0·66	1·70
Albuminoids (N × 6·35)	0·64	1·66	1·02	2·29	5·91
Starch (diastase extract inverted with HCl).	30·98	80·06	64·64	..	..
Fibre	0·88	2·26	10·68	3·83	9·89
Ash	0·51	1·31	1·42	2·09	5·23
Undetermined	5·52	14·27	21·94	29·90	77·27

The fresh root was found to contain 38·7 per cent. of dry matter. The yield of air-dried starch was 25·9 and 23·6 per cent. respectively of the total weight of the root. The starch was almost pure, the diameter of the starch granules being a little over 0·01 mm. The cassava contains hydrocyanic acid, which seems to be distributed throughout the pulp and particularly in the juices which can be expressed from the pulp. However, no injurious effect from this poison has ever been observed in the case of animals fed on the plant grown in Florida. The amount of ash in the root is quite low, showing that the cassava does not require a soil rich in mineral constituents. The amount of mineral matter taken from the soil by 100 kilos. of the fresh root is approximately only half a kilo. The albuminous matters are also present in small quantities, being only slightly larger in weight than the ash itself. The plant therefore is one which it seems quite possible to nourish almost exclusively with the ordinary constituents of air and water, and for this reason it could be recommended on the sandy soils of Florida as a crop which would require the minimum of fertilisation. The ash of the peeled root is especially rich in potash, almost one-half of the total weight being composed of this substance. The potash is combined chiefly with carbonic and phosphoric acids. In the ash of the bark, as might be expected, silica is the predominant element, more than half the total weight consisting of this substance. Assuming a yield of five tons of roots per acre, the weights of the important fertilising materials removed by such a crop can be readily calculated from the data given. Since the bark forms approximately 2·2 per cent. of the entire root the total crop would be made up of the following amounts of bark and peeled root:—

	Lb.		Lb.	
Peeled root.........	9,780	containing........	49·88	ash
Bark root........	220	„	4·44	„
	10,000	„	54·32	

The more important mineral matters contained therein are:—

—–	Ash from Peeled Root, 49·88 lb.	Ash from Bark, 4·44 lb.	Total Ash from 5 tons, 54·32 lb.
	Lb.	Lb.	Lb.
CaO	5·31	0·29	5·60
MgO......	3·67	0·15	3·82
K_2O	20·77	0·65	21·42
P_2O_5	7·77	0·11	7·88
			38·72

—D. B.

Abnormal Butter. F. W. Moore. J. Anal and Appl. Chem., 1893, **7**, 1, 2.

A sample of butter produced from the milk of an Ayrshire cow which had been milked 11 months previous to the time of the experiment, and was being fed on hay, ensilage, gluten meal, and cotton seed oil gave the following results:—"Volatile acids" (presumably the Reichert-Wollny figure is meant) 16·5; iodine number 39·6. The second sample of butter from the milk of a Holstein cow which had been milked for 13 months and was being fed on hay, ensilage, and cotton-seed meal, gave the figures 11·2 and 36·0 for the same criteria. Both samples were hard, pale, and smelt of tallow, the last-named property being especially perceptible in the case of the second sample. The author attributes the abnormality of these samples to the advanced stage of lactation, and the presence of cotton-seed oil in the food, both conditions tending to decrease the quantity of volatile acids, and the latter also lowering the iodine number and raising the melting point of the butter-fat. It appears that the iodine number varies less than does the figure representing the amount of volatile acids. Thus working with a herd of nine cows and examining more than 100 samples of butter, the author found that the widest range for volatile acids in the butter from a single cow was expressed by the figures 11·2 to 32·4, the next largest variation being between 17·6 and 33·1. Corresponding values for the iodine number were 30·1 to 44·8, and three other cows gave butter which showed nearly as large a range. The extreme limits were 11·2 and 33·9 for the volatile acids, and 24·2 and 44·8 for the iodine number.—B. B.

Caffeine and the Question of its Isomerism. A. B. Prescott. J. Amer. Med. Assoc. January 28, 1893, 1—15.

The following conclusions are presented as to the work already done with the object of arriving at the character of the alkaloids in tea and coffee.

1. The alkaloid counted as caffeine is mostly dissolved by ordinary hot infusions and by decoctions of tea and coffee, even if brief in maceration. Of the two beverages, coffee is apt to be a little the richer in alkaloid, but this difference is not distinctive. Three grains per pint is a common proportion.

2. Tea beverage is very rich in tannins, which are nearly absent from coffee beverage. Tannins are very slowly drawn into infusion, so that the time and temperature of

—–	Alkaloid.		Tannins.		Soluble Ash.		Potash.		Other Soluble Substances.	
	Tea.	Coffee.	Tea.	Coffee.	Tea.	Coffee.	Tea.	Coffee.	Tea.	Coffee.
I. *Total Content*, in percentages:										
1. Geisler, 1884: in averages of 30 grades (*Note A*).	2·6	..	15·2	..	3·5	..	..	..	21·7	..
2. Dragendorff, Univ. Dorpat, 1874: 23 grades (*Note B*).	2·0	1·1	12·4	..	..	..	2·3	2·4	17·0	..
3. The writer and Mr. Clark, 1876: 15 grades (*Note C*).	..	..	12·0	..	..	..	..	..	..	..
II. *Dissolved in Infusions*, as per cent. of dry article:										
1. Geisler, 1884: by infusion at 100° C. (*Note D*).	2·4	..	9·2	..	3·8	..	1·4	..	12·5	..
2. Fellows, 1880: by 10 minutes (*Note E*).	..	..	0·6	0·0	..	..	..	..	..	..
3. Fellows, 1880: by 20 minutes	..	..	1·5	0·1	..	..	..	..	..	..
4. Fellows, 1880: by 30 minutes......	..	..	2·5	0·8	..	..	..	..	..	..
5. Kenrick, 1891: (*Note F*) 13 black teas.	2·8	..	5·4	..	3·5	..	..	..	12·0	..
6. Kenrick, 1891: 18 Japan teas	2·5	..	9·4	..	3·6	..	..	..	14·6	..
III. *Content of Infusions, in Grains per Pint*:										
1. Calculated from Geisler (II. 1) (*Note G*).	2·5	..	4-13	..	3·8	..	1·4	..	12·5	..
2. Calculated from Kenrick (II. 5, 6) (*Note G*).	2·65	..	5-9	..	3·5	..	..	..	13·3	..
3. By Fellows (*Note E*) direct	..	..	3·3	0·9	..	..	..	..	..	..
4. Calculated from I. 2 and other sources (*Note H*).	..	3·5	..	..	..	9·5	..	6·3	..	56·0
5. Frequent proportions, summarised..	2·5	3·5	7·0	0·7	3·5	9·5	1·4	6·3	13·0	56·0

infusion govern its astringency. A cup of tea may have from two to six times as much of tannin as it has of alkaloid.

3. Coffee beverage carries quite constant potassium salts amounting to four times the quantity in tea beverage. A cup of coffee contains potassium salts to the extent of about twice the quantity of the alkaloid present. Some of the potassium is as phosphate.

4. The nutrient and other remaining solids in coffee infusions amount to four times the quantity of the corresponding solids in the infusion of tea.

A pint of coffee contains an average of 50 to 60 grains of solids beside alkaloid, ash, and tannin. The pharmacology of some of these bodies ought to be studied.

5. There follows to be determined the homologues of caffeine (theophylline, theobromine, and xanthine), their presence, quantity, and effect. Then remains, if found at all, any evidence as to isomeric caffeines. For these inquiries it is needful to discuss the known constitution of caffeine itself.

Caffeine stands apart from vegetable alkaloids as a class. It is not a derivative of pyridine. It does not give evidence of a closed chain of carbon atoms in the same state of saturation found in pyridine derivatives. It does not contain any part of the fruitful benzene molecule. When it is broken up in any way, aromatic compounds are not formed out of it. In all these related particulars caffeine is unlike the numerous alkaloids of cinchona, or opium, hydrastis, coca, pepper, conium, henbane, or tobacco. It stands apart, also, in the great content of nitrogen it contains, namely 28·8 per cent. Proteids have 16 per cent.; quinine has 8·6 per cent.; strychnine, 9·0 per cent. of the same element.

Caffeine is a thrice methylated xanthine as clearly as chloroform is a thrice chlorinated methane. As trimethylxanthine its chemical possibilities in general are those of xanthine itself. As a tri-derivative of xanthine, it is methyl-saturated, and does not have the obvious theoretical possibilities of isomerism that di-derivatives and mono-derivatives possess. These have been readily realised in synthesis.

In the present state of evidence we reach certain conclusions as follows:—

1. The five beverage plants owe some of the differences in their effects to their different yields of bodies not classed as active principles.

2. The total active principle of a beverage plant, the "theine," "caffeine," &c., as obtained, is perhaps liable to contain small quantities of xanthine and other homologous bodies of physiological effect.

3. The main active principle in each of the five beverage plants is, unquestionably, a trimethyl-xanthine. Chemical studies indicate, as yet, only one trimethyl derivative of xanthine. If, however, strictly pure trimethyl-xanthine, known as caffeine, from one plant clearly differs in physiological effect from the same body taken in strict purity from another plant, then the chemist will recognise a proof of isomerism, and await its explanation by later chemical researches.

PATENTS.

An Improved Process and Apparatus for Preserving Meat, Fish, and other Perishable Substances. E. Edwards, London. From F. Grognet, Courbevoie, France. Eng. Pat. 7789, April 25, 1892.

The meat, &c., cut in pieces, or left whole as in the case of fish, is thoroughly soaked in a bath composed of common salt, and small quantities of potassium acetate and a number of spices, dissolved either in weak vinegar or in a solution of salicylic acid. The food is then furnished with a protective coating by sprinkling it with powdered talc, or maize, or flour and whitening, steatite, &c., or a mixture of the above. Finally the meat, &c., is dipped in a solution of salicylic acid, and dried in a sort of wire-chamber fitted with shelves, which is made to revolve in a closed outer case, air dried by means of a drying column, being drawn through the apparatus during the process.—H. T. P.

Improvements in Apparatus for Extracting Juices or Essences from Meat, Fruit, and other Substances. F. Summerfield, Southsea. Eng. Pat. 8485, May 5, 1892.

This apparatus is more particularly suited to household purposes. It consists of an enamelled iron dish from which rise steel rods connected at the top by a cross-bar. A long screw passes through this cross-bar and carries on its lower and upper extremities respectively, a plunger and a handle. The plunger fits into a perforated iron cylinder which is placed for the purpose on a projection in the centre of the dish. The meat, &c. from which the juice is to be expressed, is packed in the cylinder, the latter placed in position under the plunger, which is then screwed down. The expressed juice collects in the basin below.—H. T. P.

Process and Apparatus for Purifying Water. C. Schmidt, E. Loh, and H. Brackebusch, Berlin. Eng. Pat. 1297, Jan. 20, 1893.

A cylindrical vessel of enamelled iron, or other suitable material, provided with an outlet near the top, has a cylinder of smaller diameter, open at both ends and standing on short feet, inserted in it. Fitted into the top of the latter is a sieve containing crystals of tartaric acid, on which the supply of water falling, all bacteria are said to be immediately killed. On reaching the bottom of the internal cylinder, the water has to rise through the annular space of the external vessel, to the outlet of that vessel, and this space is filled with lumps of marble to remove the free acid. On leaving the sieve the water should contain about 0·2 per cent. of acid, and to regulate this, it is provided with a central chamber, into which the water falls, while the annular space is divided into three compartments, one or more being filled with the acid crystals.

Instead of employing tartaric acid, the inner cylinder may be filled with stones sprinkled over with quicklime, while the outer compartment contains "kieselguhr;"—in this case no sieve is needed.—F. H. L.

Improvements in Apparatus for Filtering and Disinfecting Water. H. W. F. Krone, Hamburg. Eng. Pat. 3082, February 11, 1893.

This apparatus consists of a cistern divided centrally into two parts by a vertical partition, which being made of two layers of charcoal and one of sand, forms the filtering medium. The water supply enters the first compartment and is regulated by the usual ball-cock, but on admission the water is made to spray against the side of the partition to remove any deposit, and to this end also the bottom is sloped down to the outlet pipe. In this same compartment is fixed a vessel containing the disinfectant, which is fitted with a ball-cock arranged so as to cause a small amount of liquid to escape when the level of the water is lowered. The second compartment serves as the reservoir for the filtered water.—F. H. L.

Improvements in and Connected with Means for Charging Liquids with Carbonic Acid Gas. A. Landerer, Leipzig. Eng. Pat. 3334, February 15, 1893.

In order to render palatable water or beverages which have become stale or insipid by standing in open vessels, materials capable of generating carbonic acid gas are formed and added in the shape of pellets or tablets, which have been subjected to great pressure, whereby their solubility is reduced, and hence neither dissolve nor undergo reaction too rapidly.

These pellets may also be sufficiently protected by a coating of less soluble material. The pellets on dissolving generate carbonic acid gradually, and the gas is thus readily absorbed by the liquid. Inactive or retarding agents, consisting of salts found in solution in natural mineral waters, may be mixed with the material with advantage, as they impart a medicinal character to the liquid.—J. C. C.

Improved Apparatus for Determining the Relative Percentages of the Fluid Components of a Compound Fluid. P. V. P. Berg, Copenhagen, Denmark. Eng. Pat. 4409, February 28, 1893.

See under XXIII., *page* 548.

Improvements in Apparatus for Sterilising Liquids and in the Stoppering of Bottles and other Vessels for Holding such Liquids. R. Thiel, Lubeck, Germany. Eng. Pat 6213, March 23, 1893.

The jars or bottles for holding the liquid to be sterilised are provided with stoppers, held down by tension or compression springs, which allow the gases and steam generated in the sterilising operation to escape when above a certain pressure, and also close the vessel when the pressure has ceased. A similar device is also claimed for metallic or other vessels. The sterilising boiler serving for the reception of these vessels is provided with a movable cover and swing crane, to allow of the cover being raised and swung on one side. When the bottles or vessels containing the liquid to be sterilised have been placed in the boiler, the cover is fixed in place, and steam admitted. The air is first displaced and driven out of the boiler by the steam and the pressure is then raised to about two atmospheres. This heating causes internal pressure in the enclosed vessels, which is relieved automatically by their stoppers. After a short time the steam is shut off, and a vacuum is produced causing further relief in the vessels; on further cooling the stoppers close automatically and seal the vessels containing the now sterilised liquid.
—J. C. C.

(*B.*)—SANITARY CHEMISTRY.

Eleventh Meeting of the Representatives of the Bavarian Chemical Industries at Regensburg, August 1892. Chem. Zeit. 1892, **16**, 1148—1149.

Amongst others the following papers were read:—

"*The Noxious By-products of the Manufacture of Fulminating Mercury.*" H. Kaemmerer. Various methods are described of rendering harmless the poisonous gases given off during the solution of the mercury in nitric acid, and especially during the subsequent treatment with alcohol. As regards the different methods of dealing with explosive waste products, only one, of comparatively recent introduction, appears to be satisfactory. It is based on the fact that mercuric fulminate, when heated with a large volume of water under high pressure, splits up into metallic mercury and non-explosive mercurial compounds of unknown composition. Attention is drawn to the unhealthy nature of the process of charging percussion caps. Numerous small explosions constantly occur and the air consequently becomes laden with mercurial vapours. It is stated that in one factory in Nürnberg during the winter 1890–91, 40 per cent. of the workers suffered from mercurial poisoning.

Copper in its Relation to Preserved Articles of Food, considered from a Hygienic Point of View. B. Lehmann, and also J. Mayrhofer. Copper appears to be a normal constituent of most animal and vegetable substances. Thus, 1 kilo. of grain was found to contain 5—10 mgrms. of copper; beans, 2—7 mgrms.; cocoa, 11—27 mgrms., &c. Liver, especially, is rich in copper; for instance, bullock's liver contained 52 mgrms. The copper thus present is, however, not soluble in water, and only slightly soluble in dilute acids. 100 grms. of peas, strongly stained with copper, yielded only 2—6·7 mgrms. of the metal to 20 cc. of digestive fluid. As regards the effect of copper on the human subject, experiments showed that preserves containing 25 mgrms. of metal per kilo. exerted no injurious influence whatever; moreover, it was found that 20—30 mgrms. of copper (as acetate or sulphate) might be taken daily for three months with perfect impunity. Concerning the staining of preserves, it is stated that this is nearly always necessary in order to give them a marketable appearance. Trials made with other staining agents than copper have proved unsatisfactory, besides being more costly. In the discussion which followed Fresenius cast doubts on the legality of employing staining agents. Kerschensteiner agreed with the authors that many of the published cases of poisoning attributed to copper were more probably caused by the presence of ptomaïnes. According to Kaemmerer, copper is frequently present in artificial mineral waters, probably owing to defective tinning of the copper vessels employed. Sendtner pointed out that in France and Italy small quantities of copper (up to 40 mgrms. per kilo.) are tolerated in preserves by law. The following resolution was afterwards unanimously agreed to:—"In view of past experiences, the presence of 25 mgrms. of copper in 1 kilo. of preserves may be entirely disregarded from a hygienic standpoint."—H. T. P.

The Disinfection of Town Sewage-Water by Means of Lime. Prof. Pfuhl. Zeits. für Hygiene, 1892, 509. Proc. Inst. Civil Eng. Abs. 1893, 48.

Many towns, in default of irrigation-farms, are compelled to purify their sewage by chemical means before its discharge into rivers; and it would seem from the transactions of the German Public Health Society that, as a rule, more attention has hitherto been paid to clarification than to disinfection. The author remarks that in certain cases, as for instance, where typhoid fever or cholera may be present, it is most important that the sewage-water should be disinfected, as it might otherwise communicate the germs of those diseases to persons using the river water mingled with the effluent for drinking or for domestic purposes. Among the chemical substances most largely used in sewage treatment is lime, itself an excellent disinfectant; but it seemed doubtful whether this material, in the way in which it is now employed, really serves to destroy the bacilli of typhoid fever and cholera. In order to determine the question, the author investigated the proportions in which lime must be added so as to effect this object. Attention is directed to his previous experiments with lime, in which he found that the addition of milk of lime, in quantity equivalent to 1·37 per mille of slaked lime, was sufficient to disinfect the Berlin sewage-water, containing the bacilli of typhoid fever. It was, however, necessary to complete the investigation of this subject, and to carry out the experiments more fully. The lime was used in the proportion of $\frac{1}{3}$, $\frac{1}{2}$, and 1 per mille. To determine the rapidity with which the lime did its work, the author withdrew samples for culture at stated intervals. From the first set of tests, which are recorded in the form of a table, it is seen that only the 1-per-mille dose of lime was fatal to the germs under all conditions; though the $\frac{1}{2}$-per-mille solution destroyed all germs after two hours' exposure, and subsequent experiments proved that even $1\frac{1}{2}$ hour's action of the lime was sufficient. In a second table are shown the results of adding lime to sterilised sewage-water, into which a proportion of typhoid and cholera germs had been introduced on agar-agar, and therefore in the absence of nutritive bouillon. In this case also the lime proved as efficacious as before.

In a further series of experiments the author investigated the influence of lime upon sewage-water not previously sterilised. For this purpose 12 samples of fresh sewage were collected in flasks, and the contents of six of these flasks were sterilised, the others remaining untreated. To four of the sterilised flasks $\frac{1}{2}$ per mille of lime was added, and to the other two 1 per mille. The six flasks of untreated sewage had in each case $\frac{1}{2}$ per mille more lime than the former ones, namely, four of them 1 per mille and two of them $1\frac{1}{2}$ per mille of the lime. The contents of all the 12 flasks having received a fragment of agar culture of typhoid bacilli, were examined at intervals of 1 hour and $1\frac{1}{2}$ hours, and from these tests also it appeared that a dose of 1 per mille of lime was needed to destroy all germs of cholera and typhoid fever in from 1 to $1\frac{1}{2}$ hours; it being a condition, moreover, that the liquid should remain throughout this time in motion. For sewage at rest, the author's experiments led him to the conclusion that not less than 3 per mille of lime would be needed. At no existing sewage-works is the lime employed at present in sufficient quantities to destroy the pathogenic germs, and its value as a disinfectant is often partially neutralised by the use with it of sulphate of alumina. The author points out that a valuable index of the sufficiency or otherwise of the lime treatment is afforded by the alkalinity as tested by titration of the effluent with normal acid, and he has calculated a scale for this purpose.

The Precipitation of Tin by Zinc. A. Harpf. Oesterr. Zeits. für Berg- und Hüttenw. 1892, 635. Proc. Inst. Civil Eng. Abs. 1893, 79.

See under X., *page* 522.

PATENTS.

Improvements in Tanks or Vessels and Apparatus used in the Purification of Sewage and other Foul Waters by Precipitation, and in the Treatment of the Sludge obtained in such Process. H. Lockwood, Manchester. Eng. Pat. 10,308, May 31, 1892.

The sludge obtained from sewage by any precipitation method is dried and burnt in the apparatus claimed in this invention. The drier consists of an internal iron perforated cylinder lined with strong canvas, enveloped by an outer cylinder, a single cover closing each end of the double cylinder. The sludge is conveyed into the inner vessel and an ejector applied to the annular compartment to produce a vacuum; when the vessel is full of sludge and as much water removed as is possible, an air-pump is attached to the inside and the pressure raised as high as the cylinder will stand. The cover is then removed and the dried sludge taken out.

The destructor consists of a chamber, provided with hoppers, divided into four compartments by two perforated vertical division walls. Each compartment is provided with three perforated arched divisions one above the other, the perforations of the arches alternating with one another. The whole of the interior of this chamber is made white hot by means of liquid fuel injected by air or steam at different points, to insure the complete combustion of all organic matter in the sludge, which drops from arch to arch, the ash being removed from the bottom compartment.—J. C. C.

(*C.*)—DISINFECTANTS.

PATENT.

An Improved Disinfecting Fluid. M. Rees, Llandaff, South Wales. Eng. Pat. 1738, January 26, 1893.

Twenty-eight pounds of chloride of lime, 14 lb. of camphor, and 50 gallons of black varnish (the coal-tar product) are mixed together, and after standing some eight days the resulting substance is ready to be used in urinals and elsewhere.—F. H. L.

XIX.—PAPER, PASTEBOARD, Etc.

Notes on Oxycellulose and Bornesite. E. R. Flint and B. Tollens. Annalen, **272**, 288—290.

The authors have repeated some work of Lindsey and Tollens (Annalen, **267**, 366; this Journal, 1892, 835) on oxycellulose, a substance which has also been prepared by Sacc, Porter, and Cross and Bevan, and find that the numbers obtained in an ultimate analysis of the substance closely agree with those of the first-named investigators. Further research has shown that the body contains no methoxyl group, as it gives no methyl iodide on distillation with hydriodic acid. When dissolved in concentrated sulphuric acid, diluted and boiled, a sweetish syrup is obtained which reduces Fehling's solution. Oxy-cellulose reduces boiling Fehling's solution and turns fuchsin sulphurous acid violet. The authors conclude from this that oxycellulose contains aldehyde groups. They have further investigated some yellow crystals obtained from the wash waters of a gutta-percha works in Hanover. These they find to consist of *bornesite* or methyl-inosite of the formula $C_6H_{11}(CH_3)O_6$ A quantitative estimation of the methyl group, previously only determined qualitatively, by distillation with hydriodic acid, confirms this formula, and other properties of the substance such as melting-point (199°—203°) and specific rotation ($\alpha_D = + 31\cdot16°$) correspond with those already described by Girard. It would thus appear that certain varieties of gutta-percha contain bornesite or methyl-inosite.—T. A. L.

The Precipitation of Tin by Zinc. A. Harpf. Oesterr. Zeits. für Berg- und Hüttenw. 1892, 635. Proc. Inst. Civil Eng. Abs. 1893, 79.

See under X., *page* 522.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

The Chemical Constitution and Physiological Action of Kola-red in comparison with Caffeïne. E. Heckel. Rep. de Pharm. 1892, **48**, 433; and Chem. Zeit. Rep. 1892, **31**, 352—353.

Knebel has already shown (this Journal, 1892, 545) that the kola-nut contains a glucoside—*kolanin*—which, under the influence of a ferment also present in the nut, splits up into caffeïne, glucose, and kola-red, and that water and dilute acids can effect a similar change. In an analysis of the kola-nut the author found 2·348 per cent. of free caffeïne (extracted by chloroform). The insoluble residue on treatment with dilute acid yielded a further quantity of caffeïne equal to 1·44 per cent., showing that undecomposed kolanin was originally present. Since the digestive fluid decomposes kolanin, it is obvious that not only the free but also the combined caffeïne are available when the kola nut is administered internally. Comparative experiments made with Mosso's "ergograph" yielded diagrams which, in the case of pure caffeïne, exhibited contractions of comparatively limited amplitude. With kola-powder the duration of the contractions was longer, their amplitude increased, and the diminution of action regular. In the case of kola-red the duration of action was about the same, but the amplitude of the contractions remained constant for a longer period, and the subsequent diminution in intensity was slower. Physiologically, therefore, kola-red is more valuable than either the kola-nut or caffeïne, and this is probably because the caffeïne comes into action in the nascent state.—H. T. P.

Cream-of-Tartar Manufacture. Reports from Consuls of the United States, No. 150, 1893, 449.

The following particulars are extracted from the last reports of the United States Consuls:—

Austria-Hungary.—The manufacture of cream-of-tartar holds a foremost rank among the industries connected with wine-growing. In 1892 lees were imported to the amount of 14,684 double cwt., as against 2,604 in 1891, and the quantity of tartaric acid exported amounted to 2,907 double cwt. in 1892, as compared with 1,786 in 1891. The processes in use for the production of cream-of-tartar, tartrate of lime, and tartaric acid, not very lucidly set forth in the report, will be found in Dal Piaz, "Verwerthung der Weinrückstände." Only one patent dealing with the manufacture of tartaric acid has been acquired in Austria—that of Naquet, the French chemist, the method consisting in the action of nitric and sulphuric acids on dextrin.

France.—The south of France is the most important centre. More or less crude tartar is collected and sometimes roughly extracted by the wine-growers from lees and pomace (stalks, skins, &c.). But pure crystals are produced in special establishments. A cream-of-tartar refinery capable of turning out 500 kilos. per day costs about 20,000 dollars, and will furnish work for 10 men throughout the year. To turn out 500 kilos. per day of tartaric acid requires an outlay of 100,000 dollars, and will keep 20 men busy. The two products are so closely allied that it is usual for every establishment to make both cream-of-tartar and tartaric acid. For such a combination one engine of 60 h.p. will serve. Establishments for refining tartar differ very much, but the best in France, Italy, and Spain are after this fashion: A large wooden tank, often copper-lined, is partly filled with water and the crude tartar or lees thrown in. Steam pipes bring this to the boil, and when saturation is reached the liquid is drawn off into lead-lined tanks holding 80 hectolitres. To facilitate crystallisation, slats are placed across the top, and from these hang long strips of lead. After thorough cooling the mother-liquor is drawn off and used over again. The crude reddish crystals are collected and dried in the sun in shallow trays. They are then recrystallised till perfectly white. In order to facilitate dissolution the crystals are in all cases ground to powder under millstones. The chief market for cream-of-tartar is England and her colonies, largely for baking-powder. France, on the other hand, consumes large quantities of tartaric acid, especially since the plastering of wines has fallen into disfavour and treatment with tartaric acid has in a measure been substituted. For the manufacture of tartaric acid the inferior qualities of tartar, containing less than 10 per cent. of acid, are usually selected, the qualities containing 10 per cent. and over being set aside for refining. On entering a typical tartaric acid factory at Montpellier, piles of crude material meet the eye, all carefully separated according to their value determined in the laboratory (every establishment has its chemist). The finely-ground raw material is thrown into a large tank of hot water containing hydrochloric acid and animal charcoal; the solution is decanted, filtered, and neutralised with calcium carbonate in a hage tank provided with an agitator worked by steam. The neutral tartrate is then collected, washed, and passed through a filter-press, again mixed with water, and decomposed by sulphuric acid. The feebly soluble calcium sulphate is separated by filtration, and the liquid containing the free acid evaporated in vacuum pans. The pasty mass obtained after cooling is emptied into centrifugal machines, a dozen of which are constantly at work. The liquor is put back for resaturation and the crystals once recrystallised.

Germany. — Cream-of-tartar, tartaric acid, and tartar emetic are manufactured in very large quantities in Germany. The processes are described in "Muspratt's technische Chemie bearbeitet von Stohmann and Kerl." There are few patents connected with the subject, and they refer mostly to apparatus. The principal firms are at Nieder-Engelheim, Leipzig-Lindenau, Stuttgart, and Winkel (Rheingau).

Italy.—In the district of Florence the commerce of crude tartar and the manufacture of cream-of-tartar are of a very limited character, but in the Southern provinces and in Sicily they are somewhat more important. The process of refining consists simply in extracting by boiling water and decolourising by means of clay and animal charcoal.

Spain.—There are few factories in Andalusia, three small ones in Malaga, none in Cadiz or Jeres. The lees are mostly dried and exported to France,—Ed. T.

The Distillation of Essential Oils and Separation of the Oil from the Water. J. F. Child. Chem. and Druggist, May 20, 1893, 691.

THE principle underlying the separator described below is this:—A column of water 9 in. high will support a 10-in. column of oil sp. gr. of 0·900.

The separator is so arranged that there are two columns, which will both be of water if no oil be allowed to enter, but if sufficient does go in, one column will be of water and one of oil, with no possibility of their getting mixed.

Fig. 1 shows the chief features in the construction of such a separator. On pouring water into the funnel F, it is conducted down the tube T into the cup *c* which it soon fills, and if the supply is continued the cup will overflow and the water will gradually rise in the vessel V until the bottom of the larger tube marked L T is reached. For the water to rise any further in the vessel there would have to be an outlet for the air, which there is not, as all egress from the bottom of the larger tube or cylinder to the top of the vessel is prevented by means of a tight-fitting bung B; and thus the water is obliged to rise in the cylinder L T. The water will rise in the water outlet O W at the same rate. It will continue to rise till the line marked L of W in L T (level of water in large tube) is reached, when all water added afterwards finds an outlet through O W (*b*). Thus it will be seen that it is impossible for any water to run out of the arm O O, even when there is only water in the separator.

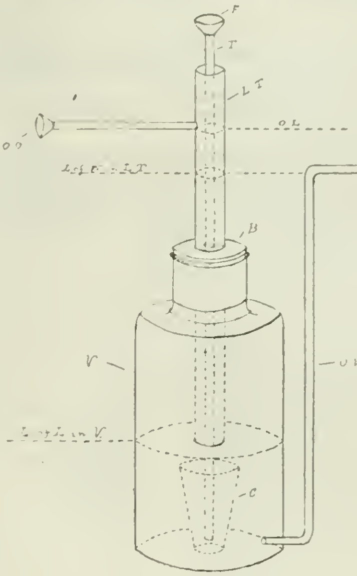


FIG. 1.

If a light oil be poured into the funnel in the same way as the water was poured in the oil passes down the small tube into the cup, from which it takes an upward course, and will gradually collect at the top of the large tube L T, the water displaced by it finding a means of escape through O W. Before any oil can run out of the arm O O, the tube L T must be full or nearly full of oil, when it will be found that the level of the oil has reached O L at the same elevation as O O, and the oil will then be able to escape. If the supply of oil is continued, a point is reached when water ceases to run off, and only the oil passes out by the arm O O.

Should the apparatus be proportionately constructed it will be found that the oil only forms a slight layer on the top of the water in the vessel V—a fact proving the principle to be correct.

There are difficulties, which are overcome as follows:—

The liquid sometimes lodges in the funnel of the model if poured in too quickly, and then trickles down the tube at a very slow rate, or perhaps passes down with a rush, violently agitating the liquid in the vessel, and also carrying down bubbles of air. These air-bubbles are objectionable because they are apt to unite with particles of water and carry them up the tube L T to the surface of the oil, where the air disengages itself and the water globules descend again.

The passage of air-bubbles down the tube is continually taking place even when the inflow is carefully regulated, for the fluid then circulates round leaving an air-passage all the way down the tube in the same way that the water escapes down the waste plug of a fixed hand-basin.

Perhaps of these two causes of the introduction of air, the former is the worse, as there is then a very strong upward current. However, the amount of water that finds its way out with the oil in the worst of cases is not more than 5 per cent.

The cause of the fluid collecting in the small tube and funnel is that the tube used in the model is, though in due proportion, too small ($\frac{3}{16}$ in. diameter), and capillary attraction no doubt accounts for it.

The following method prevents the possibility of water escaping with the oil :—

Oil and air with the water are first conducted as they rise up a second inner tube, so that they may pass to the surface, separate, and the water fall back again without in any way contaminating the oil in the outer tube. The best way of arranging this tube is shown in Fig. 2.

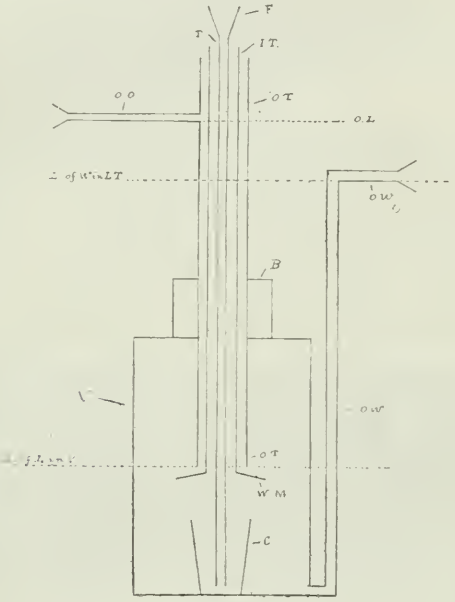


Fig. 2.

The action of the air after it enters this improved apparatus is as follows :—

The bubbles rush down the tube T and emerge into the cup *c*, from whence they take an upward course, and it is just about where the oil and water meet that the mechanical advantage is observed as regards the water-globules. If the inner tube has a sufficiently wide mouth W M fitted to it, the air, water, and oil are caught and conducted up the inner tube without injury.

No oil will be able to enter the outer tube O T until the inner one is full of oil down to the bottom of its mouth, when the oil will be able to escape round the edges of the flange W M and so into the outer one. Care must be taken that there is a fair amount of room left between the flange W M and the bottom of the outer or larger tube O T to allow the water and oil to change places easily; also to allow of the space between the top of the cup *c* and the bottom sufficient flange W M.

Most essential oils, when distilled with water, behave vastly better than when only shaken with water, so that if the separator will "part" the latter in a satisfactory manner it can hardly fail under the former condition.

If the separator is to act properly the liquid must flow into it at a steady and regular speed. To provide for this it is proposed that a regulator should be used as is shown in Fig. 3. The water and oil enter the funnel F, go down the tube T into the cup *c*, and then rise and and flow out of the arm O *a* W O (oil and water outlet) into the funnel of the separator. Should the liquid run into the funnel of the regulator (Fig. 3) quicker than it can get out of the arm O *a* W C, the level of the liquid would be raised and the water from the bottom of the vessel would be able to escape through W O. By fitting C *a* W O with a tap—say at X—the supply could be easily controlled.

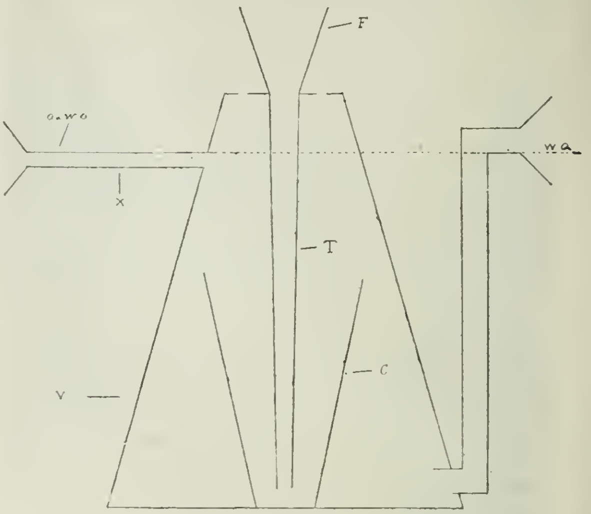


Fig. 3.

It will be seen that the effect of this preliminary treatment would be to allow the oil globules to unite somewhat and so form larger ones, get rid of an excess of water without danger of losing oil, and give a steady flow of liquid to the separator.

A few hints as to a suitable shape, &c. for the separator would perhaps be of use to those who intend to try it.

The arms O O in Figs. 1 and 2, and O *a* W O in Fig. 3 might be with advantage slanted down, in which case the the lips would no longer be required. The same must not be done with the arms O W or W O in the Figs. 1, 2, and 3; they must be kept at right angles, or they would act as siphons. But a considerable improvement could be effected by doing away with these arms W O, and substituting heads such as shown in Fig. 4, as they would answer to a rise of level in the vessel by letting out water quicker than the arms do. The lip may extend from the top of the tube instead of as shown in the drawing.

A means of raising and lowering either the oil or the water outlet is necessary to suit the specific gravity of the oil to be distilled. It would be best to alter the water column so that its length is proportionate to specific gravity of the oil. Thus to support 1 measure in length of oil sp. gr. 0·900, a column of water 0·9 in length is necessary, and so on. A screw arrangement to shorten and lengthen the water outlet is all that is wanted.

Before allowing any distillate to run into the separator and regulator both should be filled with water, and carefully adjusted on a perfectly level surface.

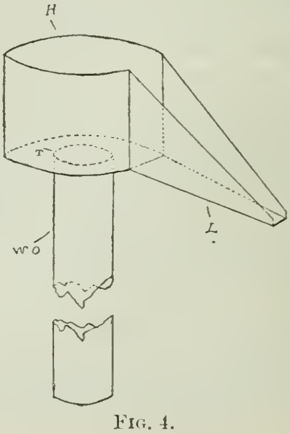


Fig. 4.

The shape of the separator may be varied considerably. For instance, the top part of the vessel V above the level of the liquid is not wanted, and could be done away with by closing over the vessel at L of L in V and letting the outer tube be fastened in the centre of the covering, which would have to be air- and water-tight, the inner tube remaining in the same relation to the outer tube as before; or the cup might be placed on one side of the separator with the inner tube and its mouth over it, and instead of putting the outer tube over that it might be put on the other side of the vessel, both tubes to reach down the same distance and to be air-tight at juncture with vessel, the tube with funnel over cup having no outlet for liquid, and the other tube to be fitted with the oil arm as usual.

The Decomposition of Chloroform. Carl Schacht and E. Biltz. Pharm. J. 1893, 1005—1006.

An interesting paper was read by David Brown on the decomposition of chloroform at an evening meeting of the Pharm. Soc. in Edinburgh last March. Whilst chloroform is not decomposed by the action of sunlight in the absence of oxygen, it is so decomposed when oxygen is present, yielding as products, chlorine, carbon oxychloride (phosgene), and water. In regard to the ultimately recognisable results of this decomposition in particular instances there is, however, one circumstance which exercises an essential determining influence; but it is not always sufficiently considered, and this fact has given rise to differences of opinion as to the nature of the decomposition and of its products. Thus Prof. Ramsay (this Journal, 1892, 772) has put forward the opinion that the only products are carbon oxychloride and hydrochloric acid, whilst others maintain that in addition to the formation of those products there is also an elimination of chlorine in the free state.

There is no doubt that this difference of opinion is entirely due to want of attention to the presence of alcohol in the chloroform experimented with, and to the misinterpretation of the chemical changes taking place. Whilst recognising as correct the first two equations—

$$4CHCl_3 + 3O_2 = 4COCl_2 + 2H_2O + 2Cl_2$$

and

$$2COCl_2 + 2H_2O = 2CO_2 + 4HCl$$

—given by Mr. Brown to represent the decomposition, it is thought necessary to add that those equations apply exclusively to the decomposition of chloroform that is perfectly free from alcohol.

Many years ago the authors succeeded in proving that the well-known influence of alcohol in preserving chloroform from decomposition is due to the alcohol taking up and chemically combining with the deleterious products resulting from the decomposition, so as to render them innocuous. More recently this fact has also been pointed out in a paper published by the authors on the preservation of chloroform from decomposition by light (Pharm. Jour. [3], xxii. 1041, and "Month," 691). Though the direct products of the decomposition of pure chloroform are only chlorine and carbon oxychloride, it is natural that in the case of chloroform containing alcohol the chlorine thus eliminated should act upon the alcohol present, and so give rise to the production of hydrochloric acid. Consequently, in the first stage of decomposition of chloroform containing alcohol, hydrochloric acid is always found in the place of free chlorine. That being the result, however minute the proportion of alcohol may be, it is evident that in such a case an observer who is not aware of the presence of alcohol in the chloroform will be led to dispute the statement that elimination of free chlorine is a primary feature of the alteration. For that reason the authors consider it to be absolutely necessary, in making experiments to ascertain the nature of the decomposition of chloroform, either to make sure that the chloroform operated with is perfectly free from alcohol, or to determine how much is present, and take that into account when interpreting the observed results.

As it appears that sufficient attention is not generally given to this point and to the purity of the chloroform experimented with, the following facts are pointed out:—

Chloroform cannot be absolutely deprived of alcohol in any other way than by repeatedly shaking it with double its volume of fresh water. This operation should be repeated at least 10 times.

To ascertain the entire absence of alcohol it is necessary to have recourse to the well-known iodoform test, or to test the chloroform with a solution of potassium bichromate exactly in the manner already described (Pharm. J. [3], xxii. 1041), any stronger solution being unsuitable for the purpose.

Chloroform quite free from alcohol has the sp. gr. 1·502 at 15° C. (59° F.), and its boiling point is 62°·05 C. (143°·7 F.) at 760 mm.

Such chloroform, when exposed to daylight of sufficient power, will begin to decompose within one or two hours. But it must be remembered that the chemical intensity of daylight varies considerably at different times. In summer it is, on an average, 10 times as powerful as in winter, and even in summer time days of feeble intensity occur. Consequently the effects produced will vary, and chloroform which in one experiment is found to show decomposition within two hours may at another time require to be exposed for a whole day to full sunlight before it shows the first signs of decomposition. From the first announcement that the Pictet chloroform had been experimentally proved to possess a capability of resisting the influence of sunlight for four days, the authors drew the conclusion that it contained alcohol, and their prediction that such was the case, without even having seen a sample, ultimately proved to be correct.

Mr. Brown's statements as to the nature of the products of the decomposition of chloroform are quite correct. These products may be easily recognised, the chloride by means of zinc iodide and starch, the carbon oxychloride by its peculiar nauseous smell, distinctly different from that of chlorine. If it be needed there is a good method of testing for carbon oxychloride, viz., shaking the decomposed chloroform with mercury, which immediately combines with the free chlorine, but does not act upon the carbon oxychloride, and thus the peculiar smell of this body becomes more easily recognisable. The presence of free chlorine is sufficiently indicated by the coloration of moistened test-paper charged with zinc iodide and starch when it is immersed in the atmosphere of the bottle, also by the bleaching of moistened litmus paper. After the removal of the free chlorine by agitation with mercury, litmus paper is longer bleached, but is then reddened, since the water in the paper determines decomposition of carbon oxychloride with production of hydrochloric acid and carbonic anhydride. Before the removal of the free chlorine this reddening of moistened litmus paper is masked by the bleaching action of the free chlorine.

The authors have not hitherto observed the formation of a straw-coloured supernatant liquid in the decomposition of chloroform, as described by Mr. Brown in his paper.

As is now well known, the decomposition of chloroform is prevented by an addition of alcohol, and not only does such an addition stop decomposition that has already commenced, but it will, with sufficient shaking, remove the free chlorine that has been eliminated, as well as the carbon oxychloride formed. The amount of alcohol requisite for that purpose depends upon the extent to which decomposition has advanced, and hence it will be seen that the length of time during which alcohol will protect chloroform will always be proportionate to the amount of alcohol added. So soon as the alcohol is consumed, by the joint action of the free chlorine and the carbon oxychloride directly resulting from decomposition of chloroform, the products of the change that has gone on up to that point without injurious consequences become all at once recognisable, just as if the alteration had suddenly commenced. At that point the presence of free chlorine and carbon oxychloride—the initial products of the decomposition—can be detected. Moreover, since hydrochloric acid will also have been formed by the subsequent reaction of the free chlorine with alcohol, that acid will also become recognisable as soon as the last trace of alcohol disappears, though it will at first be dissolved by the alcohol present. These successive changes afford an explanation of the fact that alcoholic chloroform will in the first instance evolve hydrochloric acid, originating indirectly from the reaction of chlorine with alcohol, and soon afterwards free chlorine and carbon oxychloride, originating directly from the decomposition of chloroform. The decomposition of pure chloroform, on the contrary, commences by giving rise at once to the products shown in the equation given by Mr. Brown, which coincides exactly with the one that was given by the authors in the paper above referred to.

According to the authors' experience, an addition of alcohol, amounting to one part in four hundred of chloroform (0·25 per cent.), is sufficient to prevent recognisable decomposition for one month or longer, with double that amount (0·5 per cent.), decomposition is prevented for nearly a year, and with one per cent. for many years. These, however, are only average statements, liable to variation in both directions, according to the effects produced by the varying intensity of daylight, as, indeed, Mr. Dott states that he has found to be the case in regard to chloroform of 1·498 sp. gr.

The amount of alcohol present in any sample of chloroform may be inferred with accuracy from the specific gravity of the sample in question, but as alcohol does not reduce the gravity in exact arithmetical ratio to its amount, the authors have found it necessary to determine the specific gravity of known mixtures of absolute alcohol and chloroform. In that way they have obtained the following data:—

	Specific gravity at 15° C.=59° F.
Pure chloroform	1·5020
„ „ with 0·25 per cent. alcohol	1·4977
„ „ „ 0·5 „ „	1·4939
„ „ „ 1·0 „ „	1·4854
„ „ „ 2·0 „ „	1·4705

According to these data the chloroform of 1·5 sp. gr. operated upon by Mr. Brown would have contained $\frac{1}{800}$ of absolute alcohol (provided its specific gravity was determined at 59° F.), an amount which is in close correspondence with the observed retardation of its decomposition under the influence of oxygen and sunlight.

In reference to the interesting fact of the accelerated decomposition of chloroform in an atmosphere of pure oxygen, the authors are disposed to ascribe that result to the absence of the nitrogen with which oxygen is mixed in ordinary atmospheric air. At one time they entertained the idea that ozonisation of the oxygen in contact with chloroform and under the influence of sunlight might have something to do with the decomposition, but that was during the earlier period of our investigations, and the experiments made in reference to this point during 1868 showed that no ozonisation takes place.

The authors agree with Mr. Brown's opinion that the gradual disappearance of free chlorine when chloroform is undergoing decomposition is a sign of its further action upon the chloroform, producing hydrochloric acid and altering the relative proportions of carbon oxychloride and hydrochloric acid so as to increase the latter.

Notes on the Qualitative Examination of Phenacetin. C. Platt. J. Anal. and Appl. Chem. 1893, 7, 77.

See under XXIII., *page* 550.

American Oil of Turpentine. J. H. Long. J. Anal. and Appl. Chem. 1893, 7, 98—108. Compare this Journal, 1892, 545, 549.

The author distilled the samples of turpentine from the fresh gums in the laboratory. A copper still was used and the temperature prevented from rising by distilling the gum with water.

The specific gravity and the specific rotation of the samples obtained are tabulated, and it is seen that the natural mixed turpentine oils contain bodies which have a higher specific rotation than is given by Tilden for pure "australene." His number is 21·5°; the author obtained samples which gave $[\alpha]_D = 29·581$ and 25·114°. Inasmuch as "scrape" samples (this Journal, 1892, 545) give as high a rotation as others it may be concluded that long exposure to air on the tree does not lower the rotation.

Three samples show that American turpentines exist which have a negative rotation ($[\alpha]_D = -2·02, -34·828, -16·916$) a fact which confirms the prediction of Armstrong (this Journal, 1882, 478). These samples were from spruce turpentine and it would seem probable that the low + rotation observed in many samples of American oils may be due to the presence of spruce gum in the crude gum taken to the still.

When the oil is fractionated the first distillates have a higher (+ and −) rotation than the last (compare Marsh and Gardner, Chem. Soc. Trans., 1891, 725). In one case the last fraction gave a negative rotation, which seems to indicate that the substance of higher boiling-point which accompanies pinene has a negative rotation.

Exposure to light increases the rotation of oil of turpentine (compare Armstrong and Pope, Chem. Soc. Trans., 1891, 315; this Journal, 1891, 653; Marsh and Gardner, *loc. cit.*); but inasmuch as the most pronounced case among the author's experiments was one in which there were only a few milligrams of air in the bottle and a trace of moisture in the oil, it is improbable that the production of an oxygenated compound is the cause of the alteration.

The increased rotation produced by oxidation is already known; the author confirms previous statements.

Removal of the brownish product formed when sodium is allowed to remain in commercial turpentine oils in closed bottles does not seem to alter the rotation.

The hydrochloride of dextro-pinene, $C_{10}H_{16}HCl$, was found to have a specific rotation $[\alpha]_D = +6·733$. Pesci and Wallach state that this compound is inactive (Jahresberichte, 1888, 900; 1889, 737).—A. G. B.

The Physiological Action of the Nitrites of the Paraffin Series considered in Connection with their Chemical Constitution. Part II.—Action of the Nitrites on Muscular Tissue and Discussion of Results. J. T. Cash and W. R. Dunstan. Proc. Royal Soc. 52, 91—93; this Journal, 1891, 652.

The authors have studied the effects of the vapours of these nitrites on striated muscular tissue, the experiments being made with the triceps and gastrocnemius of *Rama temporaria*. The muscle was contained in an air-tight chamber into which a known quantity of the vapour could be admitted, and which also allowed connection to be made between the muscle and the recording apparatus. The amounts of the nitrites employed varied between $\frac{1}{30}$ and $\frac{1}{400}$ cc. Two different orders of activity have been observed (1) with reference to the extent to which equal quantities of the nitrites shorten the muscle, (2) with reference to the rapidity with which shortening is produced. It has also been ascertained that very minute doses, insufficient to cause passive contraction, will still prevent the muscle from responding to stimulation.

The authors go on to discuss the connection between the physiological action and the chemical constitution of the nitrite causing it. The general conclusion arrived at is that the action is not solely, nor in some cases even mainly, dependent on the quantity of NO_2 present. The results of this research have an important bearing on the employment of nitrites for therapeutic purposes. The practical value of the research, from a medical point of view, will be considered elsewhere.—D. E. J.

An Improved Meter for Estimating the Volume and Density of Liquids. A. V. L. Bedout, Paris. Eng. Pat. 8272, May 2, 1892.

See under I., *page* 510.

A Simple Method of Determining Water in Iodine. C. Meineke. Chem. Zeit. 1892, **16**, 1149.

See under XXIII., *page* 549.

Solubility of Cream of Tartar in Diluted Alcohol. W. H. Wenger. Amer. Chem. J. **14**, 624—625.

M. Chancel has studied the solubility of cream of tartar in water, wine, &c. at varying temperatures, but figures are given only for 10·5 per cent. alcohol. In the author's experiments, measured amounts of a saturated aqueous solution of cream of tartar were mixed with the calculated amount of 92 per cent. alcohol, to give residual liquids of the desired strength of alcohol. The mixtures were repeatedly shaken, and kept for some days at about 25° C., after which measured amounts were filtered off and titrated with $\frac{N}{10}$ sodium hydroxide. The following numbers show the amount of cream of tartar dissolved, in grms. per 1,000 cc.:—

Alcohol.	Cream of Tartar dissolved.	Alcohol.	Cream of Tartar dissolved.
Per Cent.		Per Cent.	
90	0·15	40	1·32
80	0·19	30	1·96
70	0·30	20	3·01
60	0·41	10	4·51
50	0·79	Water.	5·75

N. H. J. M.

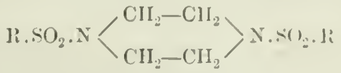
PATENTS.

Improvements in the Separation and Obtainment of the Constituents of Gaseous Mechanial Mixtures. J. H. Parkinson, Stretford. Eng. Pat. 4411, March 5, 1892.

This invention consists of a combination of compressing pumps and reservoirs containing liquefied gases such as are used for liquefying air and the so-called permanent gases, the central tube being surrounded with a jacket of liquefied oxygen. Air is passed through this central tube and becomes liquefied at the ordinary pressure. It then passes into a centrifugal separator, where it is said to be separated into its constituents by means of centrifugal force. The nitrogen may also be removed by allowing sufficient heat to reach the liquefied air to evaporate the former gas only, which evaporation may be assisted by means of an exhaust pump. Or the temperature of the above-mentioned central tube may be so adjusted that the oxygen only is liquefied. The escaping nitrogen may be made by means of regenerator tubes to cool the incoming air, which then deposits its impurities. Liquid oxygen is also said to be separated from liquefied air by passing the latter through a brass tube forming the core of an electro-magnet, the oxygen being attracted to the sides of the tube. On breaking the circuit the oxygen is released and flows out. The apparatus may also be used for separating nitrous oxide from impurities, carbonic anhydride from kiln gases, and carbonic oxide from water-gas.—H. K. T.

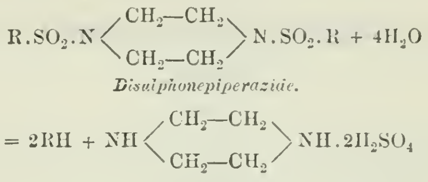
Manufacture or Production of Aromatic Disulphonethylenediamides, Aromatic Disulphonpiperazides, and Piperazine. W. Marckwald and J. F. Holtz, Berlin, Germany. Eng. Pat. 7120, April 13, 1892.

The invention relates primarily to the manufacture of piperazine from an aromatic disulphonepiperazide—



in which R represents a phenyl, tolyl, xylyl, or naphthyl residue.

By the action of an aromatic sulphochloride on ethylenediamine, or by that of an aromatic sulphamide on ethylene chloride or bromide an aromatic disulphone-ethylenediamine is obtained; the reaction is carried out in presence of alkali. By the further action of ethylene chloride or bromide on the disulphone-ethylenediamines the disulphonepiperazides of the above general formula are got, those derived from the sulphochlorides or sulphamides of benzene, ortho- and para-toluene, xylene, α- and β- naphthalene having been prepared. Heated with dilute acid to 200°—250° C., or with strong sulphuric acid to 180°—200° C., the disulphone piperazides are decomposed with the formation of piperazine sulphate, from which the free base is obtained by heating with powdered sodium hydrate. The decomposition takes place according to the equation—


Disulphonepiperazide.

Piperazine sulphate.

—C. A. K.

Manufacture of the Alumina Salts of the Naphthol Sulphonic Acids. C. D. Abel, London. From Farbwerke vormals Meister, Lucius and Brüning, Hoechst am Main, Germany. Eng. Pat. 10,668, June 4, 1892.

The aluminium salts of the naphthol sulphonic acids are produced by boiling the lead or calcium salts of the sulphonic acid with the requisite quantity of sulphate of aluminium. The insoluble sulphate formed is filtered off and the filtrate concentrated, when a white crust of the aluminium salt is left which is dried and ground up. Aluminium salts of the mono- and di-sulphonic acids of α- and β-naphthol are thus prepared. They are readily soluble in water, and possess an extraordinary astringo-antiseptic action.—C. A. K.

Improvements in the Manufacture of Antiseptics. J. Y. Johnson, London. From "Dr. F. von Heyden Nachfolger," Dresden, Germany. Eng. Pat. 13,291, July 20, 1892.

The highly poisonous nature of the phenols has caused their acid esters or "Salols" to be much used as clinical antiseptics. For certain purposes, such as the disinfection of the intestines, these latter are found to be hardly energetic enough, splitting up into acid and free phenol as they do, too slowly to be wholly satisfactory. The inventors find that by conversion into a salt of bismuth a phenol yields a comparatively innocuous product, possessing, however, superior disinfecting action to that of the salols. The following are the typical methods of manufacture:—A solution of 38 parts of phenol in 400 of water and 16 parts of sodium hydrate are mixed by thorough stirring with 49 parts of bismuth nitrate. The precipitated compound is boiled with water, washed, and dried, and forms a greyish white powder containing about 80 per cent. of Bi_2O_3. A solution of 5 parts of resorcinol in 150 of water is mixed with an acid solution of 49 parts of bismuth nitrate. The solution is highly diluted, and neutralised if necessary, till the resorcinate separates. The inventors claim the following bismuth salts as new products :—Phenolate ; *o*, *m*, and *p*, cresolates, xylenolates, chlorophenolates, bromophenolates ; trichloro-, tribromo-, and tri-iodophenolates ; *o*, *m*, and *p*, nitrophenolates, amidophenolate ; "kinophenolate ;" α and β naphtholates ; thymolate ; pyrocatechinate ; resorcinate ; "hydroquinonate" ; guaiacolate ; creosotinate (from beech tar creosote) ; eugenolate ; and pyrogallate.—F. H. L.

A New Compound or Derivative of Para-tolyldimethylpyrazolone, and Process for Obtaining the Same. L. F. Riedel and H. Thoms, Berlin, Germany. Eng. Pat. 19,329, October 27, 1892.

Para-tolyldimethylpyrazolone prepared by methylating the product of the action of para-tolylhydrazine on acetyl acetic ester, forms a salt with salicylic acid. The two products are fused together in molecular proportions ; an oily mass is first formed which gradually solidifies, and is then recrystallised from alcohol or from acetic ether. The salicylate $C_{12}H_{14}N_2O . C_7H_6O_3$ is sparingly soluble in water, readily in alcohol and in ether, and melts at 101°—102° C. The name "Tolysal" is proposed for the new product which is of therapeutic value for nervous derangements and for neuralgic pains.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

Improvements in the Manufacture of Transparent Materials and the Application of the same to Photographic and other Purposes. T. Christy, London. Eng. Pat. 7567, April 21, 1892.

This invention relates to certain improvements in the manufacture of a transparent tissue described in Eng. Pat. 13,917 of 1888, and 12,230 of 1890. (This Journal 1891, 1016.)

A solution of gelatin is used, with which is incorporated a ruby colouring matter, to this is added a chromium salt or other reagent which will render the glutinous matter insoluble, or it may be subsequently treated with a fixing bath, such as chrome alum, for the same purpose. Glycerin may also be combined with the material to give it flexible properties.

This gelatinous matter may be employed as a film upon glass ; or paper, silk tissues, or other fabric may be treated with it.—J. C. C.

Improvements in Dissolving Cellulose and Allied Compounds. C. F. Cross, E. J. Bevan and C. Beadle, London. Eng. Pat. 8700, May 7, 1892.

See under V., *page* 516.

Improvements in or Relating to the Manufacture of Sensitised Films for Carbon Printing. J. T. Clarke, Harrow, Middlesex. Eng. Pat. 11,254, June 15, 1892.

In place of the usual paper support, a film of celluloid or transparent insoluble gelatine, sufficiently thin to allow of the image being received by the sensitive material through the said film, is employed. After exposure, the soluble portions of the gelatino-carbon film may be removed by washing in the usual manner, and after drying, the print is ready for mounting on cardboard or glass, without the necessity of transferring it to any other support or removing the original support. A further advantage of this method is that the image is not reversed as regards right and left.
—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

Preliminary Note on the Pressure Developed by some New Explosives. Capt. Noble, C.B. Proc. R. Soc. **52**, 123—129.

Artillerists have agreed that, except under certain circumstances, the maximum working pressure in a gun should not exceed 17 tons per inch or about 2,500 atm. Now if cordite and pebble powder are taken as illustrations, it is found that with the former explosives it is possible to obtain with the same maximum pressure as much as 50 per cent. more energy than with the latter, the extra energy being obtained by the development of higher pressures in the fore part of the gun. It therefore becomes a matter of considerable importance to ascertain if these higher pressures in any way affect the safety of the chase.

Guns were prepared having crusher gauges placed at various points along the bore, and the results obtained were compared with those obtained by altogether independent means. In the author's opinion the crusher gauge is perfectly reliable so long as the products of combustion do not enter the gauge with a high velocity, which, however, will necessarily be the case if the gauge is placed in the forward part of the gun, where the products are in rapid motion. The author arranged a 4·7 in. Q.F. gun in such a manner that he was able to obtain a curve determined from the time at which the projectile passed 16 points along the bore. From this curve, by methods elsewhere described, the curve giving the velocity at all points of the bore can be deduced, and from the velocity curve can be deduced the pressures generating these velocities.

The explosives used were as follows :—

(*a*.) *Ordinary Service Pebble Powder.*—A charge of 12 lb. gave rise to a mean pressure of 2,424 atm. (max., 2,566 ; min., 2,277) as determined by the crusher-gauge in the powder chamber. It gave to a 45 lb. projectile a mean muzzle velocity of 1,839 ft. secs., corresponding to a muzzle energy of 1,055 ft. tons. 1 grm. of pebble powder at 0° C. and 760 mm. generates 280 cc. of permanent gas and develops 720 grm. units of heat.

(*b*.) *Amide Powder.*—A charge of 10 lb. 8 oz. gave rise to a mean pressure of 2,332 atm. (max., 2,500 ; min., 2,165) ; muzzle-velocity, 2,036 ft.-secs. ; muzzle energy, 1,293 ft.-tons. 1 grm. of amide powder generates 400 cc. of permanent gas and develops 821 heat units.

(*c*.) *Ballistite.*—A charge of 5 lb. 8 oz. developed a mean pressure of 2,180 atm. (max., 2,210 ; min., 2,142). Muzzle velocity, 2,140 ft.-secs. ; muzzle energy, 1,429 ft.-tons. 1 grm. generates 615 cc. of gas, and 1,365 heat units.

(*d*.) *Cordite.*—Charge, 5 lb. 8 oz. Mean pressure, 2,027 atm. (max., 2,070 ; min., 1,970) ; muzzle velocity, 2,146 ft.-secs. ; muzzle energy, 1,437 ft.-tons. 1 grm. at N.P.T. generates 700 cc. of permanent gas and 1,260 heat units.

The author gives a figure showing these results graphically. The ordinates show both the positions at which the pressures were determined and the magnitudes of these pressures in tons per square inch. On the axis of abscissæ is shown the travel of the shot in feet. In the calculation of the pressures it is assumed that the pressures will uniformly increase and then uniformly decrease before and after complete ignition of the explosive. It is improbable that this assumption is strictly true, as even when the combustion is comparatively slow it appears probable that there is a generation of gas in various parts of the bore causing a difference in pressure. The author thinks that some of the discrepancies of the crusher-gauge when placed in the forward parts of the gun may be due to these differences in pressure. These irregularities, however, would not seriously alter the curves and would have no appreciable effect upon the strength of the gun in a radial direction.

The author goes on to make a comparison between the pressures as indicated by the curve and those obtained from crusher-gauges, and his conclusion is, that while crusher-gauges placed in the chase are capable of giving valuable comparative results, they cannot be relied on for absolute determinations unless confirmed by independent observations.
—D. E. J.

PATENTS.

New or Improved Manufacture of Smokeless Powder and High Explosives. J. K. v. Falkenstein and A. M. Böhm, Vienna, Austria. Eng. Pat. 7238, April 14, 1892.

Natural fibrous, but preferably amorphous, cellulose is nitrated, and then placed in a solution of potassium permanganate, so as to obtain a uniform product not liable to decompose. Nitric acid is afterwards added to neutralise the alkali formed, the nitro-cellulose is allowed to settle and by further addition of nitric acid, on application of heat, the hydrated oxide of manganese is converted into nitrate. The residual nitro-cellulose is washed, ground, dried and pressed. For smokeless powder it is ground and polished. For high explosives it is mixed with potassium bichromate, or neutral chromate or ammonium chromate, and the mixture after being granulated or pressed into blocks and dried may be saturated with nitro-glycerin.

The amorphous cellulose referred to above, the use of which greatly facilitates nitration and involves comparatively small quantities of nitrating mixture, is made as follows:—Into a solution of 1 part by weight of potassium permanganate in 10 parts of water cooled to 12—14° C., 2—4 parts of comminuted cellulose are gradually introduced, the pasty brown mass being continually stirred. It is then freed from manganese oxide by treatment with dilute nitric acid, washed, pressed, ground to the greatest practicable degree of fineness and dried.—Ed. T.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS, ETC.

Notes on Sampling. H. R. Wood. School of Mines Quarterly, 1892, **13**, 364—368.

Vein and Mine Sampling.—A prospect or first sampling done on a vein should be made from a series of pits dug at intervals along the vein, as a single excavation cannot represent the average value of the ore. Such pits should be 10—12 feet in depth; the depth is, however, to be regulated by the nature of the ore. Surface samples are no criterion of the value of the vein throughout: if, for example, the surface cappings consist of iron oxides and carbonates of low assay, a short distance down may reach the ore-body in the form of sulphides. Gold bearing veins are frequently richer at the surface, and the gold is more apt to be in the form of large agglutinations, though at the immediate outcrop the gold may be entirely removed. When gold accompanies iron pyrites and oxidation goes on, the ferrous sulphate formed, acting as a slight solvent of gold, removes it or washes it out, or deposits it in nugget-like masses.

In sampling ore in which there is native silver or silver sulphide, the same care is taken to get a quantity of ore representative of the quality of the vein, holding rock and silver in constant ratio.

For buying or selling purposes a mine should be sampled throughout at all levels and the shaft as well.

1. When the ledge is exposed in end of tunnel, sampled thus ×.
2. When the ledge is exposed in bottom of the shaft, sampled thus ×.
3. When the tunnel follows ledge the vein should be sampled from wall to wall, across both roof and floor, every 10 or 20 feet.
4. In the shaft the vein should be sampled from wall to wall on both sides every 50 feet.

These samples may be kept separate, assayed singly, and the mean result taken; or the samples may be combined, quartered, crushed, and assayed. The result is the value of the ore output from the whole mine.

Pay-streaks, when distinctly marked from the rest of the vein, may be separately sampled; such streaks usually constitute first-class ore, and the balance second class. Careful sampling should be made from wall to wall when the ledge is decomposed on the surface, marked variations being kept separate.

Dump Sampling.—This may be accomplished by a blindfolded sampler who picks up from the pile the fragments of vein and ore with which his hand comes in contact; or the pile may be sampled by a careful selection from its surface. These methods are not as accurate as the regular ones for buying and selling purposes. The most satisfactory method of sampling a mine is to take 5—10 tons of the ore to a mill or smelter where its actual commercial value can be ascertained.

Smelter Sampling. Slags.—Slags are best sampled while they are hot and fluid. A slender iron rod is thrust into the fluid, quickly withdrawn, and immediately dipped into a bucket of water, into which the coating of slag falls. When run in pigs, the slag is broken before too cool and the rod thrust into its centre; whilst when the slag is run into pots the surface is broken and a portion of the molten liquid removed by means of an iron ladle, but care should be taken that all the particles of matter have settled. The slag in the cup should be cooled slowly and should have a glassy fracture. The sampling of solid slag is not so satisfactory. Surface samples should be avoided.

Matte.—This is sampled in the same manner as slag; care must be taken not to thrust the ladle quite to the bottom of the vessel containing the molten substance.

Zinc Pots.—The following is the method of sampling the zinc pots in the desilverising process:—After the final zincing and the last alloy of zinc, a rich silver-lead is skimmed from the surface of the pot. To sample the bottom of the pot, a long handled pair of tongs having a cavity at each end, resembling in fact a bullet mould is (while open) thrust into the pot and moved backwards and forwards in the molten mass, then suddenly closed, withdrawn and opened on a clean board or flag stone, two bullets are usually taken. The upper portion of the pot is sampled by thrusting into the molten liquid a thin bar of steel rounded at the end, the thin coating of lead which adheres is removed by slitting one side. The lower portion of the pot usually runs a trifle higher than the surface sample. It is, however, possible to judge by the nature of the alloy, crystalline structure, &c., whether the silver is all taken out.

Bullion.—This is sampled direct from the blast-furnaces by means of a punch hammer which removes a core from the bar, these cores may be duplicated from different parts of the bar.

When pure lead is manufactured, the desilverising process is continued until the lead assays 0·005 of silver or less to the assay ton. The zincing process is repeated, and a sample taken in the same way after each removal of the zinc alloys. The assayer uses two assay tons from the top and bottom of the pot, which he first scorifies and then cupels.

Blast furnaces are sampled at the lead wells, the antimony and copper oxides brushed off the surface, and a little lead poured on to a flat cold sheet of iron near. The softening furnace is sampled in much the same way, the surface cleaned and the sample poured on the flagstone pavement near.

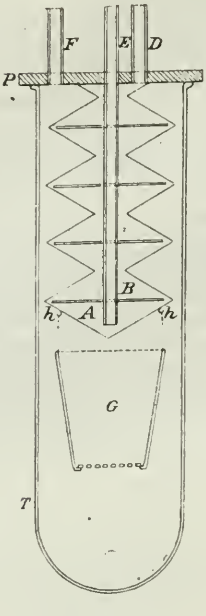
In sampling cupels the surface oxide is brushed away, a cup thrust in and the contents poured on to a clean portion of the hearth. In the case of silver furnaces, a clean bar or poker is thrust into the molten silver, and the coating knocked off on to the hearth.—A. R. L.

A New Extraction Apparatus. H. W. Wiley. J. Anal. and Appl. Chem. 1893, **7**, 65—68.

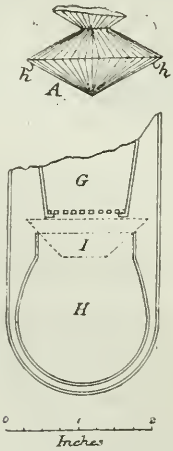
Knorr's extraction apparatus was designed for the purpose of avoiding corks; it is claimed that the apparatus now described is a cheap and efficient substitute for that of Knorr.

In Fig. 1, A is a condensing surface made of copper, the bottom section of which is shown in elevation in Fig. 2. Cold water is supplied through the tube E and is made to pass against the sides of the condenser by the circular baffle plates B, finally flowing away through the tube D. F is for the introduction of the solvent. The brass plate P is accurately turned so as to fit tke ground surface of the mouth of the large test tube T. The substance to be extracted is disposed in the crucible G, suspended from the hooks *h*. This crucible is of porcelain with a loose bottom of perforated platinum which is covered by a layer of asbestos, so arranged that the percolation of the solvent through it may be of such a rate that the substance to be extracted is covered by a layer of the solvent.

Fig. 1.



Figs. 2 and 3.



The dried extract may be weighed in the test tube itself or in a small flask H (Fig. 3) made to fit the test tube. While the solvent is being collected in this the funnel I is inserted to prevent the escape of splashes.

Ten cc. of ether or alcohol are sufficient for the extraction, and there is scarcely any loss in six hours if P be well turned and F be closed when all the air has been expelled.

—A. G. B.

PATENTS.

An Improvement in Thermometers. F. S. Tomey, Birmingham. Eng. Pat. 9349, May 17, 1892.

In these thermometers the usual enamelled back is omitted in the stem, the scale and figures being etched on the back of the thermometer, the figures of course being reversed; after etching, the graduations and figures are filled in with black enamel. The back is then coated with a fusible enamel or glass paint, and fused by heat. To prevent bursting the bulb of the thermometer during this operation a safety bulb is provided at the top of the thermometer. By these means the coating serves both as a backing and as a protector for the scale against injury from acids, &c.

—J. C. C.

Improved Apparatus for Determining the Relative Percentages of the Fluid Components of a Compound Fluid. P. V. P. Berg, Copenhagen, Denmark. Eng. Pat. 4409, February 28, 1893.

A centrifugal machine, consisting of an annular covered drum, into which fit a number of annular trays divided into separate compartments, each intended to hold one test tube, by partitions radiating from the centre. In practice, test tubes containing the liquids to be examined are packed in the trays, the latter placed in position in the drum (which must be quite full), the lid screwed down, and the whole rotated at a high speed by suitable gearing. Separation of the component fluids is effected in a few minutes. The tubes are then placed in a stand, and the height of the various layers determined by suitable means. By means of this apparatus a large number of samples may be tested at the same time, and if a few tubes should be broken during the operation, the remainder will in no way be injured.

—H. T. P.

An Improved Meter for Estimating the Volume and Density of Liquids. A. V. L. Bedout, Paris. Eng. Pat. 8272, May 2, 1892.

See under I., *page* 510.

INORGANIC CHEMISTRY—QUALITATIVE.

Notes on Capillary Separation of Substances in Solution. Lester Reed. Proc. Chem. Soc. 1893, 123—126.

Although the separation of salts in solution by selective absorption in bibulous paper has been partly investigated by E. Fischer and E. Schmidmer (Ann., **272**, 156—169), the author has ventured to enumerate observations of his own. His attention was first drawn to the subject by noticing the wide, colourless, very sharply defined margin which is obtained when a drop of moderately dilute solution of eosin (potassium eoside) is allowed to spread upon filter paper, although a saturated solution of eosin does not yield this margin. On adding potassium chromate to such a dilute solution of eosin, and repeating the experiment, the margin obtained is no longer colourless, but yellow, and the presence of chromate may be at once detected in this margin by touching it with a platinum wire moistened in a solution of silver nitrate, which produces a dark red spot on the yellow margin. If this yellow margin be cut off and extracted with water, a solution of potassium chromate free from eosin is at once obtained; and, conversely, eosin free from potassium chromate may be obtained if, after the drying of the drop, a drop of pure water be added and allowed to diffuse outwards from the centre; the appearance then obtained is that of a dark red central portion surrounded by a colourless margin, which is again surrounded by a yellow ring of potassium chromate, a practically complete separation or analysis of the mixture of the two salts being thus effected in a very short time. To prevent the drying of the drops during their expansion, the author performed most of the experiments in an atmosphere saturated with aqueous vapour, by placing the filter-paper on which the drop lay on a small porcelain dish containing a little water, covering this with a bell jar moistened on the inside with water. When thus treated, a drop of moderately dilute solution of potassium chromate affords a most unmistakable, colourless, moist margin, in which silver nitrate fails to detect chromate. After this he examined in a similar way the diffusion of a mixed solution of ferric chloride and copper sulphate, testing the marginal region, after allowing about an hour for expansion, with potassium ferrocyanide, which demonstrated the existence of a marginal ring containing copper but free from iron. In the case of a solution of ammonia alum, using as tests for ammonium and aluminium respectively Nessler's test and tincture of logwood containing ammonium carbonate, no separation of the constituents was detected, both extending to the extreme limit of moisture; so that in this case he had not obtained any free water margin, and the same remark applied to chrome alum. Employing a mixture of the solutions of copper sulphate, ferric chloride, and ammonia alum, a beautiful separation is readily effected. Externally in this case, there is a ring of pure alum detectible by the logwood test, within which is an annular zone jointly occupied by copper sulphate and alum, which is shown to be free from iron by yielding a pure chocolate colour with potassium ferrocyanide; and, lastly, a central zone where all three salts are present, and which is coloured dark blue by ferrocyanide, the lines of demarcation between these three zones being perfectly sharp and definite. In applying the logwood test by means of platinum wire, it is necessary to dry the minute spots and to compare them with similarly dried spots yielded by the same test on clean filter-paper. In the absence of alum the drops are buff; in its presence, purple. A drop of ferric chloride solution, while spreading upon filter-paper, frequently presents an appearance, more or less noticeable, of concentric rings, suggesting, perhaps, the presence of more than one hydrate in solution. Imagining that the presence of hydrates in solution might be in some way or other connected with the formation or diameters of these free water margins, the author prepared a solution of potassium bichromate corresponding in strength to Guthrie's cryohydrate, viz.,—

$$K_2Cr_2O_7 + 292H_2O$$

It readily yielded a margin of water, and it is remarkable that this margin is of about the same width as that yielded either by a saturated, or by a very much more dilute, solution of the salt. The author continued the dilution of this solution in geometrical progression, as with ferric chloride, until he had brought it to $\frac{1}{128}$th of the strength of the cryohydrate, but even this great dilution had little or no effect on the diameter of the free water margin, a result notably differing from that obtained in the case of ferric chloride or sulphuric acid. Copper sulphate solution, on the other hand, undergoes great change in diameter of free water margin on dilution. Hence it may be inquired whether a change in the diameter of free water margin, which must obviously represent a change in the relative velocities of water and the dissolved substance, may not in all cases be an evidence either of dissociation or of changes in the composition of the hydrates existing in solution. Sulphuric acid yields beautifully definite results, the test relied on being that of drying the filter-paper at a high temperature, when the portion over which the acid has extended chars. A free water margin begins to be formed at about the strength of 1 part of acid by volume to 200 parts of water; and when a dilution of about 1 in 4,000 is reached, the acid (as was the case with ferric chloride) seems to have almost totally lost its power of diffusing, and yields a relatively enormous free water margin. It would be very interesting if it could be shown that this inner zone of non-diffusible sulphuric acid represents a definite hydrate, the diffusibility of which is arrested by its enormous molecular weight, perhaps approaching those of such non-diffusible colloidal substances as the albuminoids; and such a hydrate might possibly be at or near the extreme limit of possible hydration of the acid.

Detection of Arsenic in Alkaline Solution. John Clark. Proc. Chem. Soc. 1893, 119.

The author shortly reviews the different methods by which arseniuretted hydrogen is generated in an alkaline solution, and finds, as pointed out by Hager, that Fleitmann's process, which depends on the interaction of finely-divided zinc and caustic potash, does not detect arsenic acid, but he is unable to confirm the statement of H. Fresenius, that Gatehouse's modification of Fleitmann's test indicates arsenic acid, as he has not been able to volatilise the slightest trace of arsenic by heating arsenate of soda with a large excess of pure aluminium and caustic soda, and he attributes the results obtained by Fresenius to the use of impure aluminium, or to the presence of arsenious acid in the arsenic acid. Experiments made to test the applicability of the Gatehouse process in estimating arsenic seem to show that, although it is very delicate and very convenient, it does give quantitative results, even when the whole of the arsenic is in the form of arsenious acid. He also finds that arsenic acid in an alkaline solution resists the action of sodium amalgam, and he concludes, therefore, that none of the methods which have been proposed for the generation of arseniuretted hydrogen in an alkaline solution detect arsenic acid.

Improvements in Reinsch's Process. John Clark. Proc. Chem. Soc. 1893, 119.

Reinsch's process, as carried out in the ordinary way, is capable of demonstrating the presence of very minute quantities of arsenic, and, according to Letheby, it withdraws every, and the smallest, trace of arsenic from organic mixtures, but there are two objections to its use in medico-legal cases.

1st. When the quantity of arsenic is small, a stain is obtained which it is sometimes difficult to identify as arsenic, because the coated copper when heated is apt to give a layer of chloride of copper and organic matter, instead of arsenious acid; and

2nd. It is not suitable for the quantitative estimation of arsenic, as it is not possible by means of heat to volatilise the whole of the arsenic from the copper.

The author's improvements consist in identifying the arsenic or antimony on the copper with greater certainty, and at the same time estimating the amount of each when they occur together. For this purpose he digests the coated copper in a cold mixture of dilute caustic potash and peroxide of hydrogen, which dissolves the arsenic and antimony, and converts them into arsenate and antimonate of potassium. The solution is then boiled, filtered, to get rid of the oxide of copper, evaporated to small bulk, and distilled with ferrous chloride and strong hydrochloric acid. The distillate is then saturated with sulphuretted hydrogen, and the arsenic weighed as sulphide, after being freed from traces of sulphur by washing with carbon bisulphide and alcohol. The residual liquid, from which the arsenic has been thus removed by distillation, is then tested for antimony.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Preparation of Chloric Acid. Estimation of Potassium by means of Perchloric Acid in Presence of Acids of difficult Volatility and Non-Volatile Acids. R. Caspari. Zeits. ang. Chem. 1893, 68—74.

The method for the preparation of chloric acid which was found most suitable is based on Hutstein's method for the conversion of potassium chlorate into perchlorate (Graham-Otto's Lehrb. Aufl. IV. Bd. II. 239), from which the acid is liberated by means of fluosilicic acid. Large quantities of perchloric acid can be easily and cheaply prepared in this manner.

The potassium determination by means of perchloric acid gives exact results even in presence of considerable amounts of the most frequently occurring bases, as well as difficultly volatile and non-volatile acids (all, however, soluble in alcohol), with the single exception of sulphuric acid.—N. H. J. M.

The Estimation of Nitrogen in Nitrates. A. Devarda. Chem. Zeit. 1892, 16, 1952.

The reduction of nitric nitrogen to ammonia is rapidly induced in an alkaline solution by an alloy of aluminium (45 parts), copper (50), and zinc (5). This is brittle and readily powdered. It is used in the following manner:— 10 grms. of the nitrate to be tested are dissolved in a litre of water. 50 cc. of the solution are placed in a conical flask of 600—1,000 cc. capacity, and to it are added 60 cc. of water, 5 cc. of alcohol, and 40 cc. of potassium hydrate solution of sp. gr. 1·3. 2—2·5 grms. of the powdered alloy are finally added, and the flask thereupon connected with a distilling tube. The reaction is started by gently heating, and is allowed to continue without the application of further heat until the evolution of hydrogen has almost ceased, this requiring about half an hour. The liquid is next gently heated for about 10 minutes to dissolve the zinc still contained in small quantity in the alloy residue, and then the ammonia is expelled by boiling the solution vigorously for 20 minutes.

The concentration of the potassium hydrate solution used is of great importance. If of greater density than that indicated, the action between it and the alloy is at first too energetic; if more dilute, the action has to be assisted by external heat.

Nitrogen in mixtures of nitrates and ammonium salts may be similarly determined, the ammonia liberated by the potash being in this case distilled away before the reducing alloy is added.

A convenient form of distilling apparatus consists of a glass tube, 1 cm. wide, in two pieces, joined by india-rubber tubing. The portion connected with the flask is 30—35 cm. long, and is expanded in its middle into a bulb of 30 cc. size, which is filled with glass beads. Above the bulb it is bent downwards and connected with the second portion, which is also provided with a bulb and dips into the standard acid employed for the absorption of the ammonia.
—E. B.

A Simple Method of Determining Water in Iodine. C. Meineke. Chem. Zeit. 1892, 16, 1149—1150.

A known weight of the iodine to be examined is placed in a test-tube and at once covered with 4—5 times its volume of previously ignited silver powder. After weighing, the contents of the tube are very gently heated until all the iodine has been converted into silver iodide. The water which sublimes into the upper portion of the tube may then be expelled by stronger heating, and the tube, after cooling, be weighed again. The loss in weight represents the amount of water originally present. The test-analyses given are exceedingly satisfactory. With iodine containing chlorine or bromine equally good results are obtained, but in presence of cyanogen the method is untrustworthy since considerable portions of that body (as iodide) always volatilise and escape fixation.—H. T. P.

ORGANIC CHEMISTRY.—QUALITATIVE.

Notes on the Qualitative Examination of Phenacetin. C. Platt. J. Anal. and Appl. Chem. 1893, 7, 77—83.

The manufacture of phenacetin involves the following operations:—(1.) Phenol is converted into nitrophenol by gradually adding one part of it to two parts of nitric acid in four parts of water. The resulting oil is washed and distilled with steam, when orthonitrophenol distils over leaving paranitrophenol as a residue. (2.) The nitrophenol [presumably the paraderivative] is treated with ethyl iodide, producing ethylnitrophenol (paranitropheneoïl, $C_6H_4(NO_2)OC_2H_5$). (3.) This last is treated with sodium amalgam, whereby the nitro group is reduced, forming phenetidine ($C_6H_4(NH_2)OC_2H_5$). (4.) The phenetidine is finally treated with glacial acetic acid, which converts it into phenacetin $C_6H_4(NHCH_3CO)OC_2H_5$, which is therefore paracetamidophenetoïl.

Phenacetin melts at about 135° C., and a fall of 2° below this affords legitimate cause for suspicion. The following tests serve for its identification:—(1.) Boil with hydrochloric acid, dilute the solution with water, cool and filter from the reprecipitated crystals, two or three drops of potassium dichromate added to the filtrate will produce a ruby-red colour. (2.) Boil with water, cool and filter; add bromine water until a yellow colour is produced, the solution should remain clear if the sample be unadulterated. (3.) Boil with hydrochloric acid and ferric chloride, a red colour is produced. (4.) Boil with 10—12 per cent. nitric acid, bright yellow crystals of the nitro-derivative separate out and the liquid becomes orange. (5.) Heat with alcohol and sulphuric acid, ethyl acetate will be evolved; heat the solution with potash and chloroform to obtain the carbylamine reaction. (6.) Boil with caustic potash, alcohol will be evolved (distinction from acetanilide).

The following tests serve to detect any considerable adulteration of phenacetin with acetanilide, &c.:—

(1.) *Acetanilide in Phenacetin.*—The presence of 5 per cent. of acetanilide will lower the melting-point of phenacetin to 127—128°. (2.) A well-cooled solution of phenacetin in concentrated hydrochloric acid gives a red colour with chlorine water, while acetanilide under the same treatment gives a dark blue colour which afterwards fades. (3.) The hydrochloric acid solution of phenacetin gives a violet colour with potassium permanganate, changing to dark ruby-red, while in the case of acetanilide a green colour is produced. (4.) The diluted hydrochloric acid solution of phenacetin gives a red colour with a weak solution of chromic acid; acetanilide, under the same conditions, gives at first a yellowish green, and then a dark green solution in which potash produces a blue precipitate. (5.) Small quantities of acetanilide may be detected in phenacetin by treating the alcoholic solution with caustic soda or potash in the presence of chloroform; the characteristic odour of a carbylamine will indicate the presence of acetanilide.

Antipyrine in Phenacetin.—To detect antipyrine in phenacetin, boil the sample with a little water, cool and filter. Boil the filtrate with potassium nitrite and dilute nitric acid, then add some of Plugge's reagent (a solution of mercurious nitrate with a little nitrous acid) and again boil. If no red colour is produced, the sample may be considered as practically pure.

Paraphenetidine in Phenacetin.—Paraphenetidine may be detected in phenacetin by melting 2·5 grm. of chloral hydrate in a test-tube in a water bath and adding 0·5 grm. of the phenacetin to be tested; if pure it will dissolve to a colourless solution, which acquires a pinkish tint after long digestion. The presence of a trace of paraphenetidine will cause the mixture to become dark violet to a reddish or bluish violet, according to the amount present. Another test is to dissolve 0·5 grm. in warm alcohol and add 5 cc. of a solution of iodine in potassium iodide, the solidified mixture is then heated to boiling until the solution is complete; paraphenetidine will show itself by a rose-red colour, becoming more pronounced as the phenacetin recrystallises.

The following might possibly be confounded with phenacetin:—(1.) *Exalgin,* or methyl acetanilide, $C_6H_5N(CH_3)COCH_3$; melting-point 101°, very soluble in hot water. (2.) *Thalline,* or tetrahydroparaquinanisol sulphate, $C_9H_{10}NOCH_3 . H_2SO_4$; a white crystalline powder, melting-point 110°, moderately soluble in water, sparingly soluble in cold alcohol. (3.) *Kairine* or methyl tetrahydroxyquinoline hydrochloride, $C_9H_{10}NOCH_3 . HCl + H_2O$; a greyish or yellowish crystalline powder of phenol-like odour and saline taste, melting-point 110°, moderately soluble in hot water and difficultly soluble in alcohol or glycerin. (4.) *Pyrodine* or acetylphenylhydrazine. $C_6H_5N_2H_2C_2H_3O$, is the impure commercial powder which is called hydracetine when purified; it is then a white crystalline powder, sparingly soluble in water and nearly tasteless. (5.) *Salol or phenyl salicylate*—

$$C_6H_4(OH)COOC_6H_5$$

a white tasteless powder with a slight aromatic odour, insoluble in water but soluble in alcohol. Compare this Journal, 1892, 1028.—A. G. B.

Solid Lubricants. Holde. Mitt. Königl. Versuchs. 1892, **4**, 186.

See under XII., *page* 527.

The Occurrence of Boric Acid in Beer and Hops. J. Brand. Zeits. ges. Brauw. 1892, **15**, 427; Chem. Zeit. Rep. 1892, **31**, 350.

See under XVII., *page* 535.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Examination of Bone Meal, Meat Meal, and similar Phosphatic and Nitrogenous Manures. W. Hess. Zeits. ang. Chem. 1893, 74—79.

Owing to the presence in bone meal of particles richer in phosphates and other particles richer in nitrogen than others, too much care cannot be taken in sampling. It is advisable when a sample is received for analysis first to take a smaller sample, and from this to take the portions actually analysed. It is also an advantage to make the two analyses (phosphates and nitrogen) with one weighed quantity. For this purpose the following simplification of Weibull's method (Chem. Zeit. 1892, 1689) is recommended:—5 grms. of a carefully made 50-grm. sample of the meal are boiled with sulphuric acid (35 cc.) in presence of mercuric oxide (0·5—1·0 grm.) in a 300-cc. or 350-cc. Kjeldahl flask. After dilution with water the solution is cooled and made up to 500 cc. Of this solution 200 cc. are used for the completion of the nitrogen determination. For the estimation of phosphoric acid a portion of the solution is filtered and 50 cc. treated with an equal volume of Märcker's ammoniacal citrate solution and 20 cc. of magnesia mixture. The analysis is then continued in the usual manner, except that it is advisable to heat the precipitate for two or three minutes to remove any mercury. There is also a slight correction (= 0·0003 grm.) to be made for silica present in the precipitate.

In the case of more highly nitrogenous manures, such as meat, blood, and horse meals, the same amount (5 grms.) may be treated with sulphuric acid, but only 50 cc. of the dilute solution used for the estimation of nitrogen.

—N. H. J. M.

The Electrolytic Estimation of Copper as applied to Invert Sugar Determinations. B. B. Ross. Anal. and Appl. Chem. 1893, **7**, 83—86.

The cuprous oxide is precipitated in a beaker, and at once brought upon an asbestos filter in an ordinary funnel, and washed with hot water as usual, without troubling to remove the whole of the precipitate from the beaker. The asbestos and precipitate are then returned to the beaker, and the funnel rinsed with a nitric acid solution containing 4 cc. of acid of 1·4 sp. gr. per 100 cc. The beaker is then filled with 200 cc. of this acid, the electrodes are immersed in the liquid, and a current equivalent to 0·5—0·7 cc. of electrolytic gas per minute is passed. The anode is a flat spiral of platinum wire resting on the bottom of the beaker; the kathode, a platinum cylinder suspended vertically. The cuprous oxide will dissolve during the electrolysis, and need not be in solution before the circuit is closed. Eight hours were required for the complete deposition of the copper.—A. G. B.

An improved Method for the Gravimetric Estimation of Furfurolhydrazone. W. H. Krug. J. Anal. and Appl. Chem. 1893, **7**, 68—77.

The author reviews the history of the pentoses and of the furfurol reaction which has led to their detection. He regards the estimation of their parent substances, the pentosans, in feeding stuffs as particularly important in view of Stone's demonstration of the indigestibility of these substances, and of the fact that, unless separately estimated, they are included in the soluble carbohydrates, and regarded as being equal to these in feeding value.

In commenting on the delicacy of the aniline acetate reaction for furfurol the author claims that one part of furfurol in 100,000 of water will give a brilliant red colour with this reagent.

The improvement here in the estimation of the furfurol, obtained by distilling the pentosan-containing substance with dilute hydrochloric acid, is in the gravimetric method of de Chalmot and Tollens (this Journal, 891, 577). After precipitating with phenyl hydrazine acetate, the author allows the liquid to stand over night before filtering, thus avoiding the loss entailed by the second precipitation, which occurs if the filtration be effected immediately. The last traces of the precipitate are difficult to remove from the beaker; this is overcome by washing the precipitate in the beaker and filtering tube (*loc. cit.*) with 100 cc. of water, and dissolving both in 30—40 cc. of alcohol. The alcoholic solution is evaporated in a weighed flask and the residue dried in a current of air at 60°.

The author prefers the gravimetric method to Stone's volumetric method (this Journal, 1891, 1039), but neither is, in his opinion, capable of affording more than an approximate determination of the furfurol present.

The following factors are given by Tollens for calculating furfurol to pentose.

Per cent. of Furfurol obtained from 5 grm. of substance.	
	Factors for Arabinose.
$2\frac{1}{2}$ or less	$\frac{100}{53}$
5 or more	$\frac{100}{49}$
	Factors for Xylose.
1	$\frac{100}{70}$
$2\frac{1}{2}$	$\frac{100}{59}$
5 or more	$\frac{100}{53}$
	Factors for Pentaglucoses.
$2\frac{1}{2}$ or less	$\frac{100}{60}$
5 or more	$\frac{100}{52}$

—A. G. B.

A Study of Oxycellulose. A. Nastjukoff. Bull. Soc. Ind. Mulhouse, 1892, 493.

See under V., *page* 516.

Solubility of Rosin Oil and Mineral Oil in Acetone. E. Wiederhold. J. Prakt. Chem. **47**, 1893, 394—397.

Rosin oil is miscible with acetone in all proportions, while mineral oils are either insoluble or require a large volume of acetone to effect solution. The test is best made in a graduated mixing cylinder divided into a scale of 0·1 cc. The acetone employed should be neutral and free from water, but it is not necessary to completely remove aldehydic substances. The method was applied to the following varieties of rosin oil:—Blue oil, yellow thick oil, pale odourless oil, red oil, patent oil and non-fluorescent, inodorous oil commercially known as "retinol." On treating these oils with half their volume of acetone, a perfectly clear solution was obtained. Commercial acetone is not always free from water, and its presence affects the solubility in a corresponding degree; thus thin oils were found to require from 5 to 6 vols. of acetone to effect complete solution, whilst thick oils required from 7 to 8 vols. It should further be borne in mind that anhydrous acetone absorbs moisture from the atmosphere when kept in open vessels. The reaction is as a matter of fact of such delicacy that it can be used with advantage as a means of determining the amount of water in a sample of acetone.

The behaviour of mineral oils from petroleum towards acetone is essentially different in character. As an illustration, the following examples are quoted:—

1. Burning oil of 0·830 sp. gr. At 15°, 1 vol. requires 4 vols. of acetone.

2. Russian spindle oil of 0·898 sp. gr. At 15°, 1 vol. requires 40—41 vols. of acetone.

3. Oleonaphtha of 0·908 sp. gr. At 15°, 1 vol. requires 70—71 vols. of acetone.

In practice it suffices to treat 2 cc. of the oil with 20 cc. of acetone, in order to obtain concordant results of sufficient accuracy for comparative tests. The following oils were examined:—

——	Specific Gravity.	Insoluble at + 15°.
		Cc.
1. Russian cylinder oil (Nobel)	0·913	1·7—1·8
2. Russian "distillate" (Nobel)	0·910	1·5
3. Mineral oil I. (Schibaeff)	0·908	1·5
4. Caucasine I. (Nobel)	0·808	1·5
5. Oleonaphtha A. A. (W. Schliemann)	0·905—7	1·5
6. Bakunite (Deneys and Co.)	0·905—9	1·5
7. Russian spindle oil (Nobel)	0·898	1·3
8. Pale machinery oil (Thompson and Bedford).	0·905—10	1·1
9. Extra spindle oil (Thompson and Bedford).	0·885	0·8

American cylinder oils were found to remain practically undissolved, for instance, valvoline A. A. cylinder oil of Leonard and Ellis, steam ref. extra cylinder oil, and B. and T. XXX. valve oil of Thompson and Bedford. In all cases the acetone solution assumed a pale yellowish or bluish colour. For oils having a gelatinous consistence, or for crude oils and fats of dark colour, the use of a mixing cylinder to which it is possible to apply heat is recommended. For this purpose, the glass foot of the cylinder is replaced by wood weighted with lead, the sealed end of the glass tube being inserted into a socket cut into the wooden foot, and in order to observe the scale down to the bottom of the cylinder, a vertical slit is cut into the socket. A small thermometer passes through the glass stopper, and is fused to it.

The solution of the oil in the acetone proceeds in anything but a regular manner, the most readily soluble portions being first attacked. This is clearly seen by the above figures, for if the solution took effect in a uniform ratio 1 cc. of oleonaphtha should require only 40 cc. of acetone for complete solution whilst in practice from 70 to 71 cc. are required, and even then it oftens happens that after decanting the clear solution a thin layer of a solid paraffin-like substance remains, which possessing the same degree of refrangibility as the solution escapes observation within the latter. The above results were obtained with neutral oils free from fatty acids, and it is always necessary to examine oils for acidity before making the test. For this purpose the cuprous oxide method described by the author in 1874 is recommended. It is based on the fact that cuprous oxide is easily decomposed by free fatty acids, a copper soap being obtained which dissolves in the oil with a green colour. The disadvantage of the method is that it requires 12 hours' duration to complete the reaction, but this defect is more than compensated for by the high degree of reliability which characterises the reaction. The same remark applies to the acetone method. The separation in the mixing cylinder takes between 12 and 24 hours before it is completed, but after this period very accurate readings may be made. It is best to conduct the method in a room exposed to as little variation of temperature as possible.

Finkener recommends the use of a mixture of 10 volumes of alcohol of 0·818 sp. gr., and one volume of chloroform. On treating 1 vol. of mixed oil with 10 vols. of this mixture at 23° the whole of the rosin oil is dissolved, the mineral oil remaining in the insoluble portion. The author found that by increasing the chloroform mixture to 16 volumes the solution could be effected at the ordinary temperature.

It is of course most important that a consumer should have the means of distinguishing rosin oil from mineral oil, but the recognition of additions of rosin oil to mineral oil plays a much more important part, and it has not been possible hitherto to achieve this result by chemical means. Every addition of rosin oil to a mineral oil increases its specific gravity. Oleonaphtha has a sp. gr. of 0·906—0·908, but it is possible to obtain an oil of the same specific gravity by mixing 6 parts of Russian spindle oil with 1 part of red rosin oil. When this mixture is tested by the acetone method only 1 cc. remains undissolved on treating 2 cc. of the oil with 20 cc. of acetone. Pure oleonaphtha, however, yields 1·5 cc. of insoluble residue when treated under similar conditions.—D. B.

Estimation of Ash in Mineral Lubricating Oils. A. Stepanow. Zap. Imp. Russk. tech. Obszcz. 1892, **26**, 27; and Chem. Zeit. Rep. 1892, **31**, 348.

The direct ignition of lubricating oil for the purpose of determining the ash is attended with certain inconveniences. Much soot is evolved, and a very difficultly combustible residue of coke remains. To avoid this the author evaporates off the bulk of the oil prior to the ignition proper. For this purpose 70—90 grm. of oil are heated in a platinum dish, over which is placed a closely-fitting conical or globular glass cover connected to a condenser, a receiver, and finally a powerful aspirator, by means of tubing. In about 15 minutes the greater part of the oil will have been evaporated and collected in the receiver. A fresh portion is then poured into the dish, and so on, until 200—300 grm. have been treated. The comparatively small residue of coke remaining in the dish may then be heated until no more fumes are evolved, and finally ignited over a blow-pipe or in a current of oxygen.—H. T. P.

ANALYTICAL AND SCIENTIFIC NOTES.

Stability and Instability of Viscous Liquids. A. B. Basset. Proc. Royal Soc. **52**, 273—276.

The author has investigated the theoretical explanation of the stability and instability of viscous liquids. This subject has been experimentally studied by Professor O. Reynolds, one of whose most striking experiments consisted in causing water to flow from a cistern through a long circular tube, while, by means of suitable appliances, a fine stream of coloured liquid was made to flow down the centre of the tube along with the water. When a certain velocity was attained, the coloured stream broke off at a certain point in the tube, and mixed with the water, showing that the motion was unstable. The results of the author's theoretical investigation may be summed up as follows:—(1.) The tendency to instability increases as the velocity of the liquid, the radius of the tube, and the co-efficient of sliding friction increase, but diminishes as the viscosity increases. (2.) The tendency to instability increases as the wave-length of the disturbance increases.

Further problems relating to jets and wave-motion are discussed, including the well-known calming effect of "pouring oil on troubled waters." It is pointed out that since the viscosity of olive oil in C.G.S. units is about 3·25, whilst that of water is about 0·014, the former may be considered as a highly viscous liquid, and the latter as a frictionless one. Taking the surface-tension between oil and water as 20·56, and the surface-tension between oil and air as 36·9, the author finds that when a thin film of oil has spread over the water the motion will be stable unless the wave length of the disturbance lies between about 9/11 and 6/5 of a centimetre. This result satisfactorily explains the effect of oil in calming stormy water.
—D. E. J.

The Action of Light in Preventing Putrefactive Decomposition and in Inducing the Formation of Hydrogen Peroxide in Organic Liquids. Arthur Richardson. Proc. Chem. Soc. 1893, 121.

It was shown in 1878 by Downes and Blunt (Proc. Roy. Soc. **26**, 488) that the development of bacteria and other putrefactive organisms is arrested under the influence of sunlight and oxygen; Janowski, Buchner, and Marshall Ward (this Journal, 1893, 472) have recently made observations of a similar character. This sterilising influence of light in presence of oxygen has apparently always been regarded as the outcome of an action exercised within the organism; the author describes a number of experiments with urine, made with the object of ascertaining whether, when sterilisation has been effected by light, any oxidising agent, such as hydrogen peroxide, is formed, and whether such substance may not be the sterilising agent.

In the method of testing reliance is chiefly placed on the production of a yellow colour on addition of a solution of titanic oxide in sulphuric acid; it is shown that this test affords a means of accurately estimating small quantities of hydrogen peroxide.

The author finds that, although no hydrogen peroxide is formed by the action of oxygen on sterilised urine in the dark, an appreciable amount is formed on exposing such urine to light, which is a proof that the production of the peroxide is not dependent on the presence of organisms. Urine in which bacteria have once flourished and which has then been sterilised at 100° no longer gives hydrogen peroxide on insolation.

Substances which destroy hydrogen peroxide were found to facilitate growth; thus, two portions of sterilised urine were exposed to light during several days, and to one of them was added a quantity of sterilised manganese dioxide; both were then placed in the dark: whereas both originally contained hydrogen peroxide, after 24 hours that to which no manganese peroxide had been added alone gave the yellow colour with titanic acid; and after 14 days, fungoid growths had developed in the liquid containing manganese peroxide, while the other portion was still clear and contained hydrogen peroxide.

Experiments are described, showing that if peroxide of hydrogen be added to fresh urine, this may be kept during a considerable period in the dark without the peroxide being entirely decomposed, and that its presence renders the liquid much less prone to undergo change under the influence of organisms, while, if added to urine in which fermentative change has already set in, it is rapidly decomposed.

The Influence of Moisture in Promoting Chemical Action. Preliminary Note. H. Brereton Baker. Proc. Chem. Soc. 1893, 129.

It has been shown by the author (C. S. Trans. 1885; Phil. Trans. 1888) that when moisture is removed as completely as possible, certain substances, *e.g.*, carbon, sulphur, phosphorus, &c., can be heated in an atmosphere of oxygen without undergoing visible combustion; and he has been engaged during the last two years in continuing the investigation, with the object of ascertaining in what way moisture promotes chemical action. One of the cases which he has studied is the formation of ammonium chloride from ammonia and hydrogen chloride. A difficulty presented itself at the outset in drying ammonia-gas, as it is absorbed by phosphoric oxide; this was overcome by drying the gas as completely as possible by freshly ignited lime, after which it was found that phosphoric oxide did not absorb any appreciable quantity. Hydrogen chloride was dried in a similar way by sulphuric acid, and finally by a week's contact with phosphoric oxide. On allowing the dried gases to mix, *no ammonium chloride fumes were produced*, and no contraction was indicated by the mercury gauge attached to the apparatus; and it may therefore be concluded that ammonia and hydrogen chloride do not combine when dry. On introducing a small quantity of moist air, union at once takes place, however. In like manner, sulphur trioxide was found not to unite either with lime or barium monoxide or copper oxide. Furthermore, no brown fumes were produced on mixing dry nitric oxide with dry oxygen.

New Books.

Handwörterbuch der Pharmacie. Praktisches Handbuch für Apotheker, Ärzte, Medicinalbeamte, und Drogisten. Herausgegeben von A. Brestowski. *9te Lieferung.* Wien und Leipzig: W. Braumüller, K. U. K. Hof und Universitäts-Buchhändler. 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. Price 2*s.* 5*d.* each number.

See this Journal, 1893, 384. Part 9 is now issued of this new Dictionary of Pharmacy.

It commences with "*Faülnissalkaloïde*" and ends with "*Gerbstoffe*" (Tanning materials).

Jahresbericht ueber die Leistungen der Chemischen Technologie, mit besonderer Berücksichtigung der Gewerbestatistik fur das Jahr 1892. Von Dr. Ferdinand Fischer. Mit 227 Abbildungen. Leipzig: Verlag von Otto Wigand, 1892. London, H. Grevel and Co., 33 King Street, Covent Garden. Price 24*s.*

This standard work, which may be regarded as the old "Wagner's Technology" on an improved and exalted scale, now appears as the Report for the year 1892, by Dr. Ferdinand Fischer, on all that has been done, more particularly in the German Empire, to advance chemical industry.

The work is published as an 8vo. volume in paper cover, which contains table of contents, subject-matter extending over 1124 pages, and alphabetical indexes of authors and subjects. Finally, there is a register of all the German patents referred to in the pages of the work, with the pages on which such references are made. The text is illustrated by 227 engravings referring to apparatus and plant, and the treatment of the whole subject may be gathered from the following epitome of the sub-divisions of the same:—

Group I. Chemical Technology of Fuel (pages 1 to 112). Wood, Peat, Coal, and Coke. Petroleum, Ozokerite, Paraffin. Illuminating Gas. Illumination, Water- and Generator-Gases. Furnaces and Furnace Arrangements, &c. Heating and Ventilation. Processes of Investigation. Calorimetry. Photometry. Statistics. Group II. Chemical Metallurgy (pages 113 to 285), Iron; Slags, their formation and utilisation. Pig Iron. Casting Iron. Purification of Iron. Steel. Manganese, Cobalt, Nickel. Chromium. Aluminium. Sodium and Potassium. Copper. Lead, and Silver. Gold. Zinc and Cadmium. Other Metals. Alloys and Metal Plating. New Books. Statistics. Group III. Chemical Manufactures: Inorganic (pages 286 to 433). Sulphur and Carbon Bisulphide. Sulphuric Acid. Ammonia. Salt and the Salt Industry. Potash Salts. Soda. Hydrochloric Acid and Chlorine. Bromine and Iodine. Nitric Acid. Nitrates and Nitrites. Phosphorus, Phosphoric Acid. Phosphates. Explosives. Magnesium-, Strontium-, and Barium-Compounds. Aluminium Compounds. Chromium and Lead Compounds. Antimony and Arsenic Compounds. Other Compounds. Oxygen and Hydrogen. Water and Ice. New Books. Statistics. Group IV. Chemical Manufactures: Organic (pages 434 to 611). Alcohol Preparations. Organic Acids. Aromatic Compounds. Organic Colouring Matters. Naphthalene and Anthracene Colours. Azo Colours. Other Organic Colouring Matters. Alkaloids. Ethereal

Oils. Other Organic Compounds. New Books. Group V. Glass, Earthenware, Cements, Artificial Stone, &c. (pages 612 to 679). Group VI. Foodstuffs (pages 680 to 960). Flour and Bread. Starch and Dextrin. Sugar. Fermentation Industries, Wine and Beer. New Books. Statistics. Group VII. Chemical Technology of Fibres (pages 961 to 1032). Fibrous Materials. Bleaching. Dyeing and Printing. Paper. New Books. Group VIII. Other Organic Chemical Industries (pages 1033 to 1079). Fats, Oils, and Lubricants, Fatty Acids, Soaps, Glycerin, Varnishes, Resins, Paints, India-rubber, &c. Tanning. Glues. Manures, &c. Preserving Wood.

Experiments upon Magnesia Alba, Quick-lime, and other Alkaline Substances. By Joseph Black, M.D. Professor of Chemistry in the University of Edinburgh (1766—1797). Edinburgh: W. F. Clay, 18, Teviot Place. London: Simpkin, Marshall, Hamilton, Kent, and Co., Limited. 1893. Price 1*s*. 6*d*.

This is a reprint, carefully and exactly made, of the original paper by Black. The main objects in view in reprinting it are as follows:—

1. To enable students of the history of chemistry to possess themselves of a copy of this most important contribution to the foundation of chemistry as an exact science.

2. To place within the reach of every student of chemistry a model of clear reasoning and of inductive investigation.

The work is a pamphlet of 47 pages, but strongly bound in cloth.

Trade Report.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Warning to Exporters of British Goods to Turkey.

Mr. W. H. Wrench, Acting British Consul-General at Constantinople, in a report to the Foreign Office, dated the 8th May, states that it cannot too often be impressed upon British merchants engaged in trade with Turkey that difficulties with the Turkish Custom-house authorities are increasing. They are chiefly to be met with in connection with the passage of imports, and may roughly be classified under the three following heads:—1. Political. 2. Medical. 3. Those connected with explosives.

The following instances of these difficulties have occurred within the last few months:—

2. *Medical.*—*a.* Some casks of malt vinegar were stopped by the Custom-house as unfit for human consumption. After consular representations, a sample was sent to the School of Medicine for fresh analysis, which, when finally obtained, showed the vinegar to be of excellent quality, and it was eventually released.

b. A regulation having been passed prohibiting the entry into Turkey of all drugs of which the ingredients are unknown, the Custom-house authorities at once seized upon and confiscated patent medicines of all kinds, such as "Collis and Browne's Chlorodyne," "Eno's Fruit Salt," "Cockle's Pills," and even a bottle of "Rowland's Macassar Hair Oil."

c. Last month some "sanitary walking sticks," for the use of persons of sedentary habit, were seized by the Custom-house upon the grounds of their being weighted, and, therefore, dangerous.

3. *Explosives.*—*a.* Some toy cartridges were recently brought out for use in a variety show. The Custom-house seized and forwarded them to the Grand Master of Artillery, who prohibited their delivery.

b. A quantity of yellow aniline colours were examined at the Custom-house and pronounced harmless. It was subsequently discovered, however, that the powders in question, when sprinkled upon glowing embers, gave forth a crackling sound such as that produced by ordinary table salt under similar circumstances. They were at once declared to be explosives, and were handed over to the Grand Master of Artillery.

c. A consignment of chlorate of potash shipped to the address of a hospital at Constantinople was seized and confiscated by the Custom-house upon the same grounds as those mentioned above.—*Board of Trade Journal.*

Fibre Industry at Zanzibar.

In a report to the Foreign Office on the trade of Zanzibar for 1892, Mr. Rennell Rodd refers to the possible development of a considerable coir and fibre industry there, owing to the abundance of fibre-producing plants, which overrun the fertile portions of the island wherever the ground is not cleared for cloves, and also of the intention of an English firm to set up a fibre-extracting mill. Mr. Rodd continues:—

It is satisfactory to be able to record that this mill, the property of Messrs. Boustead, Ridley, and Co., is now in full working order, its complicated machinery being run, without European supervision, entirely by natives of the island, who have been trained and instructed in their work by an energetic partner in the house. Some 50 native men and women are now employed in preparing fibre, spinning yarn, &c., and a separate branch has lately been established for the weaving of matting. At the outset about 1,000 cocoanuts were worked up in a day; now the efficiency of labour has so developed that though the number of workers has been reduced 4,000 nuts are disposed of per day. A difficulty is experienced in the supply of material, although the coco-tree flourishes throughout the island, in consequence of the absence of any adequate means of transport; it consequently pays better to take dhow-loads of nuts from the mainland than to collect them on the island itself. The same difficulty stands in the way of utilising the aloe-leaf, which grows in a desultory way wherever the ground is not cleared, and which would produce a still more valuble fibre did any means exist for collecting and bringing the raw material to the mills.—[*No.* 1,194, *Foreign Office Annual Series.*]

GENERAL TRADE NOTES.

The Consumption of Native and Foreign Cements in Japan.

According to a communication by the Belgian Legation at Yokohama, published in the *Bulletin du Musée Commercial* of the 13th May, the works for the improvement of the port of Yokohama commenced some years ago and still in course of execution, have already absorbed enormous quantities of cement.

At first the article was ordered from abroad, in accordance with the recommendation of the engineer-in-chief, whose confidence in the Japanese product was but limited. The first tender was in 1889 for a supply of 2,000 tons, which was furnished by England.

Since that time, however, the native manufacturers have succeeded, not only in having their cements accepted, but also in obtaining the monopoly of orders; almost all the materials of the two moles, which constitute the most important element of the port, are, in consequence, of Japanese origin.

When the work is now almost finished, it is discovered that a large number of the blocks of concrete used are cracking and decomposing under the action of the water. It is feared that the two immense walls which must break the violence of the waves will have to be recommenced.

This result is attributed to the bad quality of the Japanese cement, but whatever may be the cause, a reaction is being manifested in favour of the foreign product. The article, which had, as it were, been banished from the market, is now again greatly in demand.—*Board of Trade Journal.*

MINERAL AND METAL PRODUCTION OF THE UNITED STATES, 1891—1892.

No.	Products.	Customary Measures.	1891.			1892.		
			Quantity. Customary Measures.	Quantity. Metric Tons.	Value at Place of Production.	Quantity. Customary Measures.	Quantity. Metric Tons.	Value of Place of Production.
	NON-METALLIC.				Dols.			Dols.
1	Asbestos	Short Tons†	66	59·8	3,960	100	90·7	5,000
2	Asphaltum	„	45,054	40,884	242,264	54,985	49,896	291,250
3	Barytes (crude)	Long Tons‡	31,069	31,576	118,363	26,500	26,932	106,000
4	Borax	Lb.	11,830,000	5,367	768,950	14,243,099	6,462	925,810
5	Bromine	„	368,786	167	73,757	379,480	172	64,512
6	Building stone	.. ..	..	..	47,294,746	..	..	45,000,000
7	Cement	Bbls.,300—400lb.	8,222,792	..	6,680,951	8,465,953	..	6,586,098
8	Coal, anthracite	Long Tons	45,249,492	45,988,594	76,019,145	44,419,414	45,144,958	74,624,614
9	Coal, bituminous (c)	„	106,129,033	107,862,538	118,864,516	108,946,081	110,725,600	122,019,610
10	Cobalt oxide	Lb.	7,200	3·3	..	8,600	4	6,450
11	Corundum	Short Tons	2,265	2,055	90,230	2,200	1,997	88,000
12	Chrome ore	Long Tons	1,372	1,396	20,580	3,000	3,048	30,000
13	Feldspar	„	10,000	10,163	50,000	16,000	16,262	60,000
14	Flint	„	15,000	15,245	60,000	16,000	16,262	64,000
15	Fluorspar	Short Tons	6,320	5,735	38,000	9,000	8,167	54,000
16	Grindstones	.. ..	..	..	476,113	..	..	560,000
17	Gypsum	Short Tons	208,126	188,862	628,051	225,000	204,175	675,000
18	Infusorial earth	„	..	..	21,988	..	..	20,000
19	Lime	Bbls., 200 lb.	60,000,000	5,444,646	35,000,000	70,000,000	6,352,087	38,500,000
20	Limestone for iron flux	Long Tons	5,000,000	5,081,650	2,300,000	4,560,000	4,634,750	2,097,600
21	Manganese ore	„	23,416	23,898	239,129	17,000	17,277	170,000
22	Marls	Short Tons	135,000	122,505	67,500	135,000	122,505	67,500
23	Mica	Lb.	75,000	34	100,000	75,000	34	100,000
24	Millstones	.. ..	..	..	16,587	..	..	16,000
25	Mineral paints	Long Tons	47,562	48,430	658,478	50,000	50,817	650,000
26	Mineral waters	Gallons	18,392,732	..	2,996,259	..	..	3,000,000
27	Natural gas	.. ..	..	..	15,500,084	..	..	13,000,000
28	Novaculite	Lb.	1,375,000	628	150,000	..	..	150,000
29	Ozokerite (refined)	„	50,000	23	3,000	130,000	58·9	7,800
30	Petroleum (j)	Bbls., 42 gals.	54,291,980	7,595,702	32,575,186	54,344,500	7,603,049	30,229,128
31	Phosphate rock	Long Tons	587,988	597,589	3,651,150	641,382	651,801	2,361,219
32	Plumbago	Lb.	1,506,065	684	75,350	1,298,363	589	64,920
33	Potters' clay	Long Tons	400,000	406,532	900,000	450,000	457,349	1,000,000
34	Pyrites	„	109,319	111,105	317,280	106,250	107,985	357,000
35	Precious stones	.. ..	..	..	235,300	..	..	188,000
36	Rutile	Lb.	300	304	800	300	304	800
37	Salt	Bbls., 280 lb.	10,233,701	1,300,107	5,639,083	11,585,754	1,471,875	5,879,222
38	Slate (for pigment)	Long Tons	2,000	2,032	20,000	..	..	20,000
39	Soapstone	Short Tons	16,514	14,985	243,981	19,000	17,241	266,000
40	Sulphur	„	1,200	1,089	39,600	1,825	1,656	54,750
41	Talc (fibrous)	„	53,054	48,143	493,068	51,000	46,279	459,000
42	Zinc-white	„	..	..	1,600,000	..	..	1,200,000
	Total value of non-metallic mineral products	.. ..	..	..	354,273,449	..	..	350,959,283
	METALLIC.							
43	Aluminium, value at New York	Lb.	168,075	76	126,056	294,313	134	191,303
44	Antimony, value at San Francisco	Short Tons	455	413	45,500	478	433	51,600
45	Copper, value at New York (h)	Lb.	297,600,000	135,027	38,522,500	335,380,000	152,168	37,850,000
46	Gold, coining value	Troy Oz.	1,604,840	*49,915	33,175,000	1,596,516	*49,657	33,000,000
47	Pig-iron, value at New York	Long Tons	8,279,870	8,415,079	140,757,790	9,120,413	9,269,319	136,806,915
48	Lead, value at New York	Short Tons	202,060	183,303	17,574,000	218,500	198,276	17,917,000
49	Nickel, value at New York (i)	Lb.	120,848	55	72,509	96,152	43	57,691
50	Platinum (crude)	Troy Oz.	450	..	3,150	350	..	1,750
51	Quicksilver, value at San Francisco	Flasks, 76½ lb.	22,926	777·13	1,037,381	27,993	974·03	1,119,720
52	Silver, coining value	Troy Oz.	58,330,000	*1,814,226	75,416,565	64,900,000	*2,018,616	83,909,210
53	Tin	Lb.	125,198	56·8	25,085	143,400	65	29,827
54	Zinc, value at New York	Short Tons	80,263	72,834	8,058,405	83,300	75,589	7,703,580
	Total value of metallic mineral products	.. ..	..	..	314,813,941	..	..	318,638,596
	Total value of non-metallic mineral products	.. ..	..	..	354,273,449	..	..	350,959,283
	Estimated value of mineral products, unspecified (g)	.. ..	..	..	10,000,000	..	..	10,000,000
	Grand total	.. ..	..	..	679,087,390	..	..	679,597,879

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* Kilogrammes. † Short tons = 2,000 lb. ‡ Long tons = 2,240 lb. § Metric tons = 2,204 lb.

(c) Including brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

(g) Including fire-clay, common brick clay, terra cotta, building sand, glass sand, limestone used as flux in lead-smelting, limestone used in glass-making, iron where used as flux in lead-smelting, tin ore, iridosmine, nitrate of soda, carbonate of soda, sulphate of soda, native alum, mineral soap, strontia, and pumice-stone.

(h) Including copper from imported pyrites, except in 1881, for which no returns are available.

(i) Including nickel in copper-nickel alloy and in exported ore and matte.

(j) The production of petroleum stated in gallons is calculated in kilolitres, and converted to metric tons by multiplying by 0·88. This, of course, gives a result only approximately correct, as the specific gravity of the various kinds of oil varies.

—*Eng. and Mining Journal.*

Platinum Ores in Oural.

Fears need not be entertained, says the *Journal des Mines*, that the supplies of platinum will fall short in the future. There exists at Biseisky, in the Oural, beds of platiniferous ores which themselves will suffice to supply the needs of the whole world for many years to come. Platinum is also found in Brazil, and in the Cordillera.

In the Oural platinum is met with in grains mixed with sand in the proportion of 17 to 20 grms. for each 1,600 kilos. of sand. The whole of the platinum extracted from this district is sent to St. Petersburg, where it is treated and shipped abroad. The annual consumption is at present from 3,000 to 4,000 kilos., but it is constantly increasing.

—*Ibid.*

Minerals in the Russian Caucasus.

The petroleum wells at Balachari, Saburchi, and Bibi-Abab produced 5,491,970 metric tons of crude oils during the year 1892, or at the average daily rate of 15,000 tons.

The output during the first half of the year exceeded that of the second half by 110,088 tons; in March several very productive wells struck oil, those on the Apsheron peninsula reaching the enormous output of 2,000,000 poods or 32,258 tons per day; this rate of production has never been attained since, nor did the great flow last for any length of time. The outbreak of cholera was the cause of small production in June, July, and August. Altogether there were on December 31st 299 wells in operation; 150 old wells, temporarily stopped, were being cleaned and repaired before recommencing, and 81 new wells were being drilled.

The total shipments from Batoum amounted to 22,367 tons of crude petroleum, 86,542 lubricating oil, and 822,419 illuminating oil, making a total of 931,328 tons in 1892, as against 867,665 in 1891, being an increase of 63,663 tons. The value of the exports of petroleum in 1892 from Batoum amounted to 14,848,350 dols. The total quantity of illuminating oil shipped to ports east of the Suez Canal was 309,687 tons, of which 154,217 tons went to India, and the rest to Cochin China, China, Japan, Java, and Manila, and of this quantity 304,977 tons were carried in cases and the balance of 4,710 tons was carried in tank steamers.

The production and export of manganiferous iron ore in the Caucasus is steadily increasing, and will no doubt assume large proportions as soon as the trans-Caucasian railroad, now nearly completed, is opened for traffic to Chiatur. The Russian Government has shown great concern in the welfare of the mining industry of the Caucasus, and measures have been adopted for the immediate improvement of the existing tramways in the mining section of the sub-district of Sharopan. Macadamised roads are being constructed which will make the mines more accessible and which will enable the mine-owners to deliver the ore at lower rates at Kivril, which is about 50 miles distant from the mines on the trans-Caucasian road, and in direct communication with the ports of Batoum and Poti, from which the ore is expected. At present the average cost of ore at mines is 4 cents per pood (36 lb.); transportation to Kivril costs 12·5 cents; commissions and freight from Kivril 3·5 cents, making a total of 20 cents delivered at Batoum; the improvements mentioned will reduce the cost of hauling to Kivril to 2·5 cents, reducing the total cost one-half. The average f. o. b. price paid for this ore at the seaboard is 40 copecks or 20 cents per pood, or about cost.

From the port of Batoum 33,790 tons of manganiferous iron ore, valued at 454,305 dols. were exported during the year 1892; of this quantity 26,420 tons, valued at 310,330 dols., went to the United States. During the same year the exports from Poti amounted to 128,500 tons, valued at 1,556,250 dols., which would have been much larger if better accommodations for loading existed. The ore now has to be put on board the steamers in the outer roads from lighters and barges on account of insufficient depth of water in the harbour. The great increase in the production of manganiferous iron ore in the Caucasus is shown by the fact that in 1888 the exports amounted to 48,653 tons, and in 1892 to 162,290 tons.—*Eng. and Mining Journal.*

Chemicals for London.

The London County Council have accepted tenders for chemicals used in treating sewage as follows:—18,000 tons of lime at 13*s.* 9*d.* per ton, by Messrs. Hall and Co.; 2,000 tons of lime at 15*s.* 6*d.* per ton, by the Buxton Lime Firms Co. (this to be delivered at the Barking outfall); 5,000 tons of protosulphate of iron at 21*s.* 9*d.* per ton, by Messrs. T. Herschel, Jones, and Co.; 1,700 tons of sulphuric acid at 37*s.* 6*d.* per ton, by Messrs. J. M. Steel and Co.; and 1,500 tons of manganate of soda at 14*l.* per ton (or any less quantity at 14*l.* 8*s.*), by Messrs. C. Tennant, Sons, and Co.

—*Chemist and Druggist.*

Olive-growing and Oil-pressing in Morocco.

The large olive-groves of Southern Morocco, especially in the province of Soos, and in the districts round Morocco city (Marakesh) and Demnat, afford in prosperous years abundant crops of olives of fair quality, forming a very important item in the export lists of the country. Owing to damage to trees by locusts and other causes, the yield in 1892 was inferior, and only a value of 5,460*l.* was shipped, against 43,890*l.* in 1891 and 138,720*l.* in 1890. It is noteworthy that some Europeans are beginning to turn their attention to the oil pressing and refining industry; one English and one French press are already working at Mogador, while another French one, on rather a large scale, has been established at Morocco city, and is in brisk working order. There appears to be no reason why this oil, if properly refined, should not rival some European qualities.

—*Ibid.*

BOARD OF TRADE RETURNS.

Summary of Imports.

—	Month ending 31st May	
	1892.	1893.
	£	£
Metals	1,696,283	1,903,602
Chemicals and dyestuffs	544,783	497,259
Oils	579,224	574,910
Raw materials for non-textile industries.	3,609,729	3,825,123
Total value of all imports	35,035,738	36,836.951

Summary of Exports.

—	Month ending 31st May	
	1892.	1893.
	£	£
Metals (other than machinery)	2,775,746	2,846,607
Chemicals and medicines	723,090	773,125
Miscellaneous articles	2,531,853	2,719,582
Total value of all exports	17,783,969	17,822,460

IMPORTS OF OILS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut........ Cwt.	20,970	12,948	24,410	18,461
Olive .... Tuns	2,277	2,139	83,111	84,305
Palm .... Cwt.	96,537	89,411	109,033	109,338
Petroleum .... Gall.	7,976,680	12,037,764	162,550	190,253
Seed .... Tons	1,501	2,127	35,681	53,728
Train, &c.......... Tuns	1,698	1,119	38,585	20,802
Turpentine .... Cwt.	32,056	4,645	39,742	5,157
Other articles .. Value £	..	..	86,062	92,866
Total value of oils ...	..	..	579,224	574,910

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	10,945	7,592	22,715	15,031
Bristles.......... Lb.	315,637	354,522	40,720	57,345
Caoutchouc...... Cwt.	16,617	30,814	165,375	355,940
Gum :—				
Arabic......... „	4,279	8,023	11,412	17,095
Lac, &c......... „	13,781	14,914	50,976	73,768
Gutta-percha .... „	8,207	4,029	105,498	32,399
Hides, raw :—				
Dry............ „	37,770	44,485	101,032	114,493
Wet .... „	43,965	41,997	88,522	90,985
Ivory .... „	806	624	40,525	36,356
Manure :—				
Guano .... Tons	2,103	2,343	8,973	12,925
Bones.......... „	4,081	5,969	20,585	25,404
Nitrate of soda. „	31,858	22,253	257,902	204,842
Phosphate of lime „	21,070	27,976	42,612	48,526
Paraffin.......... Cwt.	48,079	80,833	73,180	92,060
Linen rags....... Tons	2,961	1,123	26,978	9,837
Esparto.......... „	14,673	17,166	67,487	88,188
Pulp of wood .... „	15,121	21,973	88,410	115,582
Rosin........... Cwt.	193,683	156,554	48,987	38,826
Tallow and stearin „	160,177	160,908	203,939	228,952
Tar ....Barrels	3,107	5,810	2,519	3,124
Wood :—				
Hewn .... Loads	221,177	225,687	426,835	432,582
Sawn .... „	315,371	300,939	744,896	691,401
Staves .... „	6,230	8,827	32,042	52,820
Mahogany ..... Tons	3,623	4,104	32,218	35,706
Other articles....Value £	..	..	905,391	967,936
Total value	..	..	3,609,729	3,825,123

Besides the above, drugs to the value of 72,726*l*. were imported as against 64,635*l*. in May 1892.

IMPORTS OF METALS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
Copper :—			£	£
Ore .... Tons	4,709	4,129	29,593	25,073
Regulus .... „	12,436	10,128	330,337	249,260
Unwrought .... „	2,967	3,097	142,159	139,916
Iron :—				
Ore............. „	211,391	348,564	153,346	232,105
Bolt, bar, &c.... „	8,820	5,594	84,079	46,561
Steel, unwrought.. „	931	852	8,681	8,306
Lead, pig and sheet „	13,561	17,948	149,408	175,863
Pyrites .... „	50,891	52,022	91,513	92,475
Quicksilver .... Lb.	447,070	839,920	40,353	75,543
Silver ore....... Value £	..	..	262,411	305,077
Tin .... Cwt.	36,354	67,210	169,932	308,879
Zinc .... Tons	3,905	5,510	86,255	100,162
Other articles ...Value £	..	..	148,216	144,382
Total value of metals	..	..	1,696,283	1,903,602

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............. Cwt.	4,329	8,358	3,992	7,987
Bark (tanners', &c.) „	39,145	34,300	18,744	13,411
Brimstone .... „	54,184	33,591	14,318	8,549
Chemicals...... Value £	..	..	120,197	116,262
Cochineal .... Cwt.	228	77	1,338	723
Cutch and gambier Tons	1,594	2,446	37,507	52,274
Dyes :—				
Aniline .... Value £	..	..	15,846	13,496
Alizarin ...... „	..	..	24,828	25,309
Other .... „	..	..	438	2,073
Indigo .... Cwt.	2,404	2,042	46,236	34,743
Nitrate of potash . „	28,191	26,580	24,153	22,318
Valonia .... Tons	3,458	1,668	46,624	22,131
Other articles... Value £	..	..	190,562	177,983
Total value of chemicals	..	..	544,733	497,259

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali........... Cwt.	540,974	551,153	194,782	169,425
Bleaching materials „	145,309	145,889	58,158	60,390
Chemical manures. Tons	20,212	21 754	155,149	155,445
Medicines....... Value £	..	..	83,772	75,272
Other articles ... „	..	..	231,229	312,593
Total value	..	..	723,090	773,125

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	10,730	10,143	43,258	40,063
Copper:— Unwrought..... „	65,459	68,166	159,893	165,350
Wrought........ „	22,393	26,743	68,507	77,370
Mixed metal.... „	12,498	28,684	32,196	67,231
Hardware..... Value £	..	..	172,231	186,541
Implements....... „	..	..	107,498	105,785
Iron and steel..... Tons	238,968	285,429	1,803,289	1,927,819
Lead............. „	9,971	8.909	117.087	94,130
Plated wares... Value £	..	..	21,439	24,886
Telegraph wires „	..	..	107,696	15,487
Tin............... Cwt.	8,640	12,499	38,679	59,740
Zinc.............. „	16,813	15,111	13,483	12,215
Other articles .. Value £	..	..	88,490	69,990
Total value.........	..	..	2,775,746	2,846,607

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST MAY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	934,700	727,800	20,808	18,066
Military stores.. Value £	..	..	90,023	61,082
Candles.......... Lb.	1,535,700	1,599,300	28,963	30,098
Caoutchouc..... Value £	..	..	85,842	96,717
Cement.......... Tons	31,120	43,988	95,432	74,481
Products of coal Value £	..	..	115,985	125,304
Earthenware... „	..	..	153.566	186,563
Stoneware...... „	..	..	14,934	16,020
Glass:— Plate........... Sq. Ft.	158,524	181,790	8,260	9,609
Flint........... Cwt.	8,185	5,747	16,615	15,857
Bottles......... „	69,553	54,672	32,463	25,029
Other kinds.... „	16,077	17,777	13,513	15,280
Leather:— Unwrought.... „	9,179	13,611	87,803	129,800
Wrought..... Value £	..	..	18,450	23,087
Seed oil.......... Tons	5,811	7 147	114,957	154,917
Floorcloth ..... Sq. Yds.	1,313,000	1,563,500	58,812	63,133
Painters' materials Val. £	..	..	142,686	135,434
Paper........... Cwt.	82,394	88,235	141,581	137,379
Rags............. Tons	4,739	4,620	33,303	35,000
Soap............. Cwt.	47,106	54,165	45,722	57,650
Total value..........	..	..	2,531,853	2,719,582

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

9808. N. Yagu. Improvements in apparatus for sterilising water. May 16.

9838. C. C. A. Forstreuter. Improvements in apparatus for evaporating, boiling, heating, and cooling liquids. Complete Specification. May 17.

9867. P. Rebbechi. A new or improved surface condenser. May 17.

10,171. G. Pettigrew. Improved still and apparatus for the distillation of ammoniacal liquor and other fluids, and the manufacture of sulphate of ammonia. May 23.

10,216. T. Ledward. An improved cooling apparatus for fluids. May 23.

10,389. H. Evers-Swindell. Improved manufacture of gas retorts, also applicable to other tubular objects of fireclay or earthenware, and apparatus therefor. May 26.

10,427. T. E. Mitton. An improvement in pressure-gauges and vacuum-gauges. May 27.

10,431. S. Barrett. Improvements in centrifugal machines for drying and separating purposes. May 27.

10,467. E. Latham and E. G. Guyot. Improvements in apparatus for evaporating liquids by means of steam. May 27.

10,585. C. W. Bildt. Feed device for gas producers. Complete Specification. May 30.

10,700. E. B. Caird and T. J. Rayner. An improvement in evaporating apparatus. Complete Specification. May 31.

10,762. H. Birkbeck.—From H. C. Michell, Canada. A new or improved heat non-conducting composition. Complete Specification. June 1.

10,803. J. Russell. An improved method of ventilating and increasing the draught of kilns, and of taking away the steam during the process of drying. June 2.

10,864. W. A. Kirkham. Improvements in or appertaining to plant for evaporating brine. June 5.

10,870. J. Fischer. Improvements in apparatus for cooling, heating, drying, or similar purposes. June 5.

11,104. S. M. Lillie. Improvements in evaporating apparatus. Complete Specification. June 6.

11,586. C. Heintz. Improved method of, and apparatus for purifying and softening liquors. June 13.

COMPLETE SPECIFICATIONS ACCEPTED.*

1892.

10,836. R. G. Ross, J. B. Hilliard, and W. Paterson. A new or improved apparatus and process for directing the passage and controlling the speed of gases, air, or fluids ascending through other fluids or liquids for the purpose of causing absorption of said gases, or for sterilising or otherwise treating the liquids through which the gases ascend, for treating water for brewing purposes or aërating malt worts, but is also applicable for other purposes. June 14.

11,249. O. Hamilton. New or improved method of mixing and dissolving solids and liquids, and apparatus therefor. June 21.

12,798. F. D. Marshall and E. Blum. Means or apparatus for effecting the turning or stirring of oxide of iron, lime, or other matters. June 21.

13,035. R. Haddan.—From W. Durr and A. Custodis. Means for measuring the density of gases and like purposes. June 14.

13,103. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Evaporating or concentrating apparatus. May 24.

14,675. A. G. Berry. Improvements in and relating to multiple effect evaporators for treating sugar and other liquids. June 21.

15,786. C. Wegener and P. Baumert. Improvements in furnaces using coal-dust or the like as fuel. May 31.

21,744. J. Laidlaw. Improvements in centrifugal machines for separating fluids of different densities. June 7.

23,217. J. C. Eno and R. Jackson. Improvements connected with machinery for drying powdered substances, particularly applicable for the manufacture of fruit salt. June 14.

1893.

2985. D. Terrace. Improvements in fastenings for retort lids and other similar lids. May 24.

5434. R. Haddan.—From E. Passburg. Evaporating apparatus. May 31.

6919. C. A. Allison.—From The Merz Universal Extractor and Construction Co. Apparatus for extracting from various substances, matters soluble in volatile solvents. June 7.

8817. E. Rund. Automatic distilling apparatus. June 7.

9514. G. Siebert. Evaporating and concentrating apparatus, particularly applicable for concentrating sulphuric acid. June 21.

II.—FUEL, GAS, and LIGHT.

Applications.

9674. F. Joynson. Obtaining carbonic acid gas from the waste products of combustion. May 15.

9888. L. Rueff and M. Steiner. Improved night-light. May 17.

10,066. H. Spicer. Improvements in the manufacture of gas for illuminating purposes. May 20.

10,190. J. Lee and S. Lancaster. Apparatus for producing an atmospheric or Bunsen smokeless flame from liquid hydrocarbons as fuel. Complete Specification. May 23.

10,227. C. R. Collins. Improvements in carburettors. Complete Specification. May 23.

10,446. S. W. Dew. Improvements in the manufacture of artificial fuel blocks and briquettes, and apparatus for that purpose. May 27.

10,501. C. H. Prichard. Improved method of heating liquids by electricity. Complete Specification. May 29.

10,515. W. E. Baker. Fire-lighting composition balls for domestic use. May 29.

10,554. The Manchester Oxygen (Brin's Patent) Co., Lim., and W. M. Jackson. Improvements in and in the mode of utilising the pressure in cylinders or reservoirs of compressed gases, in the application or employment of such gases. May 30.

10,602. E. S. Luard. The manufacture or production of gas from oily refuse. May 30.

10,612. A. J. Boult.—From A. A. Dickson. Improved process for reducing crude peat into a marketable form. Complete Specification. May 30.

11,015. H. Spicer, E. Spicer, and H. Spicer. Improvements in the manufacture of gas for illuminating and heating purposes. June 6.

11,103. W. L. Teter and H. L. Webster. Improvements relating to the generation of heat by the combustion of fuel, and to apparatus therefor. Complete Specification. June 6.

11,226. A. Lange. Improvements in lighting compositions. Complete Specification. June 8.

11,837. W. T. Crooke and T. Cartwright. Improvements in fuel for gas-fires. June 16.

11,863. E. W. Harding. Improvements in prepared fuel and in means or apparatus for use in effecting the combustion thereof for heating purposes. June 16.

11,871. J. B. Craig and D. Hancock. Improved means for increasing the illuminating power of coal-gas. June 16.

11,964. H. W. Crowther. Improvements in the treatment of the waste from gas-liquor to obtain useful products therefrom. June 17.

Complete Specifications Accepted.

1892.

3092. R. L. Barr, J. Macfarlane, E. J. Mills, and S. Young. Obtaining cyanides. May 24.

11,465. W. D. A. Bost and T. F. Haldane. Manufacture of fire-lighters. May 24.

11,504. L. Chapman. Apparatus for obtaining oxygen and nitrogen from atmospheric air. June 21.

12,924. The Northern Counties Hydro-Oxygen Gas Co., Lim., and P. B. W. Goble. Apparatus for manufacturing oil-gas. May 24.

14,105. J. Beveridge and J. B. Alliott. Improvements in or connected with the method and means for treating wool and other materials at high temperatures, whereby heat may be more effectively utilised. June 7.

14,266. J. Royle. Fire-lighters. June 14.

14,490. B. Parkin. Manufacture of illuminating gas. June 14.

18,605. G. Hüttemann and G. Spieker. Manufacture of blocks or briquettes of fuel from small coal, slack, coal-dust, and coke-dust. June 14.

1893.

4205. A. J. Boult.—From F. J. Collin. Improvements in or relating to coke-ovens. June 14.

8371. L. L. Merrifield, J. T. Westcott, and W. H. Pearson, jun. Apparatus for the manufacture of carburetted water-gas. June 7.

IV.—COLOURING MATTERS and DYES.

Applications.

9689. Read, Holliday, and Sons, Lim., and R. Holliday. The production of new colouring matters for dyeing and printing. May 15.

9894. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of azo colouring matters. May 17.

9895. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new sulpho acids and derivatives thereof. May 17.

9969. C. D. Abel.—From The Actien Gesellschaft für Anlin Fabrikation, Germany. Manufacture of basic colouring matters. May 18.

9972. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters and processes for dyeing and printing therewith. May 18.

10,320. H. A. Frasch. Method of obtaining dyestuffs from hydrocarbons by nitration. Complete Specification. May 25.

10,321. H. A. Frasch. Sulpho acid and the process of producing the same. Complete Specification. May 25.

10,322. H. A. Frasch. Art of manufacturing sulpho acid from petroleum. Complete Specification. May 25.

10,323. H. A. Frasch. Art of producing dyestuffs from natural mineral oils by sulphonation. Complete Specification. May 25.

10,996. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production and application of new colouring matters or dyes from naphthalene. June 5.

11,137. A. Ashworth. Improvements in the production and treatment of colouring matters. June 7.

11,147. A. Leabmann and A. Studer. Improvements in the manufacture of colouring matters. June 7.

11,556. A. Ashworth and J. Burger. Improvements relating to the production of colouring matters. June 13.

11,892. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs. June 16.

11,902. T. R. Shillito.—From J. R. Geigy, Switzerland. Production of azo colours. June 16.

Complete Specifications Accepted.

1892.

10,138. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture of a new class of basic dyestuffs or colouring matters and of sulpho acids thereof, and of materials or intermediate products relating thereto. May 24.

14,253. O. Imray. — From the Society of Chemical Industry, Basle. Production of azo colouring matters. June 7.

14,301. C. D. Abel.—From The Farbwerke vormals Meister, Lucius, and Brüning. Improvements in the manufacture of alpha-naphthol and of alpha-naphthol sulphonic acids from the corresponding amido-compounds. June 14.

14,398. Brooke, Simpson, and Spiller, Lim., and A. G. Green. New blue and bluish-green colouring matters, and the process for their manufacture. June 14.

14,478. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new colouring matters. June 21.

15,246. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of greenish-blue mordant-dyeing colouring matters.

16,569. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of new colouring matters. June 14.

1893.

8511. C. D. Abel.—From L. D. Huguenin and Co. Manufacture of polyazo colouring matters derived from dioxydiphenylmethan and condensation products of formic aldehyde with benzidine, tolidine, or dianisidine. June 21.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

9783. A. F. Bilderbeck-Gomess. Improvements in the treatment of textile vegetable fibres. May 16.

9816. H. H. Lake.—From W. A. Gayle, United States. An improved composition for preserving vegetable fibre. Complete Specification. May 16.

10,511. E. Toell. Improvements in the preparation of waterproof and washable woven fabrics, and in the manufacture of shirt collars, cuffs, and fronts. May 29.

10,729. W. E. Heys. From E. Godchaux, France. A new or improved substance for oiling or similarly treating wool. Complete Specification. June 1.

10,863. F. Devise. Improvements in and in the manufacture of waterproof materials. Complete Specification. June 5.

11,110. T. Birnbaum. Improvements in the manufacture of coloured waterproof fabrics. June 6.

11,140. W. G. Pond. Improvements in the ornamentation of textile fabrics. June 7.

Complete Specification Accepted.

1893.

8966. T. Buzixi and R. Menochio. An improved process for separating vegetable impurities from wool. June 14.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

9682. J. Reffitt. Improvements in the method of, and apparatus for dyeing, mordanting, and otherwise treating woven or felted fabrics and yarns. May 15.

9878. I. Frankenburg. Improvements in printing or producing designs upon waterproof fabrics. May 17.

10,154. M. Williams. Rapid bleaching materials. May 23.

10,327. J. Smith. Improvements in or connected with dyeing, tinting, sizing, and bleaching, or similarly operating upon textile fabrics or fibres and other materials. May 25.

10,447. J. D. Bulffer and C. T. Bulffer. Improvements in printing decorative designs on fabrics. Complete Specification. May 27.

10,451. A. J. Boult.—From Linkenbach and Holzhauser, Germany. Improvements in apparatus for washing, impregnating, and dyeing yarns in cops or in a similar condition. May 27.

11,019. E. Gibson. Gibson's mineral bleaching apparatus. Complete Specification. June 6.

11,202. H. H. Lake.—From G. Rusconi fu L., and Co., Italy. Improvements relating to the dyeing of silk and other textile fibres. June 7.

11,379. J. Wetter.—From J. D. Riedel and Co., Germany. Manufacture of aluminium tannico-tartaricum. Complete Specification. June 9.

11,634. O. P. Amend. Improved process of producing a fast black colour on fibrous substances. Complete Specification. Filed June 13. Date applied for November 18, 1892, being date of application in United States.

11,891. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The production of colours on fibres. June 16.

11,929. J. Riley and The Thornliebank Co., Lim. Improvements in the bleaching or cleansing of vegetable yarns and fabrics. June 17.

Complete Specifications Accepted.

1892.

10,267. R. Shaw. Apparatus for treating fibrous materials with dye or other liquors. May 31.

1893.

955. J. A. J. F. Leclercq. Machine for dyeing ribbons direct from the combs. May 31.

1220. E. Edwards. From P. Jaeger. Process for dyeing wood. May 24.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

9690. J. Taylor. Improvements in the construction of saturators employed for manufacturing sulphate of ammonia and the like. May 15.

9767. A. Vogt and A. R. Scott. Improvements in the production of chlorine. May 16.

10,053. A. J. Boult.—From A. Nieske, Germany. Improvements in or relating to the manufacture of chlorates. Complete Specification. May 19.

10,171. G. Pettigrew. *See* Class I.

10,625. E. Edwards.—From H. Wolf, Germany. Improvements in the process of manufacturing sulphuric acid. May 30.

10,680. R. J. Crowley. A liquid or preparation to dissolve coal, carbon, and like substances. May 31.

10,713. C. H. M. Lyte. An improved process for producing basic lead salts and obtaining certain by-products. May 31.

11,040. A. Brand. Improvements in the manufacture of chlorine. June 6.

11,581. W. P. Thompson.—From C. C. Bartlett, United States. Improvements in the production and separation of sulphide of nickel from ores of nickel and copper. Complete Specification. June 13.

11,797. R. Campion. Improvements in the production of soda. June 15.

Complete Specifications Accepted.

1892.

12,726. E. J. Barbier. Manufacture of sulphuric acids. June 7.

12,977. C. A. Burghardt. *See* Class XI.

12,985. J. H. Kidd. Manufacture of ferric-chloride from waste products. May 24.

13,121. E. H. Cook and A. E. Petter. Improvements in treating residues (seconds) from zinc-smelting, galvanised iron scrap, flux skimmings, and acid residues for the purpose of obtaining products therefrom. May 24.

13,411. H. Y. Castner. Bleaching compound. May 24.

14,657. A. Hand and H. Kunheim. Process for the extraction of alumina from bauxite and other substances. June 14.

14,665. C. Dreyfus. Manufacture of protosulphate and persulphate of iron. June 21.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

10,384. Count Solms-Baruth. Improvements in the manufacture of glass articles in imitation of agate. Complete Specification. May 26.

10,389. H. Evers-Swindell. *See* Class I.

10,503. A. G. Brookes.—From A. Kattentidt, Germany. Improvements in the manufacture of lamp glasses for safety-lamps and such like glasses for similar uses. May 29.

11,098. H. Tugby. Improvements in the manufacture and production of stoneware sanitary pipes and the like. June 6.

11,574. H. H. Pitt. Improvements in the manufacture of pressed glass articles and in apparatus for the same. June 13.

Complete Specifications Accepted.

1892.

13,067. E. J. Tompkinson. Manufacture or modes of making pottery articles. June 21.

13,416. H. L. Doulton and R. Meldrum. Glazing pottery. June 21.

1893.

6970. R. Haddan.—From S. Evans, C. L. Rawson, and C. T. Brown. Improvements in preparations for and ornamentation of clear glass. May 31.

IX.—BUILDING MATERIALS, CLAYS, MORTARS AND CEMENTS.

Applications.

10,044. T. L. Banks. Improvements in fireproof floors, ceilings, and the like, partly applicable to other forms of floors, ceilings, and partitions. May 19.

10,045. T. L. Banks. Improvements in fireproof framing for partition and other walls. May 19.

10,208. P. M. Justice.—From M. B. Church, United States. Improvements in the preparation of gypsum for use as plaster, mortar, and like purposes. May 23.

10,649. J. Hamilton. Improvements in concrete and artificial stone mantelpieces. May 31.

10,925. W. S. Lea and J. P. Hewitt. Revival of once used plaster of Paris. June 5.

11,383. P. Servais. Improvements in blocks for pavements, inlaid floors, walls, and the like. June 9.

Complete Specifications Accepted.

1892.

10,927. H. Birkbeck.—From H. Heise. Process for the preparation of a material for building or other purposes. June 14.

11,765. W. Webster. Improved treatment of the solid deposit or sludge from sewage for the application thereof to the manufacture of cement and other purposes. June 7.

13,602. J. C. Bloomfield. Manufacture of plaster. May 31.

13,819. W. White. Improvements in paving blocks for roads, footpaths, and other surfaces. June 21.

1893.

4987. H. B. Sheridan. Manufacture of metallic paving for roadways, footpaths, covers for streets, and the like. May 31.

X.—METALLURGY, MINING, Etc.

Applications.

9710. J. F. Duke and F. Redman. Improvements in treating tin-plate scrap, old tin vessels, or other tin-plate, in order to separate or recover the tin therefrom, and in apparatus employed therein. May 15.

9817. W. R. Ingalls and F. Wyatt. Improvements relating to the treatment of complex sulphide ores. Complete Specification. May 16.

9919. G. Nelson and A. Turner. Improvements in the process of casting ingots and chilled metal articles. May 18.

9956. H. F. Julian. Improvements in or relating to processes for the treatment of minerals and other substances for facilitating the extraction and recovery of metals contained therein, and apparatus therefor. May 18.

10,096. E. de Pass.—From H. Thofehrn, France. Improvements in the manufacture of metallic oxides and compounds. May 20.

10,215. J. A. Hunter. Improvements in the manufacture of iron and steel and compounds or preparations to be used therein. Complete Specification. May 23.

10,367. O. G. Goodman. A process of leaving malleable or soft portions of steel articles in hardening and tempering. May 26.

10,463. H. J. Kirkman. Improvements in and relating to pickling iron and steel plates and other articles previous to tinning or galvanising. May 27.

10,514. W. Wright and J. B. Hamond. Improvements in the treatment of zinc and other ores and in the recovery of by-products. May 29.

10,604. J. Bachmann. Improvements in apparatus for drying moulds for metal castings. Complete Specification. May 30.

10,608. D. W. Sugg. An improved metallic alloy. May 30.

10,672. H. B. Goldthorp. Improvements in the method of and apparatus for hardening and tempering steel wire. Complete Specification. May 31.

10,699. E. Hammesfahr. Apparatus for cooling or hardening objects of metal, alloys, and the like between plates, moulds, dies, or rollers. May 31.

10,755. J. C. Richardson. Improvements in or relating to the recovery of precious metals from their ores and apparatus therefor. June 1.

11,526. J. Bies-Albert. An improved solder. June 12.

11,581. W. P. Thompson.—From C. C. Bartlett, United States. *See* Class VII.

11,591. E. Smith and A. Smith. Improvements in the method of galvanising metal. June 13.

11,592. E. Smith and A. Smith. Improvements in the method of annealing and hardening steel wire. June 13.

11,622. R. H. Sanders and C. T. Thompson. Process of magnetic separation and apparatus adapted to the conduct of such process. Complete Specification. June 13.

11,652. J. Loevy. Improved method of and apparatus connected with the recovery of gold and silver precipitated from solutions by metals, and the recovery of the metals employed for such precipitation. June 13.

11,709. J. B. Cochrane and T. H. Taylor. Improvements in the purification of iron for casting and general foundry purposes, as also in the production of steel and wrought iron. June 14.

11,774. A. C. Wilson and H. Tomkins. An improved way of smelting iron and iron ores. June 15.

11,955. E. Oddy, J. Crossley, E. Smith, and A. Smith. Improvements in the method of and apparatus for hardening and tempering, in continuous or other lengths, steel wire bright. June 17.

Complete Specifications Accepted.

1892.

7151. J. F. Duke and F. Bedman. Improvements in separating or recovering tin from tin-plate, and apparatus for the purpose. June 21.

7152. J. F. Duke and F. Bedman. Producing metal or other castings. May 17.

9442. J. Bowing. Method of treating blue billy or purple iron ore, sand, or other ores in a similar condition, for the purpose of preparing them for the reducing furnace. May 24.

10,354. H. J. Walduck. Improvements in machinery or apparatus used for galvanising or coating sheets or plates of iron, steel, or other metals or alloys with zinc or with tin or terne metal or other metallic alloys. May 31.

12,491. J. David. Treating rich argentiferous blende and other ores. June 7.

13,960. D. Jones and B. Jones. Improved means for skimming molten metal, and apparatus for tinning iron or steel plates. June 14.

14,590. R. Taylor and D. Davies. Manufacture of tin or terne plates and means or apparatus employed therein. June 21.

14,739. N. Henzel. Improved method of converting pulverous metallic oxides into solid ores. June 21.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Applications.

9670. S. D. Williams, W. J. Clapp, and G. H. Llewellyn. An electro-chemical purifying process in iron-making and for other purposes. May 15.

9906. D. G. FitzGerald. Improvements in the manufacture of elements or electrodes for voltaic batteries and electrolytic decomposition cells. May 17.

9965. A. Longsdon. — From F. Krupp, Germany. Improvements in or connected with the working and welding of metals by electricity. Complete Specification. May 18.

10,042. F. King. Improvements in and apparatus for the manufacture of plates, grids, or supports for secondary batteries. May 19.

10,283. J. E. Hofmann. Improvements in and connected with the manufacture of electrode plates for secondary batteries. Complete Specification. May 24.

10,474. J. S. Bolton and T. J. Murday. Improvements in the construction and form of accumulators for the storage of electrical energy. May 29.

10,501. C. H. Prichard. *See* Class II.

10,584. H. Y. Castner. Improvements in connection with electrolytic apparatus. May 30.

10,765. E. J. Clubbe and A. W. Southey. Improvements in secondary voltaic batteries. June 1.

10,830. E. Bailey and G. M. Gordon. Improvements in electric storage batteries. June 2.

10,942. W. Walker, jun., and F. R. Wilkins. Improvements in primary voltaic batteries. June 5.

10,976. M. Guthrie. Improvements in apparatus for the electrolytical decompositions of brine and other liquids. June 5.

11,092. M. L. M. Hellesen. Improvements in electric batteries. Complete Specification. June 6.

11,105. T. Craney. Improvements in electrolytic apparatus. Complete Specification. June 6.

11,106. T. Craney. Improvements in electrolytic cells. Complete Specification. June 6.

11,107. T. Craney. Improvements in electrolytic apparatus. Complete Specification. June 6.

11,108. T. Craney. Improvements relating to the electrolysis of salts and to apparatus therefor. Complete Specification. June 6.

11,122. A. E. Peyrusson. Improvements in secondary batteries or accumulators. Filed June 6. Date applied for April 1, 1893, being date of application in France.

11,427. J. C. Howell, R. E. B. Crompton, C. F. Claus, jun., and the Crompton Howell Electric Storage Co., Lim. Improvements in and connected with electric accumulators or secondary batteries. June 10.

11,578. W. P. Thompson.—From C. L. Coffin, United States. A new or improved method of electrically welding metals. Complete Specification. June 13.

11,579. W. P. Thompson.—From C. L. Coffin, United States. A new or improved method of, and apparatus for, electrically heating or welding metal. Complete Specification. June 13.

11,596. W. Muir. Improvements in secondary or storage batteries. June 13.

11,610. C. J. Yarnold. Improvements in apparatus employed in the evolution and collection of hydrogen and oxygen gases by electrolysis. June 13.

11,973. Siemens, Bros. and Co., Lim., and E. F. A. Obach. Improvements in apparatus for electrolysis of water. June 17.

11,983. D. G. FitzGerald. Contact plates or electrodes for forming and charging or for alternately charging and discharging plates or elements to be used in voltaic batteries. June 17.

Complete Specifications Accepted.

1892.

10,735. H. C. Bull. Process and apparatus for the production of sodium, potassium, and like metals by electrolysis. June 14.

10,855. H. F. Kirkpatrick-Picard and H. Thame. Secondary batteries. May 24.

12,977. C. A. Burghardt. Electrolytic production of caustic soda or caustic potash. May 24.

13,542. F. E. Elmore and A. S. Elmore. An improvement in tanks or cells for electrolysis and like purposes. May 31.

14,250. S. A. Rosenthal and V. C. Doubleday. Secondary batteries. June 21.

15,120. H. W. Headland. Improvements in or applicable to electrical accumulators or secondary or storage batteries. May 24.

1893.

7389. W. P. Thompson.—From C. L. Coffin. Apparatus for electrically welding or working metals. June 21.

8808. H. Lehmann. Improvements in electric accumulators or storage batteries, applicable also as a constant primary element. June 21.

9295. T. Craney. Electrolytic apparatus. June 14.

9297. T. Craney. Electrolytic apparatus. June 14.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

9882. G. Pommerhanz. Improved process of producing consistent and semi-consistent fats and oils without applying heat. May 17.

10,033. A. J. Inston. A mode of recovering grease from waste suds which have been used in washing wool, hair, or other fibre. May 19.

10,645. W. T. Congdon and H. Herman. An improved compound for cleansing or polishing. May 31.

10,664. J. Weir and G. Weir. Improvements in separating oleaginous or fatty matters from boiler feed-water or other water. May 31.

10,707. J. Wetter.—From J. D. Riedel and Co., Germany. Process for the manufacture of new soaps containing sulphur in chemical combination. Complete Specification. May 31.

10,834. D. H. McClelland and S. W. Curriden. Improvements in oil purifiers. Complete Specification. June 2.

10,998. G. H. Hikins and J. W. W. Huddleston. Improved washing compounds. June 5.

11,034. G. W. Scollay. Improvements in the art of treating cotton-seed, linseed, and other vegetable oils. Complete Specification. June 6.

11,035. G. W. Scollay. Improvements in the method of refining vegetable oil. Complete Specification. June 6.

Complete Specifications Accepted.

1892.

9432. R. H. F. Finlay. Process of making soaps. May 24.

14,726. G. Harper. Improved compound or composition for cleaning or removing paint and varnish or for cleansing wood, metal, and stone. June 7.

19,745. C. H. Freyer.—From F. Korn. The "Excelsior" oil-purifying apparatus. May 24.

1893.

9292. H. H. Lake.—From W. N. Blakeman, jun. Treatment of drying oils for thickening the same. June 14.

9540. G. R. Geldard. A process for testing for water in butter and other fatty matters, and appliances for that purpose. June 21.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

9825. E. Edwards.—From J. W. Overton, United States. An improved paint. May 16.

9930. J. Renison. A new material for making varnish and the like. May 18.

10,072. J. Taylor. The refining of rosin. May 20.

10,303. J. C. Müller. An improved process for manufacturing paint. Complete Specification. May 24.

10,619. W. Ward and J. O. Wallace. A new or improved paint. May 30.

10,891. J. Wild and J. J. Horne. Improvements in or relating to the manufacture of india-rubber and other similarly moulded goods. June 5.

11,276. W. V. Wilson and W. B. Priest. Improvements in the manufacture of paints. June 8.

11,369. A. Gentzsch, J. Goldschmidt, and E. R. von Scanavi. An improved insulating compound and process of preparing same. Complete Specification. June 9.

11,500. F. W. Oliver. Improvement in printing ink. June 12.

11,727. W. C. Nangle. An improved paint or paint-like composition. June 14.

11,972. A. Macdonald. An improvement in the manufacture of sulphate of lead pigment. June 17.

Complete Specifications Accepted.

1892.

13,424. R. Ripley. Improvements in or appertaining to bag or washing blue. May 24.

14,726. G. Harper. *See* Class XII.

14,896. B. Pitt. A chemical compound gelatin or liquid detergent for laundry, washing, or other purposes. June 14.

1893.

2169. W. B. Abert and W. Scherer. Paints. June 7.

7277. L. Paget. Pyroxyline solvents and compounds. May 24.

7721. C. H. Hollis and A. W. Byron. A varnish or polish for leather. May 24.

8345. H. H. Lake.—From A. B. Browne. Manufacture of white lead. May 31.

9293. H. H. Lake.—From W. N. Blakeman, jun. Manufacture of pigments or paints. June 14.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

10,445. J. Pullman and A. Pullman. Improvements in machinery or apparatus for treating skins in the manufacture of leather. May 27.

11,272. J. Bergmann. Improvements in or relating to the treatment of waste from leather manufactories. June 8.

11,693. H. O. Band. An improvement in parchment. June 14.

COMPLETE SPECIFICATIONS ACCEPTED.

1893.

7732. J. S. Fairfax.—From J. D. Gallagher. Process of tanning in the manufacture of leather. May 24.

9026. L. Alexander. Improvements relating to softening, roughening, waterproofing, and increasing the durability of leather, and a composition therefor. June 21.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

9937. J. D. Lewis. An improved manure or fertilising compound. May 18.

10,189. J. Schmitt. Improved manure. Complete Specification. May 23.

11,804. H. E. Newton.—From C. Seybold and F. Heeder, Germany. Improvements in the manufacture of manures and new processes for obtaining the same. June 15.

COMPLETE SPECIFICATION ACCEPTED.

1892.

18,648. J. Carter. Manufacturing manure from sewage. June 7.

XVI.—SUGARS, STARCHES, GUMS, ETC.

APPLICATIONS.

10,840. R. C. Garton and J. Heron. Improvements in preparing or treating starch in order to manufacture a material for use in brewing, or for other purposes. June 2.

11,913. P. Lebaudy. Improvements in the artificial cooling of syrup for the manufacture of refined sugar and apparatus therefor. Complete Specification. June 17.

11,957. J. E. Pellegrini. Improvements in the manufacture of sugar and in the apparatus employed therein. Complete Specification. June 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

14,419. L. E. A. Prangey. Process and machinery for the continuous refining of sugar. May 31.

14,675. A. G. Berry. *See* Class I.

1893.

8795. F. Graeger. Treatment of molasses. June 7.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

10,132. J. Pikhart. An improvement in the manufacture of beer. May 20.

10,263. K. Michel and M. Frank. Improved method and apparatus for collecting the carbonic acid generated during the fermentation of beer or wine. May 24.

10,290. M. Wool. Process of making brandy mash and composition for same. Complete Specification. Filed May 24. Date applied for 8th November 1892, being date of application in United States.

10,302. A. E. Cromarias. Improvements relating to the treatment of beer and other fermemtescible liquids with the object of preserving the same, and to apparatus therefor. May 24.

10,379. R. C. Haines. An improvement in the manufacture of ale, beer, porter, and other malt liquors, and an improvement in the manner of selling the same. May 26.

10,914. E. O. Greening and E. W. Greening. An improved method of utilising spent hops for food and litter. June 5.

11,153. W. P. Thompson.—From Actien Maschinenbau-Anstalt vorm. Vennleth and Ellenberger, Germany. Improvements in the process of and apparatus for drying distillers' washes and the like, and for removing the acids therefrom. June 7.

11,936. F. R. Stone. An aërator and rouser for wort or liquor. June 17.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

10,518. W. Garner and A. E. Garner. Improvements in the treatment of grain or cereals in order to render them suitable for various useful purposes, such as brewing, distilling, and vinegar making, or as articles of food, and in means or apparatus to be employed therein, and for other uses. May 31.

10,836. R. G. Ross, J. B. Hilliard, and W. Paterson. *See* Class I.

21,661. H. Reid. Yeast fermenting cakes. June 7.

1893.

6963. C. A. Day.—From A. Walther. Improvements in or connected with brewing. May 31.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

10,264. E. Marshall. An improvement in the manufacture of baking powder. May 24.

10,689. M. Watson. An improved preparation of malted pulse food. May 31.

11,146. K. T. Sutherland, G. Esdaile, and C. C. Beatson. An improved treatment of leguminous and other seeds used for animal food. June 7.

B.—Sanitary Chemistry.

9691. C. Waite. An improved method of filtering sewage, obtaining a useful deposit therefrom, and rendering harmless the effluent water. May 15.

10,458. A. P. Hope. Improvements in the treatment of sewage or analogous foul waters or matters for effecting the disinfection and purification thereof. May 27.

10,887. W. H. Hill-Hartland. An improved system of town sewage disposal combined with production of electrical supply, and in means or apparatus therefor. June 5.

11,916. J. C. W. Stanley. Improvements in or relating to the treatment of fish or fish-offal and in apparatus therefor. June 17.

C.—*Disinfectants.*

10,465. P. Hakansson. Improved antiseptic and preserving agents. May 27.

10,892. A. Gladstone. An improved antiseptic dressing for yarns and cloth. June 5.

11,679. I. S. McDougall and J. T. McDougall. Improvements in disinfectants. June 14.

11,723. G. A. L. Banbury and A. G. Witherby. Improvements in or relating to disinfecting materials. June 14.

11,807. C. T. Kingzett. Improvements in sulphur candles and their holders. June 15.

11,914. I. S. McDougall and J. T. McDougall. Improvements in insecticides and anti-fungoids. June 17.

Complete Specifications Accepted.

A.—*Chemistry of Foods.*

1893.

4657. W. Chivers, J. Chivers, and S. Chivers. Improvements in or relating to powders or preparations for producing custard, blancmange, and the like. June 14.

5425. G. Popp and J. H. Becker. Process and apparatus for sterilising liquids. June 21.

5596. F. W. Golby.—From G. Oppemann. Process of purifying water for household use and consumption. May 31.

6838. G. H. Neuhauss, J. F. H. Gronwald, and E. H. C. Oelhmann. Process for destroying infectious germs in milk and apparatus therefor. June 7.

8027. C. B. Waller. A material for improving the flavour and digestibility of tea or other infusions containing tannin. May 24.

8505. A. J. Boult.—From F. Jas and C. Henny. Improvements in or relating to the sterilisation of milk. May 31.

B.—*Sanitary Chemistry.*

1892.

9780. J. B. Alliott. Treatment of sewage sludge. May 24.

11,724. J. W. Lodge. An improved complete continuous and automatic process and means to be employed in drying, absorbing, deodorising, pulverising, separating, storing, bagging, and weighing wet pulpy and pasty manure as produced and prepared by mixing, grinding, blending together human and animal excreta and urine, animal garbage, market and town refuse, spent bark, spent dyewoods, stable litter, sewage sludge, and other refuse. June 14.

11,765. W. Webster. *See* Class XIX.

13,713. A. Kozloff. A furnace or apparatus for deodorising and consuming excrement. May 31.

14,175. C. E. Bell. Manufacture of materials used in the purification and filtration of sewage and other liquids. June 14.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

9827. S. Wheeler. Improvements in the manufacture of paper and like materials. May 16.

10,510. W. H. Caldwell. Improvements in apparatus used in the manufacture of paper pulp. May 29.

11,635. J. L. T. H. Horst. Improvements relating to the treatment of waste paper for removing the print or printing ink therefrom. June 13.

Complete Specifications Accepted.

1893.

6802. W. P. Thompson.—From the Goppinger Papierfabrik, G. Krum. Manufacture of paper or cardboard resembling leather. June 21.

8334. G. L. Jaeger. Method of and apparatus for the manufacture of blotting paper. May 31.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES and EXTRACTS.

Applications.

10,701. J. Meikle, jun. Apparatus for extracting substances by volatile solvents. May 31.

10,769. J. Y. Johnson.—From F. von Heyden, Germany. Improvements in purifying saccharine. Complete Specification. June 1.

10,850. J. Wetter.—From J. D. Riedel and Co, Germany. Process for obtaining paraphenetolcarbamide. June 2.

11,380. J. Wetter.—From J. D. Riedel and Co., Germany. Manufacture of neutral aluminium salicylate, and of a soluble compound of the same. Complete Specification. June 9.

Complete Specification Accepted.

1892.

14,161. O. Imray.—From the Society of Chemical Industry, Basle. Production of dioxynaphtoemono-sulpho acid and of its salts. June 7.

XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

Applications.

10,524. B. J. B. Mills.—From A. Lumiere and L. Lumiere, France. The employment of cobaltic salts to obtain photographic images. May 29.

10,685. W. Jones and H. Jones. Improvements in or connected with the production of photographs on slate. May 31.

11,796. F. Sternberg. An improvement in photography. June 15.

11,872. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improvements in photographic developers. June 16.

Complete Specification Accepted.

1892.

9926. A. Burchett. Improvements in photography by means of coloured glasses used in combination with the photographic lens. May 31.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

9688. J. Macnab and J. Dickson. Improvements in gunpowder cartridges for mining and blasting, and the apparatus employed therein. May 15.

9800. R. Haddan.—From A. Kuehne, United States. Improvements in or relating to mine blasting or rending. Complete Specification. May 16.

10,187. H. C. Adams and A. Adams. A flashless and sparkless gunpowder. May 23.

11,073. G. Gillischewski. Improvements in pyrotechnical compositions or fireworks. Complete Specification. June 6.

11,502. E. Kübin. Improvements in or relating to explosives. June 12.

11,645. A. V. Newton.—From A. Nobel, France. Improvements in explosive compounds. June 13.

11,738. A. V. Newton.—From A Nobel, France. Improvements in the preparation and utilisation of tempered explosives. June 14.

11,739. A. V. Newton.—From A. Nobel, France. Improvements in the manufacture of fuses. June 14.

11,740. A. V. Newton.—From A. Nobel, France. An improved mode of producing nitrogen compounds. June 14.

Complete Specification Accepted.

1892.

16,567. O. Imray.—From the Chemische Fabrik, Greisheim, Germany. Manufacture of explosives. June 21.

XXIII.—ANALYTICAL CHEMISTRY.

Application.

10,261. R. J. Crowley. Improvements in or relating to apparatus to crystallise or solidify ingredients of the blood, one of these ingredients becoming magnetic; also to solidify other substances for analytical and other purposes. May 24.

PATENTS UNCLASSIFIABLE.

Applications.

9731. H. C. Bull and F. L. Marshall. Improvements in the production of carbon in a crystalline form. May 15.

10,979. F. M. Grumbacher. Improvements in and relating to the treatment of vegetable substances and the like for preserving and vulcanising the same, and for obtaining products of distillation therefrom. Complete Specification. June 5.

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Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

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The Secretary is prepared to offer 5*s.* each for copies of the Society's Journal for January 1883 in saleable condition.

LIST OF MEMBERS ELECTED, 12th JULY 1893.

Barton, G. E., Aetna Powder Works, Miller, Lake Co., Indiana, U.S.A., chemist.

Edmunds, Lewis H., 1, Garden Court, Temple, E.C., barrister-at-law.

Gibson, Albert M., 11, Queen Victoria Street, London, E.C., merchant.

Harris, Arthur, Marsh Gate Works, Stratford, E., soap maker.

Hick, Alf. W., 4, St. James Street, Warrington, analytical and pharmaceutical chemist.

Humfrey, Chas., Winnington Park, Northwich, submanager, alkali works.

Jones, Thos. Simpson, 30, Lime Street, E.C., commercial editor, "Manufacturing Chemist."

Liebert, Dr. M., c/o R. Dewhurst and Co., Lim., Birstal, near Leeds, printworks chemist.

Manning, Isaac H., c/o Chesapeake Guano Co., Baltimore, Md., U.S.A., manufacturing chemist.

Miller, Hugh L., 414, North Front Street, Wilmington, N. Carolina, U.S.A., chemist.

Milnes, Jas. M., 110, Cannon Street, London, E.C., chemical engineer.

Pethybridge, Walter, 29, Methley Street, Kennington Cross, S.E., assayer.

Phillips, Thos., Birthright View, Cornholme, Todmorden, wood distillery manager.

Reid, Wm., jr., Bombay Dyeworks, Dadur, Bombay, India, dyer.

Shields, John, D.Sc., Ph.D., University College, London, W.C., chemist.

Stock, F. W. Keating, Birchfield, Darlington, county analyst.

Taylor, Thos., Walmersley Bleach and Dyeworks, near Bury, Lancashire, bleacher and dyer.

Townsend, Chas. F., 31, Elms Road, Clapham Common, S.W., chemist.

Watts, Jno. Isaac, Fairleigh, Hartford, Cheshire, submanager, alkali works.

Willcox, Benjamin, 47, Lincoln's Inn Fields, London, W.C., patent agent.

CHANGES OF ADDRESS.

Bateman, Jno., l/o Chester; c/o J. C. and J. Field, Lim., Lambeth Marsh, S.E.

Bell, John, l/o 118; 59½, Southwark Street, S.E.; Journals as before.

Bell, Percy Carter, l/o Warrington; Bank House, The Cliff, Higher Broughton, Manchester.

Bendix, D., l/o 216A; 371, Romford Road, Forest Gate, E.

Brookes, E. A., l/o 22; 25, Claremont Grove, Didsbury Manchester.

Brown, J. Henry, l/o Portugal; Gwernol, Llandegla, Mold, North Wales.

Bunker, H. E., l/o Lower Broughton; 1, Deanley Terrace, St. Mary's Road, Newton Heath, Manchester.

Burnham, J. C., l/o Plumstead; 24, St. Stephen's Road, Lewisham, S.E.

Eastick, C. E., l/o Leyton; Clyde Wharf Refinery, Victoria Docks, E.

Felton, T., l/o Forest Gate; Granville Villa, Cleveland Road, S. Woodford, E.

Fleck, Hermann, l/o Philadelphia; American House, Reading, Pa., U.S.A.

Gibbs, D. Cecil, l/o Milton Street; 16, Finsbury Circus, London, S.E.

Hamaguchi, K., l/o Chibaken; Hiro Mura, Arito Gori, Wakayama Ken, Japan.

Harris, Booth, jr., l/o Forest Gate; Hillside, Loughton, Essex.

Hatschek, M., l/o Balham; 51, Fulham Park Gardens, Fulham, S.W.

Hughes, Thos., l/o West Wharf; 31, Loudon Square, Cardiff.

Jackson, G. B., Journals to 6, Booth Street, Piccadilly, Manchester.

Lloyd, Herbert, Journals to c/o Electric Storage Battery Co., Drexel Building, Philadelphia, Pa., U.S.A.

Lowe, W. F., l/o Cambrian View; 9, Hough Green, Chester.

McKechnie, D. M., l/o Prescot; Greystone House, Penketh, near Warrington.

Pitblado, L., l/o Melbourne; 69, Newhouse, Stirling, N.B.

Smith, J. W., l/o Massachusetts Institute of Technology; Brookfield Street, Roslindale, Boston, Mass., U.S.A.

Wander, Dr. A., l/o London; 2, Cecil Street, Greenheys, Manchester.

Warne, Thos., l/o Leeds; Lostock Gralam, near Northwich.

Whitehead, Jas., l/o Patricroft; Roach Place, Rochdale.

Wilson, J. Arthur, l/o Bury; Thistle Street, Newchurch, near Manchester.

CHANGES OF ADDRESS REQUIRED.

Aron, S. B. A., l/o Alexandria House, Balls Pond Road, N.

Wilding, J., l/o 266, Burdett Road, E.

Young, J., l/o Montague Terrace, Kelvinside, Glasgow.

Death.

Mawdsley, P. A., 8, Eaton Road, Chester.

PROCEEDINGS

OF THE

TWELFTH ANNUAL MEETING.

The Annual General Meeting of the Society was held at 3 p.m. on Wednesday, the 12th July, in the theatre of University College, Liverpool, a large number of members being present.

The Lord Mayor of Liverpool (R. D. Holt, Esq.) welcomed the members on behalf of the Corporation.

The Lord Mayor said it was his privilege to express on behalf of the City of Liverpool a very hearty welcome to the members meeting there, and the pleasure it gave to see an association of that importance holding its annual conference in the city. He was not aware himself of any science which, during the last quarter of a century, had made such progress as that of chemistry, and he felt that in Liverpool there was a suitability and propriety in holding a meeting of that kind, because on all sides they were surrounded by chemical industry. Many of them knew that very much to their cost; they felt it greatly, not in increased purity of air. It was, however, some compensation to them to feel that their pockets were not lightened by the effects of chemical industries in Lancashire, but rather the contrary. He thought they might look with very great satisfaction at the progress and prosperity which had attended this industry since it had been .in Lancashire. He hoped temptations would be offered to chemical industry to extend in the neighbourhood and make Liverpool, what he thought as a Liverpool man he might safely say, more of a manufacturing centre than it had been in the past. If there were anything he could do in his province of mayor to make their visit pleasant he should be very happy to do it.

Professor J. Campbell Brown welcomed the Society on behalf of the Senate of University College.

There was, he said, perhaps no building in the United Kingdom that could more suitably shelter a society of chemical industry than the University College of Liverpool, seeing that it was to a large extent constructed out of the proceeds of chemical industry. The adjoining block of buildings, containing the libraries and other rooms below it, was constructed entirely out of the proceeds of one branch of chemical industry, as represented by Mr. Henry Tate. A little further on they came to the Walker Engineering Laboratories, which were entirely constructed out of the proceeds of another branch of chemical industry, while the remainder of Victoria buildings—the room in which they were then sitting, the chemical laboratories, so far as those had been built, and other departments—had been constructed to a very considerable extent by members of that Society. He expressed the hope that, though perhaps in a less prominent and visible way, in years to come University College might do something for chemical industry. On behalf of the Senate, he welcomed them to that building, and hoped they might have what the Americans called a "real good time."

The President, Sir John Evans, K.C.B., D.C.L., F.R.S., briefly replied, and then took the chair.

The General Secretary read the minutes of the last General Meeting. These being duly confirmed—

Messrs. Jos. Gamble and W. P. Rix were, upon the motion of Mr. J. Fleming Stark, seconded by Mr. S. K. Muspratt, appointed scrutators.

The ballot was then declared closed.

The President then called upon the General Secretary to read the

Report of Council.

We have the honour to report that the number of members on the register is 2,784, as compared with 2,782 at the last Annual Meeting. During the year 208 new members have been elected, and 206 have been removed by death, resignation, and other causes.

Among those who have died are Dr. G. D. Longstaff, the veteran chemist, Mr. A. Norman Tate, one of our vice-presidents, and Prof. Wm. Foster, of the Middlesex Hospital, a well-known authority upon coal-gas.

During the past session 74 original papers have appeared in the Journal, precisely the same as last year. The excess of revenue over expenditure, as will be seen from the treasurer's report already in your hands, amounted last year to 590*l.* 12*s.* 4*d.*, as against 530*l.* 18*s.* 8*d.* in 1891. The Council has accordingly felt able to increase the grant towards the expenses of the annual general meetings by 50*l*

In February last, in response to a general expression of opinion that the Patent Laws of this country stand in need of revision, a committee was formed to consider the whole subject of the Patent Laws. Several meetings of that Committee have been held; and it is in contemplation to lay before the Sections during the autumn a series of questions embodying the objections which have been raised. Should their deliberations lead to agreement as to the course to be pursued, the Council then proposes, if possible in conjunction with other public bodies, to petition the Government for the appointment of a Royal Commission.

The Council takes this opportunity of expressing its sense of gratitude to those who have served during the year upon the various Committees of the Society and its Sections. We owe to the labours of these Committees the high position of the Journal as a record of current scientific progress. Thanks are also due to the authors of the many valuable papers which have appeared in the columns of the Journal from time to time.

An invitation to meet next year in Edinburgh will be laid before you, and which you will be asked to accept in the assurance of a hearty welcome.

Mr. Eustace Carey (Widnes), Chairman-elect of the Liverpool Section, moved the adoption of the Report.

Col. Gamble, C.B. (St. Helens), seconded the motion, which was carried unanimously.

The Hon. Treasurer (Mr. E. Rider Cook) then presented the accounts for the year (see Journal, 1893, p. 489), and gave a brief summary of the receipts and expenditure of the Society and of its present financial position.

Mr. R. Morris (Doncaster) moved the adoption of the accounts, and a cordial vote of thanks to Mr. E. Rider Cook for the able manner in which he had managed the finances of the Society.

Mr. S. H. Johnson (London) seconded the motion.

The vote having been carried by acclamation,—Mr. E. Rider Cook thanked the members for their continued confidence in him.

The President then delivered his address:—

PRESIDENTIAL ADDRESS.

BY SIR JOHN EVANS, K.C.B., F.R.S., ETC., ETC.

When I look at the list of those who in past years have occupied the Presidential chair of this Society, all of them men eminent in the departments of either theoretical or practical chemistry, or, indeed, of both, I cannot but feel my own insufficiency to succeed them in worthily fulfilling the duties of this post. I am, indeed, tempted to inquire how and why it was that, in accordance with the pressing invitation of some members of the Council, I ever consented to allow myself to be placed in nomination as your President. It certainly was not on the grounds of any fancied chemical attainments; nor was it from my having been in former years associated with any industry that is usually regarded as being specially connected with chemistry. Far less was it in the hope that any remarks that I might be called upon to make while acting as your President could be of any particular interest or value to those who, in all probability, are far better acquainted than I can pretend to be with any subject that properly comes within the scope of such a Society as ours. I believe, however, that the main reason that I had for allowing myself to be brought forward is one that will, to a great extent, palliate my shortcomings in so many of the essential requisites for such an office. It was the hearty and entire appreciation that I felt of the work and aims of such a Society as that of Chemical Industry, that was the prime mover in the case. Whether I regarded the organisation of the Society, with its sections at all the principal centres of chemical operations, each to a certain extent independent, but all working harmoniously together, and forming one powerful and important body, with high objects and aspirations before it; or whether I looked at it as presenting a bond of union between industries apparently unconnected, while, at the same time, furnishing information of the most useful character to each and all, I could not but recognise it as a body in the highest degree conducive to the public welfare; so that on these if on no other grounds, I should have been wanting in public spirit had I stood aloof when others urged me to accept the post of your President.

It is, I firmly believe only by some such cordial co-operation among the different industries of this country as that which our Society has inaugurated, that the commercial position of Great, or Greater, Britain is to be maintained; and the more fully the interdependence between one branch of manufacture and another is recognised and acted upon, the more likely are we, as a whole, to maintain our place in the keen race of competition with other countries.

A merely cursory glance at our Journal will at once show how numerous are the departments of British industry that are more or less dependent on chemical knowledge, the information given on current literature and the specifications of new patents being arranged under no less than three-and-twenty different heads, many of them embracing several varying occupations. Not a few of these headings would, within my own memory, have conveyed but little meaning even to experts. I need merely carry back the minds of some of the elder members of the Society, not only to the days when aniline colours were not, and Dr. Perkin was comparatively unknown, but to the time when lucifer matches had not been invented, when photography was practically non-existent, and when in most of those industries in which a knowledge of chemistry is now regarded as indispensable, the "rule of thumb" reigned absolute.

I can speak of those old times with some personal feeling, as it is now upwards of 50 years since, that having presumably completed my education, I first entered a paper-mill in order to learn the art and mystery of the manufacture of paper, with which the name of the firm of which I was until lately a member—that of John Dickinson and Co.—has been so long, and, I may venture to say, so honourably connected. It was, of course, recognised that some knowledge of chemistry was a requisite in such a manufacture, but I must freely confess that our methods were of the rudest, and that it was only as years rolled on, and first Esparto fibre, and then the different kinds of wood pulp, were introduced into the manufacture, and the various methods and results of sizing studied, that a thorough acquaintance with chemical laws became a *sine quâ non* for those who hoped for success in this branch of industry.

At the date that I have in view—say 1840—although rags were the staple material for the manufacture of paper, our consumption of them was but small, and they were principally used by us in producing paper for copper-plate work—steel plates at that time being rarely used—and for the highest class of printing papers. We consumed, however, a large quantity of raw material in the shape of the waste arising in the manufacture of linen and cotton goods, and we had collecting agents at Dundee, Belfast, Bradford, Leeds, and Manchester, who bought the waste upon the spot. At Manchester we had a mill, in which the cotton waste was cleaned, boiled, and converted into what is known as "half-stuff," which was finally bleached and made into paper at our Hertfordshire mills. In that county we had another "half-stuff" mill at Rickmansworth, where the linen waste was treated. The boiling was carried on in open keirs, or such as were partly closed, and always at a low pressure, as high pressure boilers for such materials were practically unknown. Most of the waste was twice boiled, first with caustic lime, and secondly with a small amount of soda. The "shieves," or woody particles, that were unreduced by the boiling, were got rid of by a long process of screening, or "devilling," after the "half-stuff" had been dried so far as possible in hydraulic presses. The material was then bleached in stone chambers by the direct action of chlorine gas, produced on the spot in retorts. At the mills, however, where the "half-stuff" was converted into paper, the remains of the chlorine had to be washed out, and the final bleaching of the stuff to be effected with bleaching salts. No process for the recovery of the soda used in boiling was then known, and, indeed, the quantity used was so much less than that which is now necessary with esparto, that it would not have paid to recover it. I remember, however, being engaged in some experiments for the recovery of the manganese from the spent liquor of the retorts. Even when first Mr. Routledge introduced the use of esparto fibre no evaporating or recovery process was employed, but the double advantage was soon seen of avoiding the nuisance of polluting the streams into which the waste liquors were allowed to flow, and of regaining a quantity of soda at a small cost. With the general adoption of esparto as a material a radical change in the manufacture of paper was effected, and the difficulties in which the industry had been placed by reckless commercial legislation with regard to foreign rags in a great degree removed.

What has taken place in the manufacture of paper has been paralleled in numerous other departments of commercial enterprise, and not the least in those connected with the manufacture of chemical products themselves, in many, if not indeed in most of which a complete revolution has been effected within the last fifty years, or even less. It would be a hopeless task to try to indicate the whole of the advances in chemical knowledge that have been made within that period, and yet I am tempted to give some few reminiscences of the condition of the science as exhibited in *Brande's Elements of Chemistry*, published in May, 1841, exactly 12 months after my first introduction to business, when compared with our knowledge at the present day.

Chemistry at that time was by no means in its infancy. Its foundations had been securely laid not only on the Continent, but in this country, and the names of Priestley, Cavendish, Scheele, Lavoisier, Davy, Wollaston, and other English investigators were already household words. There were, in 1841, 12 simple non-metallic substances known, from oxygen to boron, including selenium, and 43 metals from potassium to silicium, including lantanum and thorinum. For all 55, symbols had been arranged, but these were in many respects different from those which are now in universal use. C, for instance, stood for chlorine and not for carbon, while B symbolised bromine and not boron. Potassium was designated by Po and not by K, and sodium by So and not by Na, while uranium was known as Urnm and not as U.

The atomic weights of the various substances had been approximately determined, though modern investigations have in some instances materially changed their ratio. Though hydrogen has retained its place as the unit, oxygen is no longer represented by 8, but by 15·96, or even less. Sulphur that was then 16 is now 31·98. Selenium, instead of 40, has now 78 assigned to it; while the number for tellurium has been increased fourfold from 32 to 128, and phosphorus has gone up from 16 to 30·96. Whether all our present figures will stand the test of time remains to be seen, and indeed recent researches have shown cause to doubt the accuracy of some of the figures that I have quoted. For myself, as a somewhat profane outsider, I must confess that it would be a source of satisfaction if future investigations should show that the figures now having three or four places of decimals attached to them might more properly be converted into integers, and oxygen came out boldly as 16, and sulphur as 32. This is, however, a digression.

Turning to the simple substances and metals of which, as already stated, 12 and 43 respectively were known in 1841, we find them now slightly increased. Of non-metals we reckon 15, and of metals 18. Some metals, like columbium and glucinum, have dropped out of our list, the latter having now become beryllium, while others, like cæsium, didymium, erbium, and rubidium, have come in.

On the whole, the changes and advances in inorganic chemistry have not been extreme. It is in organic chemistry that what cannot be regarded as anything short of a revolution has taken place. It is not a matter on which I can dilate, but an indicative of what has been going on I may mention that while three volumes have sufficed to Roscoe and Schorlemmer for inorganic chemistry, no less than six have already appeared in continuation treating of organic chemistry, and more are to follow; so that the proportions have been reversed which prevailed in the days of Brande, who devoted 367 pages only to organic chemistry and 1,042 to introductory matter and inorganic chemistry.

But whatever may have been the advances in chemistry within the last 50 years, whether as a pure or an applied science, the extension of its boundaries towards physics in the one direction and biological studies in the other, is at least as remarkable. While the study of spectrum analysis has rendered most valuable assistance in the chemistry of the constituent substances with which we are familiar upon earth, it has enabled the astronomer to carry his speculations not only to the constitution of the sun and stars, but to that of nebulæ, comets, and meteors, and in the hands of Mr. Norman Lockyer and Mr. Huggins may yet lead us to travel with some degree of confidence in paths hitherto untrodden. In the domain of electricity it is hard to say whether that science does not owe as much to chemistry as chemistry does to it. In the practical application of electricity to lighting purposes, chemistry has still to be called on to produce some improved form of secondary battery, and some portable form of primary battery which shall prove of ready application by our miners. It is needless to recall how much our underground workers are indebted to chemistry for their comparative immunity from danger from fire-damp, a danger which the efforts now being made by chemists will, I hope, still further diminish. Electricity has also placed at the command of chemists greater intensity of heat than can be derived from ordinary sources.

The study of heat, irrespective of electricity, has largely reacted on chemistry, and while the Bessemer process has entirely revolutionised the manufacture of steel, and almost annihilated the distinction in value between that and other forms of iron, the Siemens and other furnaces have led to unprecedented economies in the expenditure of fuel, and at the same time have facilitated the application of heat in various chemical processes. In the other direction—the absence of heat—Professor Dewar has, during the present year, made most important advances. Although air had previously been liquefied, he has now been able, by means of intense cold alone, to reduce atmospheric air to the liquid condition. His further results, by a combination of enormous pressure and extreme cold, are well known, and now that oxygen and nitrogen have yielded themselves to the advances of science and have been obtained in quantities in a liquid state, it is hard to say that hydrogen is destined always to remain intractable. What may be the ultimate result of the investigations that can now be carried on at temperatures ranging from 100° to 200° C. below the freezing point of water, it is impossible to foresee. From researches already made in this country and in France, it would appear that most substances under extreme cold are, so to speak, dead, and that their ordinary affinities are in abeyance. Possibly what may be termed "glacial chemistry" may eventually enlarge our views as to the various properties of matter.

As to the advances in our knowledge of the chemistry of light, the present condition of photography may testify. When we can take the image of a bullet flying at the rate of 3,000 feet per second, with its accompanying cone of compressed air; when we can produce photographs which are practically permanent, and when we call in the action of light to engrave our steel- or copper- plates and to produce efficient substitutes for wood-cuts, we seem to be getting near the limits of the practical application of photography. And yet many of us may remember the day when the daguerreotype was regarded—and justly so—with wonder; and I can myself call to mind a still earlier form of photography, by which natural leaves were reproduced on paper sensitised with a salt of silver, of which I saw specimens in an exhibition at Dresden so long ago as the year 1839.

In the introduction of artificial light much also has been done. It is true that Pall Mall was experimentally lighted by gas in 1807, but it was not until 1842 that gas found its way into Grosvenor Square and some other aristocratic quarters of the metropolis. Since that time immense strides have been made in the process of gas manufacture, while, in consequence of the waste products arising in the process having now found commercial uses, great reductions have been made in its cost. At the present time gas has to compete with electricity as an illuminant, while, in many cases, it has been superseded by mineral oils, which are now so abundant and cheap, and of which in this Society the flashing-point may be said to be almost a burning question. If, however, gas is losing ground as an illuminant, it seems to be gaining it as a source of power, and there are prospects of a considerable increase in the use for this purpose of hydrogen and its compounds, containing far less carbon than ordinary coal-gas.

In metallurgy also, in addition to the improvements in the manufacture of steel already mentioned, many noteworthy discoveries have been made. One of the most important of these is perhaps that of the production of aluminium on a cheap scale and in quantities sufficient for various applications to ordinary use. It seems somewhat remarkable that the progress in the use of a metal at once so light and so strong is not more rapid.

The applications of some of the more modern alloys, such as phosphor-bronze, seem almost susceptible of considerable further development.

The extensive manufacture of sodium affords another instance of what was formerly the mere subject of a laboratory experiment, being now conducted upon a commercial scale.

I may here just glance at the attempts that have been made to produce artificially some of the precious stones that occur in nature. Rubies have been manufactured, not indeed such as could rank as gems, but still such as will serve to "jewel" the pivot-holes in watches; and though the results of the attempts to produce the crystallised form of carbon, which is known as the diamond, have as yet had but doubtful success, it does not appear to me that the prospect of producing genuine diamonds under combined heat and pressure is absolutely hopeless.

Another direction in which great advances have been made, and in which it seems probable that there yet remains something to be discovered, is the grouping of the various elements into small divisions, having more or less analogy the one with the other, and the classification of the atomic weights in one harmonious series. What is known as the Periodic Law of Mendeléeff and of our own Mr. John A. R. Newlands, has suggested the possibility that what we now know as metals or elements may have some at present hidden connections between them, so that eventually some of them may prove to be rather compound bodies than strictly elementary substances. This, however, is for the chemistry of the future.

In organic chemistry, which has been defined to be the chemistry of the hydrocarbons and their derivatives, it is, as I have already observed, that the most wonderful development has taken place within the last half century. Who, for instance, in 1840 could have foreseen the important part that aniline was to play in dyeing and colouring? It was not, I think, till 1856 that Perkin's mauve was really brought into commercial use, but since that time what a rainbow of colours has been produced from what would have seemed a most unpromising source! How brilliant are their hues; but as yet, in many cases, alas, how fugitive! Regarded from an artistic point of view these colours can hardly be esteemed an unmixed blessing: and even the fabrics of Eastern looms have not escaped their influence.

> "Quæ regio in terris nostri non plena *coloris?*"

Turkey, Persia, India, and China have, I fear, in many cases, sacrificed taste to cheapness, and harmony to splendour in colour. It is a source of some satisfaction to know that the woad with which our Ancient British predecessors stained their bodies is still cultivated among us for the purpose of dyeing wools, even though it has acquired the name of *Isatis tinctoria* and the colouring extract is now classed as an *Indigotin*.

Among inorganic colours I may here briefly mention ultramarine, which instead of being patiently produced by the careful treatment of lapis lazuli and sold at many shillings an ounce, is now manufactured by the ton and quoted by the hundredweight. Would that the artificial colour were as fine and permanent as the natural! I have, in my own time, seen it supersede smalts as a colouring matter in paper-making, and I have known its use not unfrequently accompanied by the abundant presence of sulphuretted hydrogen as a product of its decomposition.

Not only colouring matters but our flavours and scents have been synthetised, though art, if superseding nature for a time, must eventually acknowledge her inferiority, even in pear-drops. Whatever our æsthetic feelings under these circumstances may be, we cannot but admire the skill and scientific energy by which such results have been attained. How far "saccharine," one of the latest results of the chemist's ingenuity, is likely to supersede the use of ordinary sugar, is a question on which I decline to speculate. The manufacture of our every-day sugar has, however, itself undergone a complete metamorphosis within the last fifty years, with the result that it is now produced at what would formerly have been regarded as an absolutely impossible price. In 1840 beet sugar was in its infancy, and such has been the improvement in the growth of the beet and the process of manufacture that nearly twice the weight of sugar is now produced from a ton of beet-root as there was at that date. In the production of cane-sugar also immense economies have been effected, especially in the process of evaporation. The study of the effects of saccharine solutions on the polarisation of light, and our acquaintance with the distinctions between dextrose and lævulose, and of the conversion of starch into sugar, all come within comparatively modern times.

Much of our knowledge of the mysterious processes of fermentation is also of recent date, and it is in connection with these processes that the chemist finds himself brought into close contact with the botanist and the physiologist.

Whatever suspicions Leeuwenhoek and the early microscopists may have had with regard to the vegetable character of yeast-cells, and however clearly Cagniard de Latour and Schwann may have established its plant-like nature and its connection with fermentation, it was not until Pasteur's researches from 1857 to 1861 that the true character of the yeast-plant, and of other micro-organisms which lie at the base of most fermentative processes, can be said to have been absolutely demonstrated. The beneficial effect of his inquiries, and of his methods of obtaining a pure cultivation of yeast, is universally recognised, and has reacted in the most remarkable manner on the brewing industry.

But M. Pasteur's researches have also led to much wider results, as it has been mainly in consequence of his careful observations that the wonderful influence for good or for evil of organisms so minute as in some cases almost to defy the power of the microscope, has now been so fully recognised. The germ-theory of the origin of many diseases meets with much more general acceptance than it did but a few years ago; and though the bacilli and bacteria which are characteristic of some virulent diseases, such as anthrax, are only agents in certain fermentative processes by which poisonous matters are engendered, their existence and character seem to be placed beyond all doubt. The process of obtaining immunity from the action of these poisons by the gradual introduction of the virus into the animal system, thus rendering it insusceptible of receiving further injury from the same poison, has been successfully introduced, both among men and beasts, and hydrophobia and anthrax have been successfully combated.

A recognition of the influence of germs has led to the introduction into surgery of that antiseptic system of treatment with which the name of Lister will always be associated, and which has done so much to diminish suffering and preserve life. While upon this topic I may just allude to another instance in which chemistry has come to the assistance of medical science, I mean in the production and investigation of those anæsthetic agents which play so important a part in modern surgery, and which have done so much to alleviate human suffering.

But while the ferments produced by micro-organisms are on the one hand so pernicious, it is very doubtful whether, on the other, they are not equally beneficial, if it be really the case that such processes as digestion are in a great measure due to their action. How far the nitrification of the soil may be due to micro-organisms is a question not yet absolutely solved, though strong presumption has been raised of their being, at all events, potent factors in the case.

Now that so many diseases have been traced to pathogenic organisms which are constantly present in water contaminated by sewage, the question of the vitality of these organisms and their germs has been rightly regarded as one of great public importance, and the Royal Society in conjunction with the London County Council has instituted an investigation into it, which is being diligently prosecuted both from the botanical and the chemical points of view. The remarkable power of light, whether that of the sun or electric, in sterilising the germs of some micro-organisms, already to some extent previously known, has been conclusively demonstrated by Professor Marshall Ward.

Much has been done of late years by chemists towards the purification of sewage with the view of rendering the effluents from the ultimate drains of our large municipalities as innocuous as possible, and the results obtained have been in many instances satisfactory. They would, no doubt, have been even more so had not the imperative demands of economy limited the cost. Still, whatever may be done, I am inclined to think that there is much truth in the metrical abstract of a paper read some years ago before the Royal Society:—

> "Sewage, however disinfected,
> Is not from ill results protected;
> Though made to all appearance pure,
> It still remains, not safe, but sewer."

I will not attempt to discuss the important question of the disposal of the sewage of our great towns, but to many it will appear as somewhat of a disgrace to our powers of applying chemical knowledge, that such vast accumulations of what were originally highly fertilising substances should be discharged into the estuary of the Thames, and not only be absolutely wasted, but converted into a perpetual nuisance, brought up at each tide within the limits of the metropolis from which they started.

It is true that within the last 50 years we have imported enormous quantities of guano, phosphates, and nitrates, but of these there must eventually become a scarcity, if not an end. In the meantime, may not chemists do something to reduce the waste of fertilising agents that is now taking place among us? Agricultural colleges have been founded—agricultural chemistry is a recognised branch of science; but with increase of knowledge has come increase of foreign competition, fostered by improved means of transport and communication, and it is at the present time a doubtful point whether many soils, even if rent-free, can be cultivated in this country for cereals, except at a loss.

While touching on agricultural chemistry, I cannot pass over in silence the experiments which have now been carried on continuously for a period of 50 years at Rothamsted, by Sir John B. Lawes, assisted during the whole half-century by Dr. Gilbert. The extremely liberal provision which, during his life-time, Sir John Lawes has made for the purpose of continuing and extending his experiments, would alone entitle him to a full measure of public gratitude. When, however, we consider the nature and extent of the experiments already conducted, we must feel that no expression of public estimation can be too high when, as will shortly be the case, the Rothamsted jubilee is celebrated. As to the results already obtained, and as to the nature of the experiments still being carried on, it would be out of place here to enlarge. Remarkable, however, as are the effects of different manures on the botanical character and growth of herbage, and the strength and yield of cereals, the different results arising from the mere variation of the temperature, sunshine, and rainfall in successive years, are more remarkable still.

I feel, however, that I have detained you long enough with these crude considerations of topics more or less chemical in their character, and that it is time for me to conclude.

We are here assembled on the borders of the two counties of Lancashire and Cheshire, in both of which are great centres of chemical manufactures, and the principal productions of which are in a great degree dependent on the knowledge and due application of chemical laws. We meet at the seat of one of the most active sections of the Society of Chemical Industry, which has received us with open arms, and has provided us with an "Open Sesame" which will admit us to inspect many of the most interesting of the works and factories of the district. We gladly avail ourselves of the opportunities thus liberally opened to us, and if by chance any of us can afford assistance, advice, or encouragement to our brethren in Liverpool, I am sure that all present will gladly render it, and not forget that we are all members of one body, and all mutually interested in the advance of chemical knowledge, and especially of chemical industry.

Prof. J. Emerson Reynolds, in moving a vote of thanks to the President for his address, said that on some occasions it was necessary to make an elaborate apology for a vote of this nature. That day no such necessity existed. The address itself testified to the care with which it had been compiled, to the breadth of information which it represented, and to the scholarly skill of the constructor.

One of the most interesting points was the account of the changes which had taken place in the science of chemistry between the year 1841 and the present day. All knew the broad lines on which these changes had run, but the majority of those in the room knew the position of chemistry in 1841 only as a matter of history. It was most interesting to have the views of a President who had been through the whole of that epoch, and who recorded the results of his study of the general drift of chemical work.

The President had alluded to the changes in our mode of regarding the elements themselves. The great change in our mode of regarding the relations of the elements was really due to Newlands. But the development of the Periodic Law had scarcely come into the domain of applied chemistry as yet; and a suspicion that the elements were but complex bodies capable of being broken down or built up was but a short step towards the conversion of the baser metals into gold. The time for this had not yet come.

Reference had also been made to that branch of industry in which the President had acquired a special reputation—the industry connected with the working of textile material, but more especially of the fundamental material of all ordinary fabrics—cellulose. The President had described the rough mode of treating cellulose materials in early days, and had touched upon the development in the particular kinds of material used. This rough treatment tended to disintegrate the material, and those who performed the work but little understood on what manner of matter they were engaged. Until recently this cellulose, the essential feature of all fabric, had been a mystery. It was a mystery no longer, thanks to the splendid work of Cross, Bevan, and Beadle. There were many other topics in the address to which he might allude in speech after speech, but he would now content himself with proposing that the best thanks of the meeting be given to the President for his admirable address.

Prof. J. Campbell Brown in seconding the motion expressed high appreciation of the way in which Sir John Evans had filled the office of President during the year. Notwithstanding his numerous and important duties, he had devoted to the interests of that society his zeal and great power for organisation in a manner beyond all praise.

Prof. J. Emerson Reynolds (Dublin) then put the vote to the meeting, and it was carried by acclamation.

The President having returned thanks, read the Report of the Scrutators:—

"We have the honour to report that we have examined 195 ballot papers of which 9 were spoilt, and that the following gentlemen are duly elected ordinary members of Council:—Prof. F. Clowes, D.Sc., Mr. Thos. Fairley, Prof. G. G. Henderson, D.Sc., Mr. Robt. Irvine, and Mr. Manning Prentice. The nominations for President, Vice-Presidents, and Officers are confirmed."

(Signed) J. C. Gamble.
W. P. Rix.

The President then moved a vote of thanks to the Scrutators which was carried unanimously.

The following is therefore the composition of the Council for 1893—1894:—

President:

E. C. C. Stanford.

Vice-Presidents:

Sir F. A. Abel, Bart., F.R.S.
Horace T. Brown, F.R.S.
H. Brunner.
Wm. Crowder.
Sir John Evans, K.C.B., F.R.S.
Dr. F. Hurter.
E. K. Muspratt.
Dr. W. H. Perkin, F.R.S.
Prof. J. Emerson Reynolds, M.D., D.Sc., F.R.S.
John Spiller.
Prof. T. E. Thorpe, F.R.S.
Sir John Turney.

Ordinary Members of Council:

R. Forbes Carpenter.
Prof. Frank Clowes, D.Sc.
Dr. C. Dreyfus.
Thos. Fairley.
Prof. G. G. Henderson, D.Sc.
C. C. Hutchinson.
Robert Irvine.
John Pattinson.
Manning Prentice.
Boverton Redwood.
T. Tyrer.

With the Chairmen and Secretaries of Sections.

Honorary Treasurer:

E. Rider Cook.

Hon. Foreign Secretary:

Ludwig Mond, F.R.S.

Mr. S. H. Johnson (London) moved that Messrs. Theobald Bros. and Miall be re-elected auditors for the ensuing year at a remuneration of ten guineas.

Mr. J. M. Collett (Gloucester) seconded the motion, which was carried unanimously.

Mr. Boverton Redwood (London) proposed the re-appointment of Mr. E. Rider Cook as the representative of the Society on the Board of the Imperial Institute.

Mr. Thos. Tyrer seconded the motion, which was then put and carried unanimously.

Mr. E. Rider Cook briefly returned thanks.

Mr. E. C. C. Stanford (Glasgow) (President-elect), in inviting the Society to hold its next Annual General Meeting in Edinburgh, on behalf of the Scottish Section, said that on the last occasion when the Society met in Liverpool he had the honour of asking them to try the experiment of holding their next meeting on the north side of the border. That experiment had been sufficiently successful to embolden him to ask the Society to repeat it, and he was there again that day for the purpose. On the former occasion as he had to invite the Society to the city of Glasgow, he thought it necessary to add some qualifying circumstances, one of which was that if they did not like the city it was the easiest place in the world to get away from. As, however, he was now deputed to invite them to the capital of Scotland, no such qualifying circumstances were necessary, as few visitors wished to leave the city of Edinburgh one minute sooner than they were obliged.

It was unnecessary for him to describe the beauty of that city; he might allude to the unequalled situation, the lovely surroundings, the marvellous combination of mountain and firth, the wonderful contrast of the old and new town, and the many other attractions which have made the reputation of Modern Athens. He would only say that the beauty of the city was equalled if not excelled by the hospitality of the citizens.

At the meeting of the British Association held there last year, an eminent engineer had made a discovery; he said that there was no drinking water there. He had been offered for a fortnight every variety of liquid, each more pleasant than the other, but he had not been offered any water to drink, and he did not think there was any. Now, whether that eminent authority was too well satisfied with the other liquids to inquire for the pure element, or whether he had some gigantic water scheme in his mind he did not know. But as there were several most respected members of the Society who would not go to a city which was deficient in that article, he could assure them there was plenty of water to drink for those who asked for it, and if they found that the majority of northern people did not regard with great admiration the undiluted element, it must put it down to their misfortune as well as their fault.

He had never heard but one objection to Edinburgh, and that was that during the spring they were troubled with east winds: but an old friend of his, now gone to his rest, who had resided some years there and also in Liverpool, assured him the east wind here was the worst of the two. That might be so, seeing that Liverpool was the furthest east and got the first pull of those genial breezes; however, Edinburgh would not grudge them that proud pre-eminence. He asked them therefore to come to the north and bring their sunny southern warmth; he invited them from the east to the west to bring some of that proverbial wisdom so characteristic of the wise men of the east, and in which they of the west were supposed to be so deficient. Above all, he asked them to do their duty and come to Scotland to inspect that healthy infant—which maintained a vigorous vitality in the eye of the north wind, though far from home and languishing for another parental smile—the Scottish Section of this Society.

Mr. J. STANLEY MUIR (Hon. Secretary of the Scottish Section) seconded.

Mr. H. BRUNNER (Liverpool) then proposed, and Mr. MANNING PRENTICE (Stowmarket) seconded, that the invitation of the Scottish Section be accepted.

The PRESIDENT put the motion, which was carried unanimously.

The PRESIDENT expressed the thanks of the meeting to the authorities of the college for the kind reception they had given the members, and placed rooms at their disposal.

Mr. E. C. C. STANFORD seconded, and the PRESIDENT then put the motion, which was carried by acclamation.

The meeting then adjourned.

After the meeting the members inspected the Victoria Buildings, the Chemical, Engineering, Physical, and Natural History Departments of University College, and the Royal Infirmary adjoining.

Afternoon tea was also served.

SOIRÉE IN THE WALKER ART GALLERY.

In the evening a *conversazione* was given in the Walker Art Gallery in honour of the visitors, for whose accommodation the whole suite of rooms was thrown open. Mr. Henry Brunner (Chairman of the Liverpool Section), together with the President, received the guests in the fountain-room, and during their arrival the Bijou Naval Orchestra, under the conductorship of Mr. J. W. Collinson, played selections of music in the vestibule, while the Euterpean (Ladies) Band, directed by Miss Annie Scott, performed in the concert-room. From 9.30 to 11.30 dancing was engaged in to the music of the Bijou Naval Orchestra, and the permanent collection of pictures, statues, &c., including those recently presented by Sir John Gilbert, R.A., and the Roscoe collection, afforded the ladies and gentlemen present a rich artistic treat. The reception-room was ornately draped in the Japanese style, and the fountain looked pretty, illuminated as it was by "Fairy" lights of various colours. All the beautiful plants and flowers which lent such grace to the rooms were kindly given by Mr. J. T. Brunner, M.P., having been sent from his conservatories at Druid's Cross. The arrangements were well carried out, and gave much satisfaction to the eight or nine hundred visitors. The *artistes* who took part in the concert were Miss Annie Nelson, soprano, and Miss Emilie Scott, associate pianiste, Trinity College, London. Light refreshments were served.

SECOND DAY.—THURSDAY, JULY 13.

THE VISITS TO WORKS ON THE MERSEY AND ELSEWHERE.

In describing briefly the various visits to works, no better arrangement of the whole subject can be thought of than that of the scheme so admirably conceived and as admirably carried out by the Local Secretary, Dr. C. A. Kohn and his colleagues. For the morning of Thursday, the second day of the visit, four excursions were arranged, and over these were placed as leaders, the gentlemen whose names are given below. Four excursions were also similarly arranged for the afternoon.

MORNING.—1. WORKS OF THE UNITED ALKALI CO., LIMITED, WIDNES.

Excursion A.—Leader: Percy Bateson, Esq.

The visitors to Widnes, about 80 in number, inspected two important branches of this gigantic association, which were formerly owned by Messrs. E. Sullivan and Co., and G. Pilkington and Co. They were met by Mr. Joseph Morrison, the District Manager of the United Alkali Company, who had arranged with the sub-managers and chemists to conduct the party in groups over certain of the local works. At Messrs. Sullivan's works the process first inspected was the Hargreaves' process, where the apparatus for the preparation of the salt and its subsequent transformation into salt-cake (sulphate of soda) was explained. Afterwards, the old process for the manufacture of salt-cake was exhibited and explained. The revolving furnaces for converting the sulphate of soda into alkali attracted general attention and interest. In passing, attention was also drawn to a magnificent blowing engine built by the well-known firm of Messrs. Walker, of Wigan.

At Messrs. Pilkington's works the manufacture of caustic soda and bleaching powder was explained and illustrated, and also the process invented by the late Walter Weldon, F.R.S., for the recovery of the manganese, by means of which process most of the bleaching powder is still manufactured at the present time.

Finally, the process recently introduced by Mr. A. M. Chance for the recovery of sulphur from alkali waste was explained, particular attention being drawn to the total absence of odour of sulphuretted hydrogen even in the carbonating house, where 21 large vessels, which are connected together by an elaborate system of pipes and valves, contained that gas under a pressure of 45 lb. per square inch.

The party then adjourned to luncheon to the Central Hotel, Widnes, to which the members thereof were cordially invited by the Mayor of Widnes, Mr. F. H. Gossage, J.P.

In course of the luncheon the Mayor proposed as a toast, "Success to the Society of Chemical Industry," during which he referred to himself as the first mayor of the youngest borough in the kingdom, and added that since Widnes might be regarded as the birthplace of the Society, its members were now welcomed to that birthplace.

The President, Sir John Evans, offered the best thanks of the members of the Society for the kind entertainment and hospitable reception accorded to them that day, and proposed the health of the Mayor, a toast which was duly honoured and acknowledged.

Lunch being ended, a small party inspected the Central Laboratory Buildings recently erected by the United Alkali Co. and presided over by Dr. F. Hurter, the chemist of the Alkali Union. These well-appointed analytical, general, and physical laboratories excited general interest, more particularly the convenient electrical arrangements devised by Messrs. Siemens for electro-chemical research.

Some of the Widnes party then returned to Liverpool, whilst others went on to Prescot.

2. Messrs. Lever Brothers "Sunlight" Soap Works.

Excursion B.—Leader: Henry Brunner, Esq.

About 100 members formed a party to visit these well-known works, the property of Messrs. Lever Brothers, Limited. The party was met at Bebbington Station and conveyed in wagonettes to the works, where a reception was accorded it by Mr. W. H. Lever, Mr. J. D. Lever, and Mr. Lever, senr.

The company, in parties of 20, were taken over the extensive works by the principals of the firm and leading employés, and were shown all the various processes of soap-making. They were also taken through the printing, box-making, and other departments connected with the works.

The area covered by this large factory, with its subsidiary works at Port Sunlight, covers no less than 86 acres. There are no less than 38 soap pans for the soap-boiling processes, and of steam boilers, 19 large ones and 8 of a lesser size.

As to the number of workpeople, there are 950 in the works, this number including about 400 girls and about 250 in the buildings, &c. The soap-making capacity of the plant is estimated as equal to the production of 1,000 tons per week. The impression left upon the mind of an observer was that the most perfect organisation characterised the management of this gigantic concern. They were afterwards shown the Gladstone Hall, and then conducted over the model village erected by Messrs. Lever for their employés. At the close of the visit the party, who were hospitably entertained by Messrs. Lever Brothers, heartily thanked the members of the firm for the courtesy extended to them.

Messrs. Lever, intent on seeing their workers well housed around them and well cared for, have largely added and are still adding to the workmen's dwellings at Port Sunlight, which number 96. These are occupied by eager tenants as fast as they leave the builders' hands. At meal-times crowds of workpeople may be observed hastening towards the Gladstone Hall, while in the long winter evenings still larger numbers may be seen wending their way thither for the enjoyment of "food for the mind" in the shape of lectures, concerts, dramatic and other entertainments. It is pleasant to be able to record Messrs. Lever's opinion that those efforts to foster a common interest between themselves and those they employ have had the happiest effect in raising in a high degree and maintaining the *esprit de corps* of their rank and file.

3.—Messrs. Laird Bros. Shipbuilding Yard, Birkenhead.

Excursion C.—Leader: A. H. Knight, Esq.

These works were founded in 1824 by William Laird, the father of the late John Laird, M.P., and since that date there have been built here, including work now in hand, 600 vessels, having an aggregate tonnage of over 392,700 tons, and an aggregate of over 378,500 horse-power.

A large portion of this work has been done for the British, Foreign, and Colonial Governments. Many famous and successful vessels of the mercantile marine have likewise been constructed here. Special attention has been given to the design and construction of steamers for river navigation, some of which have been pioneers in opening up rivers that now form important channels of commerce.

Among these steamers is included the "John Randolph," the first iron steamer even seen on American waters.

Among the notable ships recently turned out are the twin-screw Atlantic liner "Columbia," built for the Hamburg-American Steam Packet Company, one of the fastest and most successful ships in the Atlantic trade; and the Chilian torpedo gunboats "Almirante Lynch" and "Almirante Condell," which have recently distinguished themselves in several naval engagements on the coast, notably that which resulted in the sinking of the "Blanco Eucalada."

Several twin-screw channel steamers of exceptional speed have also been turned out from these works during the last few years, among which may be mentioned the "Lynx," "Antelope," and "Gazelle," of 900 tons and 1,600 indicated horse-power, and with a speed of 17 knots; and also the "Ibex," of about 1,400 tons, and 4,000 indicated horse-power, with a speed of 20 knots, for the Channel Island service of the Great Western Railway Company.

The "Duke of Clarence," 2,000 tons and 4,000 indicated horse-power, and a speed of 19 knots, for the Fleetwood and Belfast service.

H.M.S. "Onyx" and "Renard," torpedo gunboats of 990 tons and 3,500 indicated horse-power, have just been delivered to the dockyard officials, and the former has satisfactorily completed her trials at Sheerness.

There is now approaching completion in one of the graving docks at the Birkenhead Iron Works the magnificent twin-screw yacht "Valiant," which has been built for Mr. J. K. Vanderbilt, of New York, and is probably the largest and most powerful private yacht in existence; and on the slips are several torpedo cruisers and torpedo boats of different classes in various stages of progress.

At Messrs. Laird's wharf on the west float, near their boiler works, are—the first-class battleship H.M.S. "Royal Oak," of 14,300 tons displacement and 13,000 indicated horse-power, rapidly approaching completion; also the twin-screw despatch vessel "Minto," of about 1,000 tons and 1,850 indicated horse-power, for the Government of India, just ready to make her trials.

4. Messrs. Cope Bros. Tobacco Factory.

Excursion D.—Leader: Prof. J. Campbell Brown.

Between 50 and 60 gentlemen, after visiting Messrs. Laird's establishment, travelled to Lord Nelson Street to inspect the extensive works of Messrs. Cope Bros. and Co., Limited. They were divided into two parties, and were conducted through the various departments, where the different processes of tobacco manufacturing and cigar and cigarette making were in progress. Great interest was evinced by the visitors, to many of whom were revealed for the first time the modes pursued in the manufacture of the fragrant weed. As showing the extensive character of the works, it is interesting to state that Messrs. Cope Bros. and Co. employ no less than 1,500 workpeople, 1,400 of whom are girls and women, engaged in the different occupations of manufacturing tobacco from the raw leaf, the making of cigars and cigarettes, labelling boxes, and making paper boxes for holding cigarettes. Other branches of industry are also carried out on the premises, the firm doing all its own printing, and making the wooden boxes in which are sent to distant parts the products of the factory. It follows as a matter of course that snuff making forms a portion of the work of the establishment. A knowledge of the fact that some 1,200*l.* a day are paid in duty on goods manufactured in the works will give some idea of the extensive nature of the firm's dealings. Regarding the earnings of the girls, the young ones begin at 4*s.* a week, and their remuneration is gradually increased up to 12*s.*, while the earnings of a journeywoman who is paid by the day, average about 18*s.* Cigar and cigarette makers are paid by piece. Their earnings vary considerably, according to the ability of the workers. One of the cigar makers, who is very expert in her business, is said to be able to make as much as 34*s.* weekly, while some of the cigarette makers can earn from 20*s.* to 24*s.* a week. So far as the hours of work are concerned, the employés may be considered to be very fortunately circumstanced. Work is commenced at nine o'clock in the morning and concluded at six o'clock, but the women, especially the married ones, do not, as a rule, come in before nine o'clock, and they are allowed to leave at five o'clock. Taking into consideration the meal hours and the time allowed for late comers to put in an appearance, the workpeople here are more favourably situated than if an eight hours' day were enforced.

If any members of this firm, which so hospitably received our members, should be curious to know how far chemical analysis lends itself at the present time to the assay of tobaccos, this curiosity may be satisfied on turning to p. 631 of this number of our Journal.

AFTERNOON.—5. LANCASHIRE WATCH CO., PRESCOT.

Excursion E.—Leaders: Messrs. W. P. Thompson and A. Smetham.

One contingent of the members took advantage of the opportunity of visiting the Lancashire Watch Company's factory at Prescot, the finest of the kind in the kingdom. About 50 of the members left Lime Street by special train at 2.55, and arrived in Prescot at a quarter past three. Others who had been visiting the chemical works at Widnes were driven over in wagonettes to the historic old town. The party was met at the door of the factory by Mr. T. P. Hewitt (managing director), Mr. Jas. Hewitt (secretary), Mr. C. J. Hewitt, and Mr. W. L. Hindley (managers). The party broke up in sections, and each of these gentlemen guiding a group conducted them all over the extensive works, explaining the many processes which the raw material passes through until it finally emerges as a delicate timepiece. The hundreds of girls and men employed in the works revealed a hive of industry in marked contrast to the slow and sluggish manual procedure of five years ago. The gentlemen and ladies first visited the machine department, where the company make their own tools, and a marked feature of the department, as showing how the trade of watchmaking had gone to other climes, was that most of the machines were of American origin. Next the frame department and the press room were inspected, where the blanks or discs for the plates, cocks, dials, caps, and wheels are stamped out of metal sheets, and where the wire used for pinions, balance staffs, &c., is cut into various lengths and worked to the thousandth part of an inch. The barrelling, pinion, punching, and escapement departments were all duly inspected, until the newer part of the factory was reached, where the process of putting together began, and where the old skilled workmen of the town come into evidence. The timing, dialling, gilding, and finishing branches were all hurried through, as the train for Liverpool was due to return at 5.20. The Messrs. Hewitt having been heartily thanked for their courtesy, the visitors took their departure.

6. R.M.S. "TEUTONIC" AND "CAMPANIA," AND THE LIVERPOOL OVERHEAD ELECTRIC RAILWAY.

Excursions G, H, and J.—Leaders: Messrs. A. H. Knight and W. Norris Jones.

The visits to inspect these huge Atlantic liners were exceedingly well attended, though of the two the "Campania" came decidedly in for the largest share of attention. With the large party visiting this gigantic steamer were the President, Sir John Evans, and the President-elect, Mr. E. C. C. Stanford. The company left the landing-stage at three o'clock by the "Crocus," being accompanied by the director of the Cunard Company, Mr. John Williamson. A pleasant sail, in bright sunshine, and on the smoothest water, brought the visitors alongside the mammoth ocean-liner. The stately proportions of the noble vessel rose high above the water, completely dwarfing, by comparison, a number of flats from which she was receiving her coal supply. Such a distance was the deck of the "Campania" from the top deck of the ferry steamer that the ordinary gangway was found to be useless, and a much longer one had to be procured to allow the passengers to board her. The magnitude of the vessel was, of course, the first subject of comment and surprise, for, with her length of 620 feet and breadth 65 feet, it is a veritable journey to travel her decks. Mr. Williamson showed the party over the ship and pointed out the many points of interest she possesses to landsmen. The greatest admiration was expressed with the luxurious style in which the state-rooms are furnished, and also with the completeness of the accommodation for those crossing the Atlantic. In fact it was felt that to go to sea for a week in such a steamer would be but to have the feeling of living in a hotel for a week, with the extra advantage that one had only, when he felt inclined, to step out of the door of the state-room to fill the lungs with pure fresh sea-air. The great triple expansion engines, of which there are two sets, were examined with curiosity and interest, and it was explained that each are capable of exerting 15,000 horse-power. During the afternoon light refreshments were served on board, and shortly before five o'clock the party returned home. Before landing, Sir John Evans, on behalf of the Society, expressed to Mr. Williamson their warm thanks for the courtesy and kindness they had so greatly enjoyed.

THE ALEXANDRA DOCK GRAIN WAREHOUSES.

Leader: Dr. T. L. Bailey.

The visitors composing this party were met by J. Christie, Esq., of the Grain Storage Company, at the warehouses, and were shown the wonderful appliances there employed for manipulating large quantities of grain.

The objects that were aimed at in designing this granary were :—1st, the greatest storage capacity on a given area of ground; 2nd, economy of construction; 3rd, immunity from fire risk; 4th, economy of labour in the several processes of discharging from ships, reception into the granary, turning over to keep the grain in marketable condition, bagging, weighing, and delivering into railway waggons and into carts. The dimensions of the building in plan are 240 ft. by 172 ft., within which are contained 250 hexagonal bins of brickwork, each 12 ft. wide in the upper portion by nearly 80 ft. deep inside, besides a large number of half-bins, used exclusively for delivery in sacks. The total capacity of the bins is 56,000 tons or 2,240,000 bushels. The top is covered over with a fireproof floor, through which there are manholes with raised lips for the passage of the grain, these being so arranged as to prevent water from getting into the bins in the event of the floor being flooded.

The grain is lifted from barges in the docks by four elevators at the dock side, and is conveyed to the granary on bands running in subways under the quay and Regent Road. The grain is dredged from the hold of the barges by the elevators, lifted 43 ft., and delivered into a receiving hopper, from which it is again lifted 32 ft. by a second elevator inside the tower, where it is delivered into a second receiving hopper. Thence it flows by gravity into a weighing hopper below, which weighs 2 tons at a time and delivers into a distributing hopper beneath. This hopper holds grain enough to maintain a continuous feed to the carrying bands, and is at the same time of sufficient capacity to receive the intermittent deliveries from the weighing hopper.

When it is desired to deliver the grain into the dock-side sheds, instead of into the bins, it is discharged either through spouts from the top of the inside elevator or from the distributing hopper. Portable bands supported on trestles are used for conveying it to the point of storage on the floors of the sheds. At No. 2 Alexandra Branch Dock there are two similar towers with elevators and other appliances, each of 100 tons nominal lifting power per hour, but capable in practice of discharging and weighing at the rate of 145 tons per hour.

The carrying power of the delivery band for the delivery of grain to vessels is 50 tons per hour, and the total length 1,270 feet, or nearly one-quarter of a mile. The granary is lighted throughout by electricity.

THE LIVERPOOL OVERHEAD RAILWAY.

Ample facilities were afforded the visitors for inspecting this splendid piece of electrical engineering, and the following condensed description of the electrical plant may now be interesting.

A Description of the Electrical Plant.

This electrical plant has been designed and manufactured by the Electric Construction Corporation, Limited, of

London and Wolverhampton, under the supervision of Mr. Thomas Parker, the Works Director.

The construction of the line and its equipments have been carried out under the direction of Sir Douglas Fox and Mr. J. H. Greathead, the engineers of the Overhead Railway Company.

The railway itself consists of an iron structure carrying a double line of rails of the ordinary standard, 4 ft. 8½ in. gauge, running for a distance of six miles along the docks, for a greater part of its length over the existing Dock Railway, giving a clear headroom under the girders of 16 feet.

Fourteen stations give the necessary facilities for taking up and setting down passengers, the maximum distance between any two stations being 1,200 yards and the minimum 300 yards.

The generating station is at the Bramley Moor Dock, adjoining the railway and about the centre of its length. Six Lancashire boilers (30 ft. by 8 ft.) supply the necessary steam at 120 lb. pressure.

The engine house contains four main engines of the horizontal coupled compound type, each capable of indicating 400 horse-power.

Each of the main engines drives, by means of cotton ropes, an Elwell-Parker Shunt Wound Two-pole Dynamo, giving an output of 500 volts 475 ampères at 400 revolutions per minute; the machines have drum armatures and magnets of the double horse-shoe type, fixed vertically.

The main switchboard is of a very simple character, each dynamo has its own voltmeter and is connected up through an ammeter to a double-pole automatic magnetic cutout, which also takes the place of a switch; from the cutout connections are made to a pair of omnibus bars, into which all the machines feed in parallel. Multiple contact switches and resistance coils in the field circuit of each machine regulate the electro-motive force. Between the omnibus bars and the main cables going out to the line, a large automatic magnetic cutout is inserted, carrying the whole current.

The motors on the line draw their supply of current from steel conductors laid in between the ordinary rails carried upon pot insulators, these in their turn being supported by wood cross-sleepers. The surface of the conductor is about 1 in. higher than the top of the ordinary rail; at the cross-over roads the conductor is bent so as to run parallel for a short distance with the ordinary rails, but leaving sufficient clearance to prevent arcing across the collector when passing over bridges across from the conductor on one side to that on the other side of the rail.

The return circuit from the motors is completed through the carriage wheels and ordinary rails, the latter being electrically jointed across the fish-plates.

The centre steel conductors on up and down roads are electrically connected at each of the 13 cross-over roads, as are also the ordinary rails, thus making a network of the conductors and removing the chance of one faulty connection interfering with the working of the line.

The collectors consist of cast-iron shoes 12 in. in width loosely hinged from an insulated block on one bogie of each carriage.

In addition to the ordinary hand brakes Westinghouse air brakes are also fitted, a supply of compressed air for working them being carried by a receiver under each carriage; the receivers are charged at the north terminal station, where an air-compressing plant is erected.

Each train has two motors, one fitted on the leading bogie of the first carriage, and the other on the trailing bogie of the second carriage. The armatures are of the drum type, mounted directly upon the axles, the magnets being series wound, of the double horse-shoe type, supported by two bearings on the axle, and also by a special arrangement of springs at the end of the magnets from the bogie framework.

When stationary and a current of 80 ampères is passed through the motor there is a torque effort on the rim of the wheels of 1,060 lb., or with 100 ampères of 1,400 lb. The dimensions and winding have not been arranged to give the maximum efficiency at full load and speed, as only for a very few minutes each journey will full speed be attained, most of the time being employed in starting and accelerating the train; the maximum speed attained by the motors will be 300 revolutions per minute, equivalent to a train speed of 30 miles per hour. The carriages are lit with incandescent lamps, supplied with current from the centre steel conductor, the same as the motors.

All the stations are lit with incandescent lamps supplied from accumulators fixed under the platforms; these accumulators also supply current for working the automatic electric signals, which are operated by the trains themselves. The accumulators are charged in series from the main dynamos at 500 volts.

The generating plant is capable of running a three minutes' service of trains over the whole length of line, each train completing the journey of six miles in 30 minutes, including a stop at all of the 14 stations.

The trains, complete with motors and full complement of passengers, weigh, approximately, 40 tons each.

Banquet at the Adelphi Hotel.

The annual dinner of the Society was held in the Adelphi Hotel, under the presidency of Sir John Evans, K.C.B. 160 members and friends sat down. During the proceedings selections of music were rendered by Mr. Josef Cantor's Glee Party.

The President proposed "The Queen," which was duly honoured.

Principal Rendall, in submitting "The Society of Chemical Industry," said he rejoiced that the Society was increasing in numbers and importance, and he was delighted to hear that they were treading closely on the heels of the men of science in Germany. Liverpool certainly owed much to chemistry, directly and indirectly, and he would venture to think that the commerce of Liverpool and those engaged in great chemical industries were doing more than any other class to redeem Liverpool from the aspersion, if such it was, that it was a mere port. Those of her citizens who were engaged in chemistry were amongst the most liberal, enlightened, and public-spirited in the promotion of great public movements; and therefore it was perhaps that if Liverpool could not claim to be the actual parent of this great Society, at least it had been one of the most effective nursing mothers which had brought the Society to the position which it now enjoyed.

Sir John Evans, in responding, said he was glad to think that during his year of office the interests of the Society had not gone back, and he hoped that the incoming Council would take into consideration some suggestions which he thought might be of advantage. He passed from among them as President, but he should always retain a warm interest in the proceedings of the Society. They must not be regarded as a strictly scientific chemical society, but they united those engaged in various industries under one common bond of union, and it was one which was calculated to promote a good understanding among those engaged in competing businesses, but still further in those engaged in commercial pursuits throughout the country. It was a Society which was of great public service, and he trusted that it might long continue and flourish.

Mr. E. C. C. Stanford, in proposing the toast of "The Trade and Commerce of Liverpool," said that he had the greatest possible admiration for the artist who had arranged the port or menu side of the programme, and for what we had received we ought to be profoundly thankful: he could not, however, admire the gentleman who had devised the starboard or toast side; he must use nautical terms in the port of Liverpool. He knew nothing whatever about the trade and commerce of Liverpool, and perhaps that was the reason he had been so suddenly called upon to propose it, or perhaps it was thought that, like the Yankee, if he didn't know any facts he "kin make them." He could only therefore speak as a visitor. The President had suggested that he might get a hint from the city motto, but he found that was something about leisure, and had nothing to do with commerce. No one, however, could visit, as they had that day, the overhead railway, and see those magnificent docks, and that noble vessel the

"Campania," without acquiring some idea of the enormous bulk of the trade of Liverpool, and the gigantic steamers required to carry its merchandise abroad. Liverpool was the great distributing centre of the alkali trade, always associated with Widnes, where they had been so hospitably entertained to-day; that wonderful town which enjoyed an atmosphere and a climate of its own, and manufactured on the spot. The Mayor had informed them that among its other great manufacturing advantages it had the cheapest gas supply in the kingdom—he meant, of course, coal-gas; he believed some other gases were distributed without money and without price. Not much had been said about its importance as a residential town, but he could not imagine a more delightful place for any man who was fond of sulphur. He understood there was no municipal objection to his taking it in the pure state before breakfast mixed with treacle, and he could finish off at night with that delightfully aromatic combination with hydrogen, which he thought must be his Satanic Majesty's pet perfume. He was told that the climate of Widnes was so particularly healthy that there were very few microbes left there, and the few that were left had the wisdom—no doubt derived from the Society of Chemical Industry—of going about provided with respirators. They all owed a deep debt to Widnes, as it was the birthplace of this Society. If, however, so far he had only shown his ignorance of "The Trade and Commerce of Liverpool," he would qualify it by coupling the toast with the name of a gentleman who knew all about it—Mr. E. K. Muspratt—a former president of the Society, a name long connected with the alkali industry, and well and honourably known throughout the world. Mr. Muspratt still took a most active part as a director of that great United Alkali Co., the works and the management of which they had all so much admired that day. He had always given the Society of Chemical Industry the credit of the inception of that colossal undertaking, in bringing the alkali makers together in the first instance, and he invited Mr. Muspratt in his reply to say if he had not been correct in that surmise.

Mr. E. K. MUSPRATT, in responding, remarked that he was not going to inflict upon them a history of the trade and commerce of Liverpool, because he would have to give them an array of figures showing the enormous growth of that commerce during this century. They need not fear that their trade—the great Atlantic steam trade—would be taken away from them and go over to Southampton so long as they had prosperity in the chemical and alkali industry of this immediate neighbourhood. The magnificent ship the "Campania," which they had visited that day, and the "Teutonic," very often bore across the ocean the products of their industry. The products of their industry, to a certain extent, enabled the Atlantic steam trade to bear the competition of nearly every other port of the world. He might also say that so long as they had enterprising citizens in this city connected with their trade—and he was glad to say that they had them still with them—they would be able, by the application of science in dredging the bar of the Mersey, to compete with other ports by enabling the Atlantic steamers to come in at any state of the tide. He would briefly indicate a few of the connections between the chemical industry and the trade of this port. When soda-ash was first made in this town it encouraged the manufacture of soap in the locality. The soap with the soda-ash gave a great stimulus to the trade in palm oil with the West Coast of Africa. Then they brought into the Mersey, but not into Liverpool, quantities of pyrites from Spain, and to Spain they sent in return large quantities of the manufactured article—caustic soda. They would therefore observe that there was a reciprocal relation between the manufacture of these articles and the trade of the port. Mr. Stanford was correct in stating that Widnes was the birthplace of that Society; he was also correct in his surmise as to the origin of the United Alkali Co. The very first idea of the origination of that Society arose amongst some gentlemen of Widnes, and the bringing together of those gentlemen at the time the Society was originated enabled them to exchange views, and this eventually resulted in the formation of the United Alkali Company. They had in the service of that company Mr. Carey, their secretary, who was one of those who initiated the Society. They had also Dr. Hurter, who had furnished the Society with some of the ablest papers which had been brought before it. They might take the credit to themselves in Widnes and Liverpool for having done something towards founding a Society which, he was glad to say, now took the foremost position amongst such societies. In fact, it was unique in the way it united science with practice. The journal they published had no competitor in the world. Although some 10 or 15 years ago there was no journal in this country, and there were numbers of journals in Germany, they had now in England produced a journal which surpassed those of any other kingdom. They knew that the commerce of Germany had increased enormously of late years, and that if England was threatened with any serious competition, it was from that country. And why? Because Germany was the first to recognise the absolute dependence of success in industry upon the application of science. England had followed in her footsteps, and he trusted that the great enterprise which had always been one of the characteristics of Englishmen would enable them in the future to compete successfully with their Teutonic rivals. He trusted also that the Society would continue to prosper, and that it would go on diffusing that knowledge among those engaged in chemical industries which would enable them in the future to take the lead as they had in the past.

Mr. HENRY BRUNNER proposed the toast, "Our Guests."

Mr. T. P. HEWITT, of the Prescot Water Factory, responded.

Mr. TYRER asked the meeting to thank heartily the Committee of the Liverpool Section, and those who had made arrangements for the meeting, coupling with this the name of Dr. Kohn.

The toast was drunk with musical honours.

Dr. KOHN replied, after which the President vacated the chair.

THIRD DAY.—FRIDAY, JULY 14TH.

VISIT TO MANCHESTER SHIP CANAL AND NORTHWICH.

Leader: Henry Brunner, Esq.

Of the numerous excursions organised for the edification of the members, none probably proved more attractive or enjoyable than the trip up the Manchester Ship Canal and the visit to the salt mines at Northwich. Owing to the large number of applications for tickets it was found necessary early in the week to give notice to the members that the excursionists would have to be divided into two parties. This was accordingly done, and half-past nine o'clock on Friday morning each party set off for the heart of the Cheshire salt industry, one by special train from Lime Street Station, and the other by steamer from the Landing Stage, viâ Eastham and the Ship Canal. The train party on arriving at Northwich was subdivided, one portion proceeding in four-in-hand brakes to the Adelaide Rock Salt Mine at Marston, and the other walking to the Baron's Quay Rock Salt Mine, permission for the inspection of which had been kindly granted by the directors of the Salt Union. The mines had been prettily illuminated for the occasion with candles, which were so arranged as to form very tasteful designs. While the visitors were inspecting the workings a number of shots were fired in order to let them see how the blasting operations were conducted. The effect produced was similar to severe thunder, the reverberations lasting for several seconds after the firing of the shots. The Adelaide mine covers an area of 15 acres, and the workings are 330 ft. below ground, the average height being 25 ft. Some 65,000 tons represent the annual output of the mine, the average purity of the rock salt, which is used chiefly for chemical and agricultural purposes, being stated to be 95 per cent. It is estimated that the rock in this one mine alone will last for many years to come. The rock-salt area in the Northwich district is about two miles in length and the same distance in width. Experimental boring has been carried on at the Adelaide mine, and a depth of 2,610 ft. attained, but beyond finding rock salt of an inferior quality 15 or 20 yards below the present workings, nothing was discovered of any note. The locality of the mine is, owing to subsidence, largely inundated with water at spots where mines stood years ago, and which 30 years back were level with the surrounding country. A huge lake has been formed in one of these places, the water being about 10 yards in depth, and this notwithstanding that some hundreds of thousand tons of earth from the excavations at the Liverpool Docks and the Manchester Ship Canal have been poured into it. Within the last two or three years the Salt Union have lost large sums in consequence of the sinking and demolition of works in the locality of this lake. One set of works alone, which have come down in that period, represented an outlay of 20,000*l*. The dimensions and output of the Baron's Quay mine are somewhat similar to the Adelaide mine, but being situate in Northwich it has a frontage to the River Weaver. The visitors, after spending upwards of an hour in the mines, met at the Baron's Quay wharf, where luncheon, hospitably provided on a sumptuous scale by Messrs. Brunner, Mond, and Co., was partaken of in a marquee. At the conclusion of the repast Mr. E. K. Muspratt expressed to the Salt Union the thanks of the company for having opened the mines for their inspection. Mr. Thomas Ward, J.P., replied on behalf of the Salt Union. Dr. Perkin next proposed a vote of thanks to Messrs. Brunner, Mond, and Co for their kindness in providing the luncheon, and the toasts to the various parties, which were very cordially drunk, were responded to for the firm by Mr. Ludwig Mond, F.R.S., on one occasion, and on another by Mr. Edward Milner.

Mr. Thomas Ward subsequently conducted a party of the excursionists over the salt museum at the Brunner Free Library, and also pointed out what to strangers to Northwich are some of the interesting features of the town. These consist mainly in houses which have either partially subsided into the earth or have lost their perpendicular bearing, and in dwellings and other buildings which, owing to the same cause—the sinking of the ground—have been reduced to ruins. The journey home along the River Weaver and the Ship Canal was commenced at half-past two, and proved a most delightful trip. The party, which travelled to Northwich by boat, arrived at their destination shortly before two o'clock, and after partaking of luncheon proceeded to view the Baron's Quay and Adelaide mines. They returned to Liverpool by special train in the evening. The visitors were all loud in their praises of the excellent arrangements made for the outing and the hospitality extended to them.

THE SMOKING CONCERT.

In the evening some 60 or 70 members of the Society attended a very enjoyable smoking concert given for their entertainment at the Reform Club, Dale Street, Mr. H. Wade Deacon, chairman of the club, as well as a prominent member of the Society, presided, and the attendance also included Mr. E. C. C. Stanford, President-elect of the Society. A capital programme of pianoforte solos, songs, and recitations was executed by the following:—Messrs. J. C. Sutherland, L. Zagury, J. Johnson, Watson Smith, J. F. Fuerst, and L. Rosenheim.

Thus ended one of the most successful and enjoyable annual meetings the Society has yet held, and though doubtless the excellent weather contributed greatly to the success, nevertheless all were agreed that the greatest praise must be accorded to the local honorary secretary. Dr. C. A. Kohn, who, with his colleagues, had so carefully arranged and carried out their programme.

ERRATUM.—This Journal, 1893, 318, col. 2, 12 lines from bottom, for "antimony contained nearly as much" *read* "antimonite often contained as much," &c.

London Section.

THE CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE, W.

Chairman: Wm. Thorp.
Vice-Chairman: W. Crowder.
Committee:

E. J. Bevan.
W. G. Blagden.
C. C. Hutchinson.
T. A. Lawson.
R. Messel.
B. E. R. Newlands.
W. Ramsay.
F. G. Adair Roberts.
A. Gordon Salamon.
G. N. Stoker.
F. Napier Sutton.
T. Tyrer.
Frank Wilson.
C. R. Alder Wright.

Hon. Local Secretary: John Heron,
74, North Side, Clapham Common, S.W.

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: E. Carey.
Vice-Chairman: H. Brunner.
Committee:

P. Bateson.
J. Campbell Brown.
V. C. Driffield.
Jos. C. Gamble.
F. Hurter.
W. Norris Jones.
G. Schack-Sommer.
E. Scott.
A. Smetham.
Frank Tate.
H. Tate, jun.

Hon. Treasurer: W P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Manchester Section.

CHEMICAL CLUB, VICTORIA HOTEL.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.
Committee:

G. H. Bailey.
F. H. Bowman.
R. F. Carpenter.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
P. Hart.
J. M. Irving.
E. Knecht.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
C. Truby.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Newcastle Section.

Chairman: A. Allhusen.
Vice-Chairman: John Pattinson.
Committee:

P. P. Bedson.
G. T. France.
T. W. Hogg.
T. W. Lovibond.
W. Martyn.
John Morrison.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
W. A. Rowell.
John Watson.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Nottingham Section.

University College, Nottingham.

Chairman: J. M. C. Paton.

Vice-Chairman: C. Spackman.

Committee:

L. Archbutt.
F. J. R. Carulla.
F. Clowes.
J. B. Coleman.
C. H. Field.
H. Forth.
J. O'Sullivan.
S. J. Pentecost.
H. J. Staples.
C. Taylor.
G. J. Ward.

Treasurer: J. T. Wood.

Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Yorkshire Section.

Chairman: A. Smithells.

Vice-Chairman: T. Fairley.

Committee:

J. E. Bedford.
F. Branson.
J. B. Cohen.
J. J. Hummel.
J. Lewkowitsch.
W. Mackay.
C. Rawson.
F. W. Richardson.
Jas. Sharp.
G. W. Slatter.
G. Ward.
T. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

Errata.—This Journal, 1893, 505, col. 2, line 2 from top, for "$\frac{672}{2} = 336$" *read* "$\frac{672 + 18}{2} = 345$."

Page 506, col. 1, line 2, below first table, for "as proved up" *read* "as proved by."

Page 505, col. 1, bottom line, for "and accepted by Leeds" *read* "though not accepted by Leeds."

Glasgow and Scottish Section.

Chairman: C. A. Fawsitt.

Vice-Chairman: E. J. Mills.

Committee:

G. Beilby.
W. J. Chrystal.
J. Clark.
C. J. Ellis.
G. G. Henderson.
R. A. Inglis.
R. Irvine.
J. Falconer King.
W. I. Macadam.
J. S. Macarthur.
T. L. Patterson.
J. Pattison.
J. B. Readman.
E. C. C. Stanford.
D. R. Steuart.
R. R. Tatlock.

Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

Journal and Patent[*] Literature.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Woven Wire and Segregation. B. Corcoran. Nat. Assoc. of Brit. and Irish Millers, Liverpool.

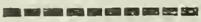
To give a logical account it was thought necessary for the explanation of sifting to be preceded by the consideration of sieves, and this again had to give place first to the material of which they are made.

Wicker-work and perforated skins can doubtless claim priority in matter of antiquity, but the most important is

Woven Wire.—The inch is the standard of measure. No. 10 is taken as an example, and the inch is divided into 10 lines (Fig. 1), the square inch into 100 squares (Fig. 2), and the cubic inch into 1,000 cubes (Fig. 3).

Figs. 1 and 2 have reference to mesh, while Fig. 3 more particularly refers to the material to be sifted or dealt with. One of the little cubes of which Fig. 3 is built up is taken as the *unit*.

Fig. 1.



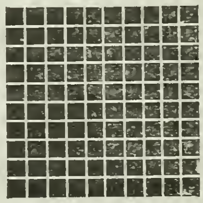


Fig. 2.

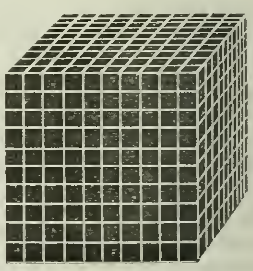


Fig. 3.

The lines in the above diagrams may be understood to have "length without breadth," but woven material is made of wire or threads having substance or thickness that occupy space, and it is desirable to show how this materially affects all calculations, and how a slight difference in their thickness alters the size of the units; in other words, when the wire is thin the units are large, and when the wire is thick the units are small. The amount of work required in dealing with the material is also altered.

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[*] Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

Mesh.—There is some uncertainty about the exact way of measuring the mesh. Woven wire should be measured from "centre to centre." It is generally only in the coarser holes that any doubt can exist as to the mode of measurement, or where hand-made wire-work is paid for by the piece, when instead of the actual 10 spaces and 10 wires in each inch, only 10 spaces and $9\frac{1}{4}$ wires are often reckoned; and this probably arises from the fact that it needs 11 wires to make 10 spaces.

Tenth of an inch mesh may mean the size of the hole "in the clear," in which case the number to the inch is regulated by the thickness of the wire, but No. 10, or 10 hole, or 10 mesh, cannot well be measured otherwise than from "centre to centre," like the *pitch* in gear wheels, which is not determined by the thickness of the teeth, and where it is only necessary to continue counting round the whole circumference to discover that there are the same number of teeth as spaces.

The safest way to count the mesh is to commence on the centre of a wire (warp) and continue until the end of any inch again coincides with the centre of a wire, and divide the number counted by the number of inches. Take $4\frac{1}{4}$ mesh as an example. At the end of the first inch the count is found to be over four mesh, and yet it is difficult to determine how much, whereas at the end of the fourth inch it comes exactly to 17, or $4\frac{1}{4}$ pitch, or the correct count.

Weaving.—Suppose ·025 be the thickness of the wire in our sample (Fig. 4). Ten such wires (warps) touching each other make a quarter of an inch, leaving the other three-quarters of the inch open space (Fig. 5). The shoots gathered together in the same manner gives the dead surface seven-sixteenths of the square inch, of which one-sixteenth is the crossing or overlapping of the wires, leaving nine-sixteenths of space to be divided into the 100 holes. In Fig. 5 the vertical lines on the left side of the illustration represent the warp, the horizontal lines at the bottom the shoot, and the dotted lines only serve to indicate quarters of the inch. The No. 10 in my first table, owing to the wire being thinner, would divide the square inch in a similar way into 25 parts, 9 only of which would be dead surface.

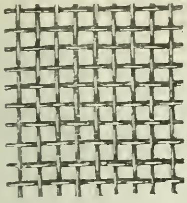


Fig. 4.

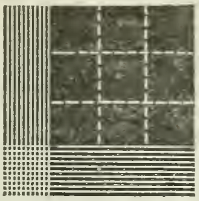


Fig. 5.

In the case of No. 10 strong rice wire (Fig. 6), such as is used in rice mills, the dead surface is nearly three-quarters of the whole (see Table II.). A foreigner generally uses thin wire for economy sake, but the reason he gives is that it sifts more freely, which, of course, is perfectly true. An Englishman usually prefers strong work. It is a common experience to be asked to weave wire of a greater thickness than the size of the whole, forgetting that it is as impossible to do this as it is to put more than 12 inches in a foot, or 20 cwt. to a ton, for the wires that keep the cross wires from coming together are bent, and therefore occupy even more space than their thickness, and it requires a specially good quality of metal to stand being knocked up to the theoretical limit.

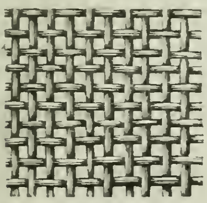


Fig. 6.

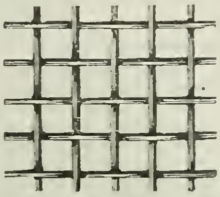


Fig. 7.

Fig. 7 is 5-mesh, Fig. 8 is same mesh of stouter wire, and Fig. 9 is section of the latter.

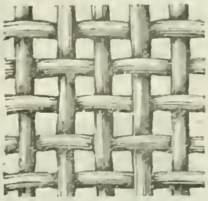


Fig. 8.

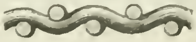


Fig. 9.

Of course there are ways of getting over these difficulties by making the mesh long instead of square (different count one way to what it is the other), warp and shoot of different thicknesses, of straight shoot, with flat warp, &c. (Figs. 10, 11, 12), but it does not immediately concern the main subject.

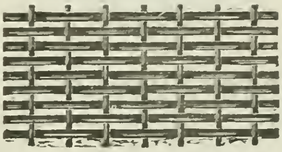


Fig. 10.

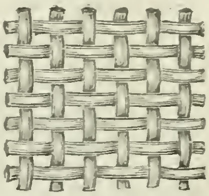


Fig 11.

The author's late father exhibited No. 150, or 22,500 square holes brass wire, in the first Great Exhibition of 1851, and No. 160 × 180, or 28,800 square holes, in the International Exhibition of 1862. The author believes that this is the finest straightforward wire weaving that has been accomplished, and that anything finer than 120 will be found to be twilled, and this is done as fine as No. 200.

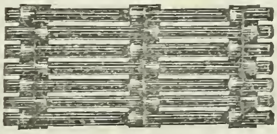


Fig. 12.

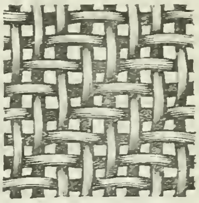


Fig. 13.

Twilling (see Fig 13, and section, Fig. 14) does not produce a clear passage through the cloth, and is not well suited for sifting, as the holes are not all open alike, but it enables a thicker wire to be woven with less power, and inferior metal can be utilised. In this way also springy material, such as horsehair, may be made into sieve bottoms of a finer mesh than is possible in ordinary weaving. It also enables almost a solid surface to be produced, as in the case of hair seating for upholstery work, where the thread warp is hidden and the horsehair brought into view, forming a smooth face.

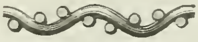


Fig. 14.

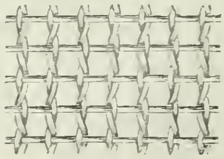


Fig. 15.

Silk Gauze.—Wire is kinked by the process of weaving, which is sufficient to keep the meshes from shifting, unless the wire is very thin. For preserving the mesh in the best silk there are two warps, which are twisted together between each shoot (see Fig. 15), otherwise the threads might be drawn together after the manner shown in Fig. 5; this gives a somewhat hexagonal-shaped hole, but in the calculations the author has averaged it, and reckoned a square hole, and with warp and shoot of parallel and equal thickness. In fine meshes there is an alternate twisted warp (see Fig. 16), in still finer only an occasional one, and in the very finest it has to be omitted altogether.

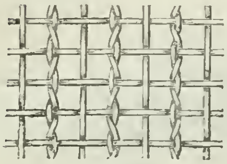


Fig. 16.

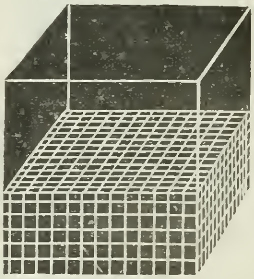


Fig. 17.

The author is indebted to some friends for their kind assistance in measuring the thickness of fine threads, &c. by the microscope.

Effect of Dead Surface.—Referring back to the cube (Fig. 3), and if instead of being divided by lines without thickness a cubic inch of material be sawn up and each saw cut be ·025 wide, which is the thickness of the wire in Fig. 4, the thousand units will occupy only a little over $\frac{2}{5}$ of the cubic inch (Fig. 17), and those of the rice wire not much more than $\frac{1}{7}$.

The unit that just fits into any hole is spoken of as respectively the unit of No. 10 sieve wire, No. 10 rice wire, No. 150 wire, No. 6 silk, &c.

The 1,000 No. 10 sieve wire units placed one layer deep, forming as it were, a tessellated pavement, occupy $5\frac{2}{3}$ in., although still requiring 10 inches of wire for each hole to be filled with a unit.

The No. 10 rice wire units closed up together only cover $2\frac{3}{4}$ in., but again still require 10 superficial inches for each unit to occupy a hole.

The 1,000 units of the No. 10 sieve wire average $5\frac{2}{3}$ deep over a square inch (Fig. 17), and those of the rice wire only $2\frac{3}{4}$ deep.

It requires 2,379 sieve wire and 7,111 rice wire units respectively to make a cubic inch, a very great increase over 1,000, the nominal cube number without thickness of wire (see Fig. 3).

Passage through the Meshes.—Suppose the units in a cubic inch be piled up in columns over the holes in a square inch of the wire, the height will be $23\frac{3}{4}$ in sieve wire and 71 in rice wire. Again, suppose the meshes or holes to be all closed so that no unit could pass through, and that some "action" opened the holes momentarily, allowing only one unit to get through each mesh before it closed again, it will be seen that this would take away the bottom layer of units resting on the meshes, and that the number of "actions" to pass the whole quantity would be the same as the number of units making the height contained in these imaginary columns.

Cube and Sphere Units.—Unfortunately, the cubic unit cannot easily pass through a mesh that it just fills, although a globe or sphere of the same diameter may do so, and therefore also spherical units have been calculated for.

The difficulty in calculating this "piling of shot" may interest some, for the author found that although each row contains the same number of balls, the *rows* fit into the interstices of their neighbours, and so occupy less space, and each *layer* drops into the recesses in the *layer* below—in other words, the number in *width* is greater than in the *length*, and in the *depth* again greater than in the width, thereby greatly increasing the total quantity contained. (See Fig. 18, where L represents the length, W the width, and H the height or depth.) Elevation and plan of a pile of spheres are given, and between these a plan of the two top layers, showing how the top one sits in the cavity of the three beneath it. The rest of the diagrams need no explanation.

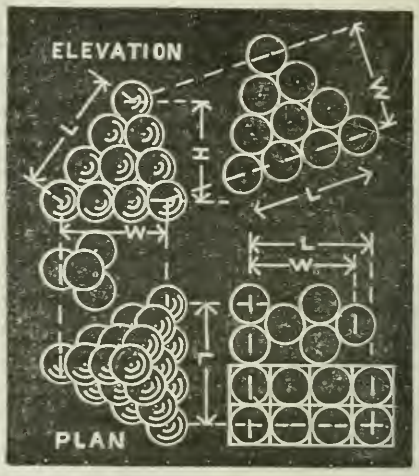


Fig. 18.

Measurement of Fractions.—Decimal parts have been spoken of as though the units were cut up into pieces to make their number fit into an inch. The division is only theoretical, to facilitate greater accuracy in calculation, for the units overlap the divisions of the inch.

Some to whom the puzzle of piling of shot had been shown made the remark that piling a definite quantity could not be calculated, as it depended on their relative size as to how many could be got into a box of particular dimensions, for the rows and layers do not commence and terminate at the same place, so the author points out that this is not his problem. He simply gives a figure that may be multiplied to give the correct number in a screen of given dimensions or a vessel of any size.

Surface of Sieve.—The holes in perforated flat sheets have an even top edge, which is easily closed by any large material resting on the surface. Woven wire presents a succession of knuckles all over, without any flat surface for the material to rest on.

Perforations, again, can be plugged so tightly by a slightly tapered rod fitted into them that water cannot pass. This is not possible in woven wire; a square rod may be fitted into the hole and the wires may press it as closely on all sides, but owing to the roundness of the wire there is a crooked passage through each corner that cannot be stopped.

A perforated hole, especially in thick plate, with its parallel sides the whole depth, is much more easily blocked than a woven mesh, for the wire presents the smallest surface at the smallest part of the hole, and even this is bent, and is not horizontal at any point.

Accuracy.—Exact truth is difficult to attain in anything, and the best scientific instruments often only enable the amount of error to be discovered and estimated.

In the tables a square mesh and wire is reckoned of even thickness, &c., and with fairly good work slight discrepancies will not make themselves felt in the ordinary way, but the demand for greater exactness in details becomes more pressing as competition increases.

In some businesses woven wire is now used as a standard gauge, usually the square number, and here some of the difficulties are pointed out.

The warp is the right count, but it may fit loosely in the reed in the loom; the shoot is seldom knocked up by the weaver to the nominal count; it is generally about 5 per

Extract from Tables of Relative Sifting Capacity, and Proportion of Different Sized Particles passing through Different Meshes of—

Table I.—Woven Wire.

Mesh, Holes to		Cube Number.	Pitch or a Hole and a Wire.	Size of Wire.		In clear Mesh or Hole without Wire.	Number of Units in a Cubic Inch.		Sifting Actions for one Inch Deep.	
Inch No.	Square Inch.			B.W.G. No.	Diameter.		Cubes.	Spheres.	Cubes.	Spheres.
			Inch.		Inch.	Inch.				
4	16	64	0·2500	20	0·0360	0·2140	102·0374	144·3022	6·3773	8·5677
5	25	125	0·2000	21	0·0320	0·1680	210·8999	298·2634	8·4390	11·9307
8	64	512	0·1250	24	0·0220	0·1030	915·1314	1294·2307	14·2989	20·2223
10	100	1,000	0·1000	25	0·0200	0·0800	1953·1250	2762·2608	19·5312	27·6237
20	400	4,000	0·0500	28½	0·0142	0·0358	21794·4927	30822·6854	54·4832	77·0567
50	2,500	125,000	0·0200	35	0·0084	0·0116	640657·7304	906027·6557	256·2628	355·1907
150	22,500	3,375,000	0·0066	45	0·0028	0·0038	13224212·0224	25772976·1643	809·9650	1145·4654
200	40,000	8,000,000	0·0050	47	0·0020	0·0030	37037025·9185	52378510·5954	925·9256	1309·4627

Table II.—Stout Woven Wire.

5	25	125	0·2000	14	0·0800	0·1200	578·6967	818·4013	23·1478	32·7361
10	100	1,000	0·1000	..	0·0250	0·0750	2370·3526	3352·2140	23·7035	33·5221
10	100	1,000	0·1000	18	0·0480	0·0520	7112·0050	10058·0545	71·1200	100·5805

Table III.—Silk Gauze.

No. 5	64	4,096	262,144	0·0156	..	0·0035	0·0121	564473·3542	798299·2823	137·8108	194·8972
10	106	11,236	1,191,016	0·0094	..	0·0030	0·0064	3812697·2656	5394798·2220	339·3287	480·1351
15	148	21,904	3,241,792	0·0068	..	0·0020	0·0048	9042241·0303	12787626·6381	417·3777	583·3467

Table IV.—Stout Silk Grit Gauze.

26	676	17,576	0·0384	..	0·0010	0·0374	19115·5482	27033·5413	28·2774	42·4474
70	4,900	343,000	0·0142	..	0·0004	0·0138	380507·5812	538115·8247	77·6546	109·8195

cent. coarser, and may be irregular, with lines of holes larger or smaller. The wire may not be round nor all of the same gauge either in warp or shoot.

In making a long length of wire the hole through which it is drawn wears so that the wire is a shade smaller in diameter at one end than at the other. The temper, again, of the metal may be uneven, allowing of unequal bend at different parts. Notwithstanding all this the average is good enough for most purposes.

Relative Capacity of Meshes.—It is well to avoid fine meshes as far as possible, especially in dealing with a large bulk of material, for by their use the process of sifting is lengthened, it is made more expensive, more power is expended, the material being treated is more rubbed, more machinery is required, the wear and tear is increased, and the renewal is more costly.

The supposed necessity for fine numbers is often the result of previous bad work, and is generally resorted to as a cure for evils that need not exist. By my third table it will be seen that No. 5 (64 mesh) silk passes twice as much as No. 10 (106 mesh), and nearly three times as much as No. 15 (148 mesh), and these proportions are greatly increased when much of the material is fine. Moreover, there are means of obtaining fine results through coarse meshes.

Separation.—In dealing with material of mixed sizes—some normal some large, and some small — over woven wire of such a mesh as just to allow the normal to pass through, the small will pour through such holes as are not blocked or partially closed by the larger pieces laying over the holes, and in their hurry these smaller will also tend to obstruct many of the normal that might otherwise have dropped through.

It becomes evident that in a mixture such as, for instance, one measure each of peas, wheat, mustard, clover, and dodder seeds, that it is economical to take the large off first. In this diagram the proportion necessary for each sieve is fairly shown by the length of the different lines representing the wires :—

Peas pass over.
Wire No. 4 ———
Wheat „
„ „ 8 ————
Mustard „
„ „ 10 —————
Clover „
„ „ 20 ——————————
Dodder passes through.

If the same mixture be fed on to a long screen, with the fine mesh at the head and the coarse at the tail in regular succession, the fine mesh not only has to bear the whole bulk passing over it, but needs to be of greater extent in consequence, and this inconvenience, although diminished at each mesh, continues all the way along the screen.

No. 20	10	8	4	Peas.
Dodder.	Clover.	Mustard.	Wheat.	

The length of each number of the wires has not been altered from the diagram above, but the screen would have to be longer, or some dodder will pass with the clover, some clover with the mustard, some mustard with the wheat, &c.

Sifting.—To take from a quantity of sand 10 per cent. that will not pass through No. 50 mesh I reckon it will need by my first table about 230 sieving actions to deal with a depth of 1 in., viz., 256, less 26 for the 10 per cent. of the coarse.

Put the sand into a No. 50 hand-sieve and shake the sieve until the separation is complete. It will be found that at first only the finest sand passes through, gradually it comes coarser as the process continues, till at last the largest particles that can possibly pass, go through, leaving the 10 per cent. of too large in the sieve. Therefore, on a screen of any considerable length it is necessary to have a succession of several meshes, coarse at the head and fine at the tail, to produce a result of average degree of fineness.

We have seen that the coarse particles impede the passage of the normal that could otherwise pass through the meshes; that the fine crowd the surface of the sieve and obstruct them; again, the normal may come the wrong way about, or get piled on the wires like an arch, and neither go through themselves nor allow others to pass; they may also come in contact with the wire more than once without passing through a mesh, and if their shape is irregular they may try several times before they are eventually worried through.

All these circumstances tend to upset one's calculations, but the author thinks they prove that the depth of the material on the sieve should be reduced as far as possible. For instance, No. 20, by my table, has in round numbers 28 cubic units over the whole surface of the wire, and requires 56 actions to make an inch deep of them pass through, but suppose we take a depth of only a quarter of an inch or 7 deep over the whole surface, which requires only 14 actions to pass all through, the trouble is greatly decreased, and in this way the calculations may be of service in regulating the right quantity of feed passing to successive machines clothed with different meshes of wire or silk.

CONCLUSION.

The speed even of water passing through a sieve is impeded by the wires, and a mass of material whose particles are not too large to pass through the meshes will rest on the surface of the wire till some action moves it. As an example, turn a peppercastor topsy-turvy and a little pepper is obtained by the action, but no more passes unless the castor is again shaken.

Work cannot be accomplished without labour. In the case of the hand sieve it is the man's arm, and in machinery the driving strap, that imparts the power. The advantages of the latter, are the more even speed and greater regularity of motion. Many motions can be given by dexterity to a hand sieve with as many different sifting results, and with machinery the number may be increased almost indefinitely.

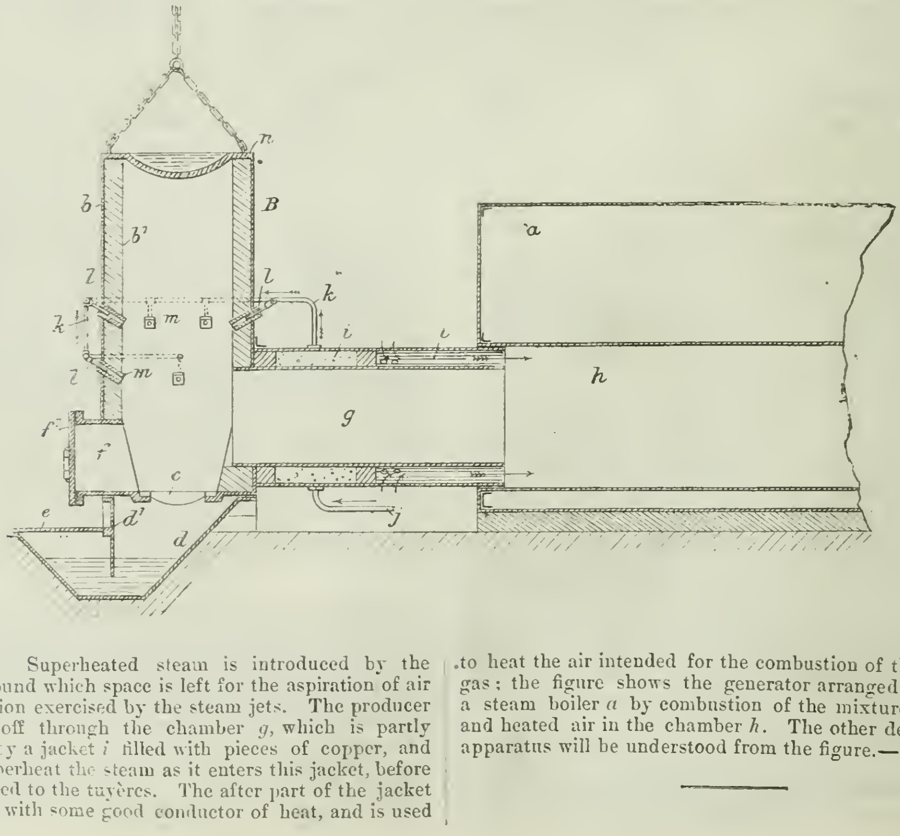
The relative value in sifting actions of these motions and combinations may probably be calculated for the different machines.

Segregation may be accomplished by many means. The author has restricted his observations to the use of meshes, but there are different methods of working even these; there are also different forces that can be utilised, and these methods and forces in combination form an endless variety of means for overcoming most difficulties.

PATENTS.

Improvements in Furnaces for the Generation of Heat or of Heating Gases. J. Blum, Spandau, Germany. Eng. Pat. 8097, April 29, 1892.

THE patentee claims protection for a new gas producer. The furnace for the generation of heating gases consists of a vertical fuel chamber (see figure), which is charged from above. Superheated steam is introduced by the tuyères *l l*, round which space is left for the aspiration of air by the suction exercised by the steam jets. The producer gas passes off through the chamber *g*, which is partly surrounded by a jacket *i* filled with pieces of copper, and serves to superheat the steam as it enters this jacket, before being supplied to the tuyères. The after part of the jacket *i* is packed with some good conductor of heat, and is used to heat the air intended for the combustion of the producer gas; the figure shows the generator arranged for heating a steam boiler *a* by combustion of the mixture of hot gas and heated air in the chamber *h*. The other details of the apparatus will be understood from the figure.—W. J. P.



Improvements in Filtering Plates and in the Method and Apparatus for manufacturing the same. L. A. Enzinger, Worms, Germany. Eng. Pat. 11,489, June, 20, 1892.

The invention has reference to the manufacture of filtering plates for use in the filtering presses described in Eng. Pat. 5982 of 1887.

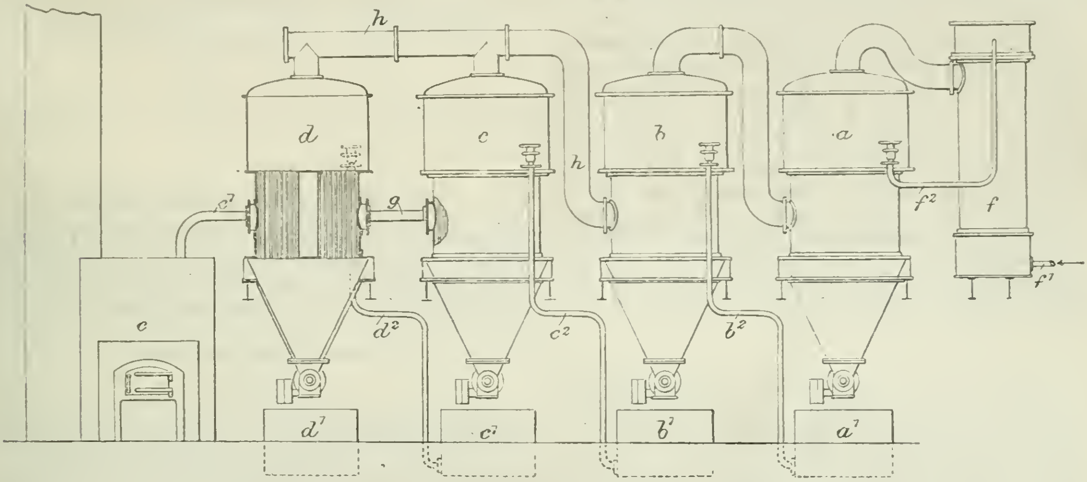
The improved plates are composed of a frame consisting of one or more compartments of rectangular, circular, or other forms, each provided on the inside with narrow strips for keeping in position the sheet of filtering material, within which strips the latter material is embedded. The plates are manufactured by placing the frames in a casing which is slightly adjustable sideways by means of springs, and perforated below. Wood, paper, or other pulp is then poured upon the frame and compressed into its place by means of the upper perforated plate of a hand press, the water flowing away through the upper and lower perforated plates. The pulp is prevented from being squeezed out sideways by the adjustable casing. When the filtering power of the prepared plates is exhausted they are knocked out and disintegrated in water into which steam is introduced. After being purified, the pulp may be used over again.—E. G. C.

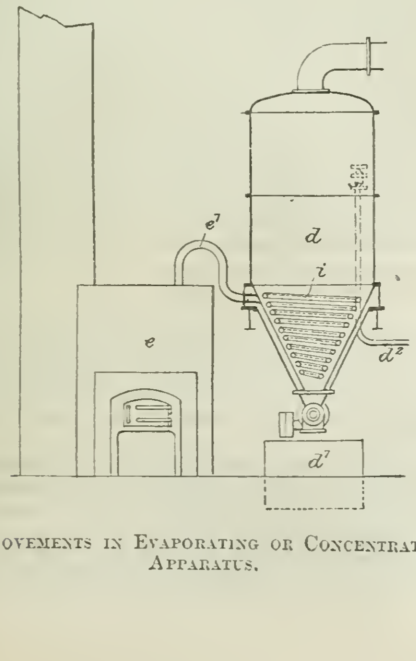
Process for the Separation and Recovery of Benzol, Alcohol, Ether, and other easily-volatile Substances from Air or other Gas. S. Pitt, Sutton. From C. Heinzerling, Frankfort-on-Maine. Eng. Pat. 12,390, July 4, 1892.

See under III., *page* 591.

Improvements in or Connected with Evaporating or Concentrating Apparatus. F. W. Scott and F. W. Scott, jun., London, and E. G. Scott, Liverpool. Eng. Pat. 13,103, July 16, 1892.

The apparatus is intended for the evaporation and concentration of liquids such as caustic soda, caustic potash, silicate of soda, and other liquids which boil at high temperatures and become viscous and of high density when concentrated. The invention is described with reference to a series of four evaporating pans, *a*, *b*, *c*, and *d*, the dilute liquid being contained in the first pan *a* and the concentrated liquid in the last two pans *c* and *d*, which latter are connected together. a^1, b^1, c^1, and d^1 are "tanks into which the contents of the evaporating vessels can be respectively discharged in a well-known manner." Superheated steam is passed into the heating system of the pan *d*, where it is nearly cooled to the temperature of boiling liquid contained therein, but not condensed, the condensation being effected in the pan *c*, and the condensation water discharged therefrom in any well-known manner. The steam from the evaporating liquid in the pans *d* and *c* is then conducted by a pipe to the heating system of the pan *b*, while the steam due to evaporation in the vessel *b* is used in the pan *a*; finally the vapour from the pan *a* is passed through a condensing apparatus containing a worm or coil in which the dilute liquid is heated before entering the system of pans. In a modified arrangement the superheated steam is injected into the liquid mass contained in the pan *d* by means of a perforated coil; the escaping steam from this pan is then carried to the heating system of the next pan and so on as before.—E. G. C.





Improvements in Evaporating or Concentrating Apparatus.

Improvements in Kilns and Furnaces, and in Steam Boilers used in connection therewith. A. Stein, Wetzlar, Prussia. Eng. Pat. 3862, February 21, 1893.

The present invention consists in surrounding the shaft of a kiln or furnace, constructed of metal plates, with a boiler in which steam is developed for driving machinery, &c.; the double purpose is thus served of utilising otherwise wasted heat and of preserving the furnace shaft from destruction by overheating. The steam boiler is so constructed in such combination that the water of the boiler

serves to cool the metal of the shaft, whilst the heat of the furnace serves reciprocally to generate steam in the boiler.
—W. J. P.

Improvements in Apparatus for Distilling and Condensing. W. E. Dennis, New York, U.S.A. Eng. Pat. 4852, March 6, 1893.

The liquid is evaporated in a cylindrical boiler with a conical end, and the steam or vapour therefrom is led away by a pipe to a row of cigar-shaped vessels placed vertically, where it condenses. The distilled liquid is afterwards removed by means of a pipe communicating with all the cigar-shaped condensing chambers.—E. G. C.

Improvements in or relating to Evaporating Apparatus. R. Haddan, London. Eng. Pat. 5434, March 13, 1893.

The purpose of the present invention is to improve the kind of evaporators used for evaporating the lighter or more volatile constituents from a liquid of any kind by means of corrugated or other heaters within a closed chamber maintained at a partial vacuum, the liquid to be evaporated being caused to flow in a film down the surfaces of the said heaters. When a liquid in a state of considerable heat is brought into contact with a heater it splutters and will not flow evenly down the surface of the same, whilst if the liquid is not previously heated a part of the heater is occupied in bringing the liquid up to the temperature of evaporation. To obviate these defects the incoming liquid is caused to circulate in a chamber at the top of the evaporator, so that the vapours therefrom may attemperate the liquid to the prevailing heat. The liquid is afterwards led into revolving troughs, which deliver it on to the face of the heater. Each heater is constructed of two flat or corrugated sheets of metal riveted or soldered together. The opening at the top is connected to a pipe which delivers the heating fluid, so that the latter may circulate through. Outlet pipes are provided below for the escape of the condensed liquid from the bottom of the interior of each heater.—E. G. C.

Improvements in Compositions for Self-Lubricating Bearings. O. Imray, London. From J. F. Newell, Gardiner, Maine, U.S.A. Eng. Pat. 6564, March 28, 1893.

The patent is claimed for a composition consisting of plumbago or graphite, a fibrous substance, an oil, and white lead, or a mixture of white and red lead, or equivalent substance, to unite with the oil and bind together the particles of plumbago or graphite and fibrous substance.
—J. L.

An Improved Apparatus for Extracting from Various Substances Matters soluble in Volatile Solvents. C. A. Allison, London. From the Merz Universal Extractor and Construction Co., of New York. Eng. Pat. 6919, April 4, 1893.

The apparatus is intended for extracting from garbage, in a cheap and inexpensive manner, such of its constituents as are soluble in volatile solvents, leaving a residue which may be of use as a fertiliser. The water and fatty matter are afterwards separated from the solvent, leaving the latter for use over again. The refuse is charged into a tank provided with a heating coil and steam injection at the bottom, and the solvent, such as benzene or naphtha, is run in from a tank and percolates through, finally passing out into a gravity separator below. The water, being of greater specific gravity than the solvent, remains at the bottom of the separator, and can be discharged; the solvent with its suspended matter afterwards pass into a vaporiser, where the solvent is vaporised, and escapes by a vertical pipe into a condenser above, leaving the fatty residue behind. The solvent, after condensation, is passed through a second gravity separator to remove any water which may have passed over with it, and it then flows into the tank ready for use over again. The fatty residue is discharged from the vaporiser through an overflow pipe. Use is made of gravity for the greater part of the separation to render the process as economical as possible.—E. G. C.

An Improved Filtering Apparatus. A. Southwell, Southampton. Eng. Pat. 12,272, July 2, 1892.

See under XVIII., *page* 614.

Improvements in Filters. S. A. Johnson, Middlesex. Eng. Pat. 13,376, July 21, 1892.

See under XVIII., *page* 615.

Apparatus for Cooling Liquids. W. H. Webb, Bootle, and J. Siddeley, Liverpool. Eng. Pat. 13,789, July 29, 1892.

See under XVIII., *page* 615.

Improvements in Automatic Distilling Apparatus. E. Rund, Pittsburg, U.S.A. Eng Pat. 8817, May 2, 1893.

See under XVIII., *page* 616.

II.—FUEL, GAS, AND LIGHT.

Apparatus for the Continuous Fractional Distillation of Crude Petroleum and Similar Liquids, also for the Manufacture of Gas from Petroleum and its Products. W. Schuchow and S. Gawrylow. Zeits. ang. Chem. 1893, 230—231.

See under III., *page* 590.

The Temperature of Ignition. A. Mitscherlich. Ber. **26**, 399—403 (compare this Journal, 1893, 436).

The author has investigated the effect of alteration of pressure on the temperature at which a mixture of oxygen and hydrogen in the proportion of 1:2 by volume explodes, and finds that at pressures less than one atmosphere, the temperature of explosion diminishes in the same proportion as the decrease of pressure, provided always that the experiments are made in precisely the same way. Alterations in the size and shape of the experimental tubes are attended by variations of the temperature of explosion. At pressures greater than one atmosphere the temperature of explosion is higher, but whether the same law is followed remains as yet undecided on account of the great experimental difficulties which were encountered. The author points out that his results are not in accordance with hitherto accepted views.—J. S.

An Investigation of Coals for making Coke in the Semet-Solvay Ovens, with the recovery of Ammonia and Tar; and Remarks on the Sources of Ammonia. J. D. Pennock. Trans. Amer. Inst. M.E., Montreal Meeting, February 1893; from Jour. Anal. and Appl. Chem. **7**, 135—151.

Twelve Semet-Solvay coke-ovens being in course of construction at Syracuse, N.Y., an investigation of various coals was made with a view to decide which were most suitable for coke-making in these ovens.

Twelve samples of coals were examined from the following sources:—1. Reynoldsville coal that had been exposed to the weather for a year. 2. Reynoldsville coal from a truck delivered direct from the mine. 3. Morris Run lump coal. 4. Morris Run fine coal. 5. Coal from the Fairmount Coal and Coke Company. 6. Special engine coal from Pardee colliery, Phillipsburg, Pa. 7. South Fork, Pa., coal. 8. Coal from Laceyville, Ill. 9. Pittsburg bituminous coal from ocean mines (gas coal). 10. Steubenville, Ohio, coal. 11. Evansville, Indiana, coal. 12. Coal from the Ohio Coal Company.

The proximate analyses of these samples dried at 90 C. were as follows:—

—	Volatile.	Fixed Carbon.	Ash.	Coke.	Water at 90° C.
1	31·14	64·49	4·37	68·86	..
2	33·00	58·07	8·93	67·00	..
3	17·73	71·92	10·35	82·27	..
4	18·12	71·89	9·99	81·88	..
5	37·20	56·68	6·12	61·88	..
6	23·86	73·00	3·14	76·80	..
7	15·51	78·60	5·84	84·14	..
8	41·60	41·15	5·04	46·19	12·20
9	39·09	57·33	3·30	60·63	0·28
10	40·44	53·60	2·07	58·67	0·88
11	38·48	43·74	11·04	54·78	6·73
12	42·27	45·92	10·16	56·08	1·64

1, 2, and 3 all produced a very good coke; 7 on account of the low volatile matter, produced a soft coke. The others produced hard cokes, but swelled, some more than others. If all these coals were available at the same price and made coke of equal quality, then the choice would fall upon the one that yielded most coke per ton of coal. 3 and 4 produced a coke in the laboratory equal to any of the others, and produced more coke than the others per cwt. of coal.

Impurities in the Coal and Coke.—3 and 4 are highest in ash, except 11. But even with this high amount of ash there is still more carbon in the cokes of 3 and 4 than in any of the others except 6 and 7.

Sulphur in the Coals and in the Coke made from them.—The following are the determinations of sulphur in the coals and cokes.

—	Sulphur in Coal.	Sulphur in Coke.
1	1·21 1·12	1·07
2	2·18 2·16	1·91
3	0·58 0·56	0·58
4	0·83 0·82	0·73
5	2·23 2·18	2·04
6	0·59 0·58	0·55
7	1·38	1·22
8	2·45	2·25
9	0·72	0·68
10	0·83	0·77
11	1·66	1·64
12	2·32	2·25

Excluding 6, from which a good coke cannot be made, 3, 4, and 9 are best as regards sulphur. 9 is, however, a gas coal. Sulphur occurs in coal in three forms:—1. As iron pyrites, FeS_2. 2. Combined with carbon and hydrogen. 3. As a fixed sulphate, usually calcium sulphate. For metallurgical purposes the first two forms are most objectionable. But when coke is burnt in kilns with limestone, sulphur in all forms is taken up by the lime and converted chiefly into calcium sulphate. When such lime is used for causticising sodium carbonate, it causes loss by converting sodium carbonate into sodium sulphate. In causticising a ton of carbonate of soda, lime containing 2 per cent. of calcium sulphate converts 42 lb. of carbonate of soda into sulphate of soda.

Analyses of the ash from the samples of coal are also given.

Nitrogen in Coal.—The nitrogen was determined both by Varentrapp and Will's soda-lime method and by Kjeldahl's method, as described in this Journal, 1886, 506. The results by the two methods agree very closely.

—	Per Cent. Nitrogen.	
	By Kjeldahl Method.	By Soda-lime Method.
1	1·96	1·92
2	1·62	1·57
3	1·30	1·40
4	1·31	1·26
5	1·96	1·87
6	1·85	1·78
7	1·32	1·29
8	1·02	..
9	1·37	..
10	1·21	..
11	1·12	..
12	1·16	1·15

It is generally considered in gasworks that the coal highest in nitrogen gives the greatest amount of ammonia. The same should be true in the Semet-Solvay ovens, since the temperature is not high enough to destroy ammonia. Two grms. of each of the first six coals were heated in a tube in a combustion furnace without air, and the ammonia expelled was determined. The operation was repeated with the addition of 2 per cent. of lime, which quantity would not injure the coke. More ammonia was recovered in every case when lime was used.

—	Per Cent. Nitrogen in Coal.	Per Cent. Nitrogen recovered by Dry Distillation.	Per Cent. of 100 parts N recovered by Dry Distillation.	Per Cent. N by Dry Distillation with 2 Per Cent. Lime.	Per Cent. of 100 parts Nitrogen by Dry Distillation with 2 Per Cent. Lime.
1	1·96	0·21	10·6	0·39	19
2	1·62	0·21	12·0	0·35	21
3	1·30	0·28	21·0	0·39	30
4	1·31	0·21	16·0	0·39	29
5	1·96	0·29	14·0	0·35	17
6	1·85	0·38	20·5	0·42	22

Sources of Ammonia.—The gasworks have up to the present time furnished the greatest part of all the ammonia made, but the author expresses the opinion that as gasworks cease to distil coal and make gas from oil: coke-ovens, gas producers, and blast furnaces will become the sources of ammonia. Reference is then made to these various methods of recovering ammonia.

Under the head of gas producers, Mond's process, as carried out at the Northwich ammonia-soda works, is described (this Journal, 1889, 505), and whilst speaking of coke-ovens reference is made to Jamieson's, the Simon-Carvés, Semet-Solvay, and Otto-Hoffman ovens (see also this Journal, 1884, 601—606). The three last named are all closed ovens, and all have regenerators for heating the air before it unites with the gas, which after the ammonia and tar have been recovered from it, is returned to heat the ovens. The greatest number of ovens of the Semet-Solvay kind is at Havre, France, where 100 are being worked successfully. The charge is four tons of coal to an oven, which is drawn every 22 hours. The coal used contains only 16 to 17 per cent. of volatile matter, and the full theoretical yield of coke is obtained by reason of the tightness of the oven. In actual practice the yield is 81 per cent. At Havre, where the coal is poor, 14 lb. of sulphate of ammonia and 31 lb. of tar are recovered per ton of coal, but at the Brunner-Mond works at Northwich, where a better coal is used, 25 to 27 lb. of sulphate and about 82 to 84 lb. of tar are obtained per ton of coal.

Benzene from closed Coke-Ovens.—According to Lunge, 1 ton of good bituminous coal yields 11,000 cubic feet of gas, containing 25·7 lb. of benzene. By cooling the gas to —70° C. this benzene is condensed. The best result thus far obtained in removing benzene from coke-oven gas is 17 lb., or about 69 per cent. of the theoretical amount.—H. S. P.

PATENTS.

An Improved Process for the Purification of Coal-Gas. C. F. Claus, London. Eng. Pat. 2838, June 28, 1881. (Second Edition.)

The carbon dioxide and the sulphide of hydrogen are removed from coal-gas by aid of "anhydrous or uncondensable gaseous ammonia," which, if it is in a truly gaseous state before using, thoroughly mixes with the coal-gas and readily takes up all impurities without condensation into a liquid taking place. With aqueous ammoniacal vapour condensation always takes place, and an excess of ammonia must be used, which necessitates the use of a large quantity of water for effecting its subsequent removal. By the use of anhydrous ammonia the complete removal of the carbon dioxide and sulphide of hydrogen is effected without an excess of ammonia being needed, and the use of excessive quantities of water for removing it is avoided. The method of preparing the anhydrous gaseous ammonia from the liquors that have been purified according to Hill's Eng. Pat. 1369 of 1868 is described, and stated to be different from that described in Hill's Eng. Pat. 510 of 1870, the difference being that the liquor is cooled before it is admitted into the stills.—R. B. P.

Improvements in Furnaces for the Generation of Heat or for Heating Gases. J. Blum, Spandau, Germany. Eng. Pat. 8097, April 29, 1892.

See under I., *page* 584.

An Improved Apparatus for the Manufacture of Gas for Lighting and Heating, and for use in Gas Engines. H. J. Rogers, Watford. Eng. Pat. 8892, May 11, 1892.

The patentee has devised a more compact form of gas producer than, as he believes, has hitherto been employed, thus simplifying the process of working, and minimising loss of heat. The producer itself is a vertical cylindrical furnace, the interior being lined with some refractory material in which is embedded a steam generator consisting either of a coil of pipes or of a tubular boiler. The superheated steam is led from the generator under the grate bars by means of an injector, which also draws in atmospheric air; if illuminating gas is required, oil is also injected from a suitably arranged tank. The ash-pit is hermetically luted, and a lever working on a fixed fulcrum in the ash-pit and carrying the necessary number of arms passing between the grate bars, serves for clinkering. The feed-valve is so arranged that by removing a loose cover the state of the fire can be observed. The gas passes from the producer through a condenser for heating the feed-water, and the air injected into the grate may be previously heated by drawing it through a coil of pipes placed in the ash-pit.—W. J. P.

Improvements relating to the Utilisation of Liquid Hydrocarbons for Lighting and Heating Purposes, and to Apparatus therefor. F. B. Hill, London, and R. D. Brett, London. Eng. Pat. 9265, May 16, 1892.

This invention has for its object the production of high-power lamps for "search lights," lighthouses, &c., burning liquid hydrocarbons. The oil is fed under pressure into a vaporising chamber, the vapour there produced is forced, together with an induced current of air, into a mixing chamber by means of an injector, and passes through the burner, which has an annular orifice. The mixed vapour and air burn here, and, turning back through the centre of the burner, pass along the chimney, the latter passing concentrically through the vaporising and mixing chambers.—R. B. P.

Improvements in Regenerative Furnaces. E. J. Duff, Glasgow. Eng. Pat. 12,667, July 9, 1892.

The improvements relate to the construction and arrangement of the regenerative chambers and their connecting flues. The regenerators are placed underneath the furnace and are preferably circular in plan. At the end of the reverberatory chamber there are vertical flues connecting the regenerator with the furnace; these flues are continued below the part leading to the regenerators, their lower ends being enlarged, to serve for collecting slag, dust, &c., which can be removed periodically through doors provided for the purpose. The regenerative chambers can be covered with comparatively light roofs, as they have no superstructure to support. The hot gases entering at the top of these chambers diffuse evenly over the checker-work instead of being concentrated on small portions of it.—R. B. P.

Improvements in Apparatus for Manufacturing Oil-Gas. The Northern Counties Hydro-Oxygen Gas Co., Lim., and P. B. W. Goble, both of Manchester. Eng. Pat. 12,924, July 14, 1892.

The retorts are set in groups of four, in a furnace chamber supplied below with flame and hot products of combustion from a furnace. Each retort is inclined in the opposite direction to, and connected to the end of, the one above it, thus forming a zig-zag channel. The oil is supplied from an hydraulic main running along the top, from which oil is fed into the higher end of the top and third retorts through siphon bends projecting some way into the retorts. From the ends of the retorts two vertical pipes lead the gas to the upper part of the hydraulic main already referred to, where any oil vapour is condensed. A second hydraulic main to receive tarry residues is provided.—R. B. P.

Apparatus for the Manufacture of Gas. J. Gray, Bradford, U.S.A. Eng. Pat. 23,419, December 20, 1892.

This invention consists of the combination of a gas generator in gas-producing apparatus, a blast device connected with the upper and lower parts of the generator, gas connections from the upper and lower parts of the said generator to a second gas generator, and one or more retorts located in the combustion chamber of the second generator, and communicating with the combustion chamber, the whole system being provided with suitable valves. Air and steam are blown alternately into the top and bottom of one or the other of the generators, and the resulting water-gas, mixed with oil vapour, is passed through the second generator and its retorts. Each generator is also capable of being worked singly whilst the other is being charged.—H. K. T.

Improvements in Kilns and Furnaces, and in Steam Boilers used in connection therewith. A. Stein, Wetzlar, Prussia. Eng. Pat. 3862, February 21, 1893.

See under I., page 585.

A Combined Gas and Coke Furnace. H. Schomburg, Berlin, Germany. Eng. Pat. 7002, April 5, 1893.

This furnace is in two parts, the front consisting of a gas retort, constructed of masonry or moulded, with an inclined fire-grate; the back part is termed a "gas and coke generator."

The gas from the coal on the inclined fire-grate is rapidly driven off; the fuel, in the form of coke, passes into the back part of the furnace, which is widened out to twice or more times the width of the fire-grate at one part, and reduced to a half or less of the width of the fire-grate at its upper part, where the outlet is. The coke is converted into carbon monoxide, which burns without smoke. Air, heated in passages built in the walls of the furnace, is admitted round the lip of the outlet to obtain the maximum effect from the fuel. The furnace is shown attached to a steam generator. Briefly, then, the improved furnace consists of a gas-retort, in which solid fuel is first partly consumed, and then passes on to a second combustion chamber, where the combustion is completed.—R. B. P.

Improvements in Coke-Ovens. T. Bauer, Berlin, Germany. Eng. Pat. 20,769, 1892; April 8, 1893.

The inventor has devised a horizontal coke-oven between each pair of combustion chambers of which is an intermediate space provided with suitable pipes and serving for the preliminary heating of the gas and air employed in the combustion. Special arrangements are made to ensure uniform mixture of the air and gas before burning; channels are also provided, which are fitted with dampers and arranged along the series of furnaces above the furnace chambers and combustion chambers, and so connected with these, by openings, as to enable the furnaces to be closed or controlled at will, completing an arrangement which also allows of any oven being detached from the series for repairs.

These arrangements admit of a series of furnaces being operated partly direct and partly by condensation.—W. J. P.

Improvements in Apparatus for the Manufacture of Carburetted Water-Gas. L. L. Merrifield, Franklin, Mass. J. T. Westcott, Cramers Hill, N.J., U.S.A., and W. H. Pearson, Toronto, Canada. Eng. Pat. 8371, April 25, 1893.

This apparatus consists of a generating chamber and a set of superheating or fixing chambers; the latter are contained in a single shell, being separated from one another by arched partitions provided with openings for the passage of products of combustion from one chamber to the next. Each fixing chamber is partially filled with checker-work. The lowest chamber has two air-blast inlets, one at the upper and the other at the lower end, where there is also a gas exit pipe. All the chambers have supply pipes for admitting hydrocarbon vapours or liquids. The top chamber has, in addition, two exit branches at its upper end, one for the water-gas and the other leading to a chimney flue.

The generating chamber has a grate, below which are two inlet pipes, one for an air blast and the other for steam; also two outlet flues, one leading to the lower end of the lowest fixing chamber and the other to the upper end of the top chamber. Near the top of the generating chamber is another steam inlet and another pair of exit flues leading to the same places as the lower pair; all four flues are fitted with valves for controlling the direction of the gases leaving the generating chamber. Fuel is introduced through a top charging door, ignited, and the lower air blast turned on; "producer" gas is formed and passes out through one of the top exit flues to the lowest fixing chamber, where it meets with air from the two blast inlets in this chamber and burns. The products of combustion pass up through all the chambers heating the checker-work, and out through the top exit to the chimney flue. When the flue and checker-work have attained a sufficiently high temperature all the air blasts are shut off and the exit to the chimney closed. Steam is then admitted by the inlet under the grate, and, passing up through the fuel, becomes converted into water-gas. This passes through one of the top exit flues to the lowest fixing chamber and becomes superheated by the checker work. Hydrocarbon vapour is admitted into the top of this chamber, where it is gasified and mixes with the water-gas. The mixture passes through the checker-work in the other chamber and the gasified hydrocarbon becomes "fixed" in the water-gas. It then passes out through the top gas exit to the scrubbers, &c. When the fuel in the generating chamber ceases to decompose the steam all the valves at the time open are shut. The heating-up process before described is then repeated. When this is effected the production of water-gas is again commenced by opening the upper steam inlet; the steam now travels downwards through the fuel, out of one of the lower exit flues, to the top of the uppermost fixing chamber, is mixed therein with gasified hydrocarbon vapour, and passes down through the other chambers to the lower gas exit and on to the scrubbers. The heating-up process is again gone through, and so on, the direction in which the steam and water-gas pass through the fuel and fixing chambers respectively being alternately upwards and downwards.—R. B. P.

Improvements relating to the Manufacture of Gas. H. H. Lake, London. From W. H. Harris, Boston, U.S.A. Eng. Pat. 12,441, July 5, 1893.

The process is one for making gas in a single generator and regenerator or fixing chamber. Steam, preferably superheated, is mixed with highly-heated products from the combustion of bituminous coal or similar substances; the mixture is then passed over a mass of highly-heated fire-resisting material and becomes converted into gas. The first process is conducted in a slightly conical combustion chamber. This is closed at the top by a conical charging valve, through which the coal is introduced. At the lower end are tuyères for supplying a hot blast to the burning coal. Steam is admitted above the layer of coal at right angles to the ascending products of combustion, whereby a thorough mixing is effected. The mixture passes through an outlet at the upper part of the combustion chamber into the regenerator or fixing chamber, which consists of a serpentine flue filled with balls of fire-resisting material. A superheating coil for the steam and an annular chamber for heating the blast are built into the walls of the combustion chamber in order to economise heat. Means of enriching the gas for illuminating purposes are described. The process is continuous.—R. B. P.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

An Improved Method of Purifying Toluene, Benzene, &c. R. J. Friswell. Chem. News, 68, 1893, 27.

Of late years the demand for toluene has so much increased that large quantities of the by-products from the oil-gas factories have been worked up to recover the toluene and benzene which Armstrong some years back discovered in them.

This has caused much trouble in separating traces of paraffins, which, though not so troublesome with benzene, render toluene almost unworkable, unless treated in a special manner. These substances are not indicated by any variation of the boiling-points, which are now uniformly good, but can be at once detected by vigorously shaking the sample with an equal volume of pure sulphuric acid of 1·842 sp. gr.

Under these circumstances a sample made from pure coal oils separates sharply into two layers when allowed to rest after shaking, and the acid is colourless, or of a very faint brown tint, and remains so for 24 hours or more.

On the contrary, the samples contaminated with these bodies form an emulsion, which takes five to ten minutes to separate completely, and the acid is more or less bright orange-coloured. In about one hour the surface of the acid is deep green, and this tint gradually spreads through the liquid, so that in 10 to 12 hours the whole is deep green, or even black, while a distinct odour of sulphurous acid is easily detected.

A sample of toluene behaving in this way may be at once rejected by anyone desiring to avoid an immense amount of trouble in working it.

It is, however, an easy matter to render toluene quite equal to the best samples prepared from pure coal oils by a very simple and inexpensive treatment.

It is, of course, well known that agitation with concentrated oil of vitriol will effect the removal, by solution, of most of these bodies; but unfortunately at the same time great loss of toluene occurs, owing to its easy solubility in the acid. Its recovery by hydrolysis is, needless to say, an expensive operation.

It is no secret that many makers have used fuming acid, and have alleged that, notwithstanding increased loss, it has proved cheaper to use than ordinary vitriol. The use of oxidising agents dissolved in the vitriol has been found quite ineffective.

The movement in the direction of stronger acid is an entirely erroneous one, and the secret of success lies in an opposite direction.

It is quite possible to employ an acid too weak to dissolve the toluene, but quite strong enough to wash out the paraffins, but this treatment is rendered expensive by reason of the large volume of acid and number of treatments required. It is, however, possible to make use of an acid which shall act in a different manner, viz., render the paraffin-like bodies, part of which it dissolves, much less volatile by polymerising them.

This may be carried out as follows:—Crude toluene boiling between 110°—130° C. is agitated thoroughly for four hours with 10 per cent. by volume of sulphuric acid of sp. gr. 1·803. It is allowed to rest, and drawn off from the acid in the usual manner, and washed once with enough caustic soda to remove traces of acid. Very thorough agitation is necessary, and certain samples may require more acid or a longer time of treatment. The loss should not exceed 5 per cent. About half of this is due to the paraffins removed.

It is then at once transferred to the rectifying still, and the pure toluene taken off. This will be found by the acid test quite equal to the best toluene made from coal oils. In fact 95 per cent. of the distillates will pass this test.

The residues in the still consist partly of the polymerised bodies, their boiling-points lying between 260° and 285° C.

The waste acid on dilution deposits a deep green oil, which, when nearly free from acid, is soluble in water. When distilled with water a very heavy oil comes over with the distillate. The acid cannot be recovered unless this substance is separated by dilution, as, if heated directly as drawn from the toluene, it evolves large volumes of sulphurous oxide and becomes nearly solid from separation of carbon.

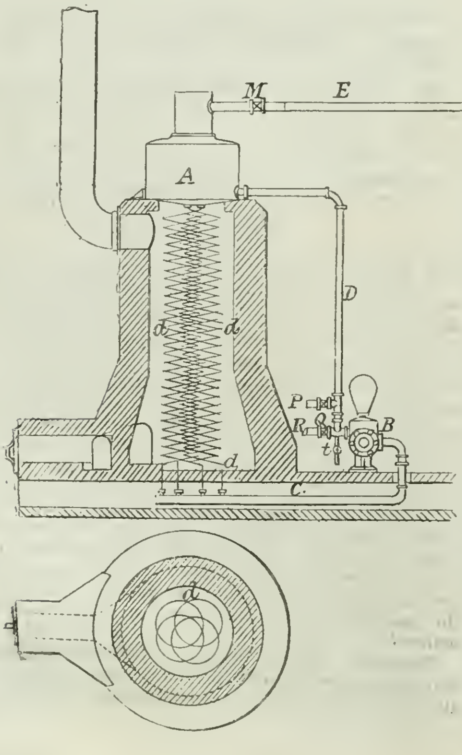
A Study of Californian Petroleum. F. Lengfeld and E. O'Neill. Amer. Chem. J. **15**, 19.

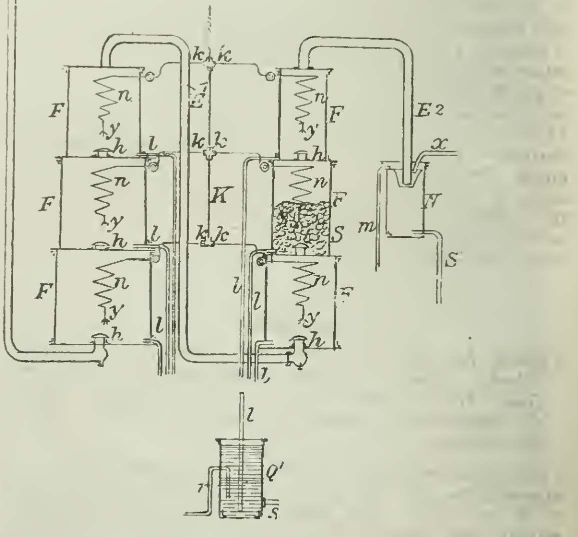
The industry in Californian petroleum has now reached large dimensions, the production in 1888 attaining 705,000 barrels (40-gall.); but nevertheless the oil has not hitherto been subjected to systematic investigation.

This is a preliminary notice of an exhaustive fractionation of a specimen from Pico Cañon (Los Angeles). The crude petroleum has a sp. gr. 0·8414 at 15°, and a refractive index 1·4810 at 14° C. A quantity of 18 litres was fractionated at 40°—300° C., collecting at every 10°, and refractionating these fractions at 5° interval. The fractions were, on the whole, uniform in amount, with a tendency to collect in larger amounts at 75°—85°, 150°—160°, 190°—200°, and 240°—250° C. The increase in gravity from 0·6344 to 0·8649, and in refraction from 1·3669 to 1·4824, is regularly maintained throughout the fractions.—C. F. C.

Apparatus for the Continuous Fractional Distillation of Crude Petroleum and similar Liquids: also for the Manufacture of Gas from Petroleum and its Products. W. Schuchow and S. Gawrylow. Zeits. ang. Chem. 1893, 230—231.

The crude petroleum or residues from petroleum distillation are drawn through the pipe R and delivered by means of





the pressure pump B through C, into a series of coils *d*. These are walled in an oven and exposed to a high temperature. According to the temperature employed the liquid entering the coils is either volatilised or undergoes destructive distillation. To produce the latter, the heating is effected under pressure by closing the taps M and F.

The escaping vapours or gases, as the case may be, pass into the cylinder A, from which any condensed vapours are either simply drawn off for further use by means of pipe D and tap P, or sent back into the coils through the pump by opening tap Q. Part of the liquid to be distilled may also be pumped directly into A, which will then act as a dephlegmator.

If high boiling oils or residues are worked it will be found useful to introduce, by means of the by-pass *t*, the first runnings from petroleum, as gasoline, petroleum ether, &c.

The vapours or gases leaving A by means of pipe E are conducted into a series of cylinders F, entering them at the bottom *h*, and leaving at the top. The vapours or gases are met by a fine spray of cooling liquid (having a lower boiling-point than the vapours to be condensed), which is introduced into the condensers F by means of pipes K, *k*, and coil *n*, ending with the rose *y*. Thus it is possible to condense, *e.g.*, by one pound of injected water eight pounds of vaporised petroleum. The vapours that have not been condensed in F are finally conducted into N, where they are met on entering through pipe E_2 by a jet of water *x*. The condensed water runs away through S′, being heavier than the oil which is drawn off through pipe *m*.

The vapours condensed in F flow whilst still hot into boxes Q′, through which a stream of water is kept running; the oil separates from the water in these boxes and is run off at convenience.—J. L.

Products of Destructive Distillation of Wood: Methyl-furfurol and Methyl-pyromucic Acid. H. B. Hill and W. L. Jennings. Amer. Chem. J. **15**, 159.

The authors have separated methyl-furfurol from the higher boiling fractions (175° C.). A determination was also made of the relative yields of furfurol and of this homologue by fractionating 50 kilos. of the crude oils. Of the former (represented approximately by the fraction 160°—165°) 60 per cent. was obtained; of the methyl derivative (fraction 182°—186°) 2 per cent. was obtained, calculated on the original oil.

The pure product boiled at 187°, and the sp. gr. at 18° was 1·1087. Oxidation by silver oxide was found to give a high yield of methyl-pyromucic acid (m.p. 108—109°), viz., 84 per cent. of the theoretical quantity. By treatment with bromine at low temperatures a tetra-bromo derivative is obtained; at ordinary temperatures a bromomethylpyromucic acid (m.p. 150°—151°) with the Br in the furfuran ring; at higher temperatures (50°—60°) the Br enters the side chain and forms ω-bromomethyl-pyromucic acid (m.p. 147°—148°). The authors have also prepared a dibromo derivative with one Br in the C_4 ring, the other in the side chain. By the action of water the Br atom in the side chain in both these derivatives is replaced by OH. From the fractions of the original oil boiling at 200°—225° the authors isolated guaiacol (this Journal, 1885, 151—157; and 1892, 395—403).—C. F. C.

PATENTS.

Process for the Separation and Recovery of Benzol, Alcohol, Ether, and other easily-volatile Substances from Air or other Gas. S. Pitt, Sutton. From C. Heinzerling, Frankfort-on-Maine, Germany. Eng. Pat. 12,390, July 4, 1892.

The vapour-laden air or other gas is compressed to 2—6 atmospheres, and then cooled in a suitable condenser to 8° C. or 10° C. The compressed and cooled gaseous mixture next passes through a series of surface condensers, consisting of nests of pipes cooled externally, to a motor cylinder, in which it is allowed to expand and perform work. This causes a further reduction of its temperature, and the expanded and cooled gases passing from the motor cylinder round the pipes of the surface condensers act as the cooling medium. The work performed is used to assist the gas compressor. By suitably proportioning the condensers, &c., the compressed gases may be cooled down to from − 25° C. to − 10° C., and in the motor cylinder to from − 60° C. to − 80° C. To prevent the blocking of the motor cylinder by solid products of condensation, spiral conductors, which can be heated by an electric current, are placed round the outlet and inlet pipes and the valves.

Any solid products forming in the condensers are got rid of by admitting some of the original uncooled uncompressed gaseous mixture.—R. B. P.

Safety Arrangements for Floating and Stationary Inflammable Oil Storage Tanks. B. H. Thwaite, Liverpool. Eng. Pat. 12,860, July 13, 1892.

To allow any gases evolved from the oil to escape, and at the same time to prevent the ingress of air on the contraction of the oil, escape pipes, which terminate in an hydraulic seal, or are led through the side of the vessel below the water line, are fitted to the top of the storage tanks. To compensate for excessive contraction of the oil means for introducing fresh oil or gas are provided. To prevent the formation of an explosive mixture in the tanks when they are emptied, the use of carbon dioxide, or steam, for filling up the space left vacant by the outflowing oil is claimed, so also is the use of a refrigerating medium passing through water jackets, pipes, coils, &c., for keeping the temperature of the oil below its flashing point or that of volatilisation. Inclined floors, provided with collecting wells placed below the tanks, for dealing with leakage, are described and claimed.—R. B. P.

IV.—COLOURING MATTERS AND DYES.

The Constitution of the Colouring Matters of the Rosaniline Group. A. Rosenstiehl. Comptes rend. **116**, 1893, 194—197.

Hofmann's researches on the constitution of rosaniline were carried out on a salt which he considered to be a trihydrochloride. This substance it is impossible to obtain in a state of purity by the wet way, as it loses acid before giving up all its water, nevertheless on analysis it always gives more chlorine than is required for three atoms, but less than four to the molecule of rosaniline. By treating the dry colouring matters with dry hydrochloric or hydrobromic acid gas, diluted with air to moderate the action, and subsequently exposing the products *in vacuô* over sulphuric acid for two or three days to remove the excess of acid absorbed, or by passing over them a stream of dry cold air, the weights are found to remain constant, and the substances may be obtained pure. They have not the metallic lustre characteristic of the original colouring matter, but their aqueous solutions have the usual colour, yet if allowed to deliquesce the colour of the liquid is different. The poly-acid salts of rosaniline are not stable, but the methyl derivatives are more so. The author prepared and analysed the following compounds:—rosaniline hydrochloride (C_{19}) and hydrobromide, hexamethylrosaniline hydrochloride and hydrobromide, and tetramethyldiamidotriphenylcarbinol hydrochloride and hydrobromide, and found in the first four cases that the amount of halogen present agreed closely with that required for four atoms in the molecule, and in the last two for three atoms per molecule.

Rosaniline and its congeners, therefore, present to acids two distinct properties: they are mainly alcohols, but are also basic, and these compounds stand midway between alkaline bases and alcohols. Rosaniline itself is no triamine, but the colouring matters derived from it are the ethereal salts of tertiary amido-alcohols of the aromatic series.

—F. H. L.

Azo Derivatives of Pyrocatechol. O. N. Witt and F. Mayer. Ber. **26**, 1072.

The trustworthiness of the so-called law of Griess, that only those diamines and dihydroxyhydrocarbons which contain the substituting groups in the meta position are susceptible of combination with diazo compounds, had already been shaken by the observation of one of the authors (O. N. Witt, Ger. Pat. 49,979 and 49,872, 1889) that naphtho-quinol (naphtho-pyrocatechol) unites in the usual way with diazo compounds to form beautiful azo dyes. The authors now find that the typical pyrocatechol itself, under suitable conditions, reacts energetically with diazo compounds. A direct and an indirect method are described, success being dependent upon the choice of the solvent, the concentration of the solutions, and the addition of suitable reagents for the fixation of the acid liberated during the reaction.

Direct method.—Aniline-azo-pyrocatechol—

$$C_6H_5.N = N.C_6H_3(OH)_2$$

A mixture of an alcoholic solution of pyrocatechol with a very concentrated solution of diazo benzene chloride is allowed to stand for some time and then poured upon ice, whereupon the dye separates as a garnet-red precipitate, which may be purified by boiling once or twice with an aqueous solution of ammonium acetate, and finally by recrystallisation from alcohol. Three modifications are described.

Paratoluidine-azo-pyrocatechol—

$$CH_3.C_6H_4.N = N.C_6H_3(OH)_2$$

may be prepared in exactly the same way.

Paranitraniline-azo-pyrocatechol—

$$C_6H_4NO_2.N = N.C_6H_3(OH)_2$$

13·8 grms. of paranitraniline are dissolved in 60 cc. of glacial acetic acid, and 20 cc. of concentrated hydrochloric acid added. The solution, which may be cooled to 0° C. without yielding a precipitate, is diazotised by the addition of the necessary quantity of sodium nitrite in concentrated aqueous solution, and poured into a concentrated aqueous solution of pyrocatechol mixed with the calculated quantity of sodium acetate. The colouring matter separates at once in a blood-red crystalline form. The diacetate is prepared by warming the substance thus obtained with acetic anhydride and dry sodium acetate on the water-bath, and may be recrystallised from methyl alcohol.

Indirect method.—Starting from the fact that guiacol combines with diazo compounds, the authors endeavoured to find a mono-ether of pyrocatechol possessing a similar property and, at the same time, the power of easily detaching the radicle contained therein. This body they secured in pyrocatechol monobenzoate. It is easily obtained by stirring intimately together an aqueous solution of pyrocatechol with the theoretical quantity of benzoyl chloride, and then adding a solution of caustic soda. The precipitate formed is collected, moistened with methyl alcohol, dried, and recrystallised from a large quantity of water. It combines easily with diazo compounds. With diazo benzene, pale yellow leaflets, soluble in dilute alkalis, are obtained. On heating, saponification immediately sets in; the benzoyl group is detached with formation of the aniline-azo-pyrocatechol already described.—Ed. T.

Chemical Investigation of Handwriting. A. Robertson and J. J. Hofmann. Pharm. Centr. 1892, **33**, 225.

See under XXIII., *page* 628.

Ortho-, Para-, and Peri-Disulphonic Derivatives of Naphthalene. Henry E. Armstrong and W. P. Wynne. Proc. Chem. Soc. 1893 [126], 166–168.

In a previous communication, dealing with the results of the examination of a large number of disulphonic acids (this Journal, 1890, 802), attention was drawn to the "'invincible objection' of two sulphonic radicles to *remain* in either contiguous or para- or peri-positions" relatively to one another when disulphonic acids are formed by the action of sulphuric acid either on naphthalene or on the chloro-, amido-, or hydroxy-naphthalenes. Further investigation has failed to supply a single exception to this rule, and it is noteworthy that of the known disulphonic acids only two —the No. II. α-naphthylaminedisulphonic acid of Dahl & Co.'s German Patent No. 41,957 (*loc. cit.*, p. 799), and the minor product of the sulphonation of potassium 2:3′-chloronaphthalenesulphonate contain the two sulphonic radicles relatively in the positions 1:2′, the favoured positions being 1:4′, 2:4′, 2:2′, and 2:3′, the position 1:3 being taken up only in the case of sulphonation products of certain β-chloro- and β-amido-naphthalenesulphonic acids. Moreover, while the number of naphthalenedisulphonic acids obtainable, either by the sulphonation of naphthalene or by eliminating the NH_2 radicle from naphthylaminedisulphonic acids amounts to six, it is very significant that only two naphthylaminetrisulphonic acids—the 1:3:2′- and 1:3:3′-derivatives—can be obtained by sulphonating naphthalene, and that the only trisulphonic acids obtained by sulphonating the naphthols and naphthylamines contain their sulphonic radicles relatively in one or other of these positions.

While preparing the final account of seven years' investigations the authors endeavoured in various ways to prepare the missing acids containing the sulphonic radicles in the positions which are avoided in all products of direct sulphonation, so that their behaviour towards sulphonating agents might be studied in order that the explanation of this remarkable law of substitution might be given. While engaged in these experiments the authors learnt that a process had been devised in the laboratory of the Farbenfabriken vormals F. Bayer and Co., of Elberfeld, which made it possible to prepare all the acids the authors were in search of.

The process consists in displacing the amido-group in a naphthylamine derivative by SH and oxidising the resulting thio-derivative by means of alkaline permanganate; the thihydride is prepared by Leuckart's method (J. Prakt. Chem. [2], **41**, 218) by submitting the diazo-compound prepared from the amine to treatment with potassium xanthate and hydrolysing the resulting xanthate. The thihydride thus formed being unstable in presence of oxygen, the corresponding disulphide is usually obtained. The process is described in the German Patent Anmeldung F. 6099, Cl. 22, of the Farbenfabriken vorm. Friedr. Bayer and Co., Elberfeld, in which an account is given of three new disulphonic, seven new trisulphonic, and two tetrasulphonic acids of naphthalene. By means of the description given the authors have been able without the slightest difficulty to prepare the various acids.

In the present note only three new disulphonic and one new trisulphonic acid are referred to: the remaining acids will be described in a later communication. On treatment with phosphorus pentachloride, the 1:1′- and 1:2-acids yield products which apparently are the corresponding anhydrides. This behaviour is of interest, as an extension of the observations made in V. Meyer's laboratory on the formation of anhydrides of disulphonic acids of thiophen. It is remarkable that the R-acid, in which there are two contiguous β-sulphonic groups, has not been found to yield an anhydride.

In the first instance the authors availed themselves of the method for preparing from the (Badische) 1:2′-β-naphthylaminesulphonic acid the 1:2′-naphthalenedisulphonic acid previously discovered by them (this Journal, 1890, 799). The product is identical with that obtained from Dahl's No. II. α-naphthylaminedisulphonic acid, and thus an independent proof is afforded of the somewhat remarkable constitution assigned to this acid.

1 : 1′-*Naphthalenedisulphonic acid*, $C_{10}H_6(SO_3H)_2$, was prepared from the Schöllkopf 1 : 1′-α-naphthylaminesulphonic acid.

1 : 2-*Naphthalenedisulphonic acid* was obtained from the Landshoff and Meyer 1 : 2-α-naphthylamine sulphonic acid.

1 : 4-*Naphthalenedisulphonic acid* was prepared from naphthionic acid.

2 : 2′ : 3′ - *Naphthalenetrisulphonic acid*, $C_{10}H_5(SO_3H)_3$, was obtained from 2 : 2′ : 3-β-naphthylaminedisulphonic acid (amido-R-acid).

The method of substituting the SO_3H radicle for NH_2 has been extended to the chloro-β-naphthylaminesulphonic acids, and in particular to the 1 : 2 : 2′- or "No. 3" acid, with the object of comparing the product with the α-chloronaphthalene-2 : 2′-disulphonic acid obtained from Alén's α - nitronaphthalene-2 : 2′ - disulphonic chloride, to which Clève attributes a like constitution (Ber. **25**, 2490). The authors take this opportunity of stating that further investigation has shown that, contrary to their previously expressed view (this Journal, 1890, 802), the No. 2 and No. 3 acids have an independent origin.

By the discovery of the disulphonic acids here described, we are now placed in possession of nine of the ten possible acids. The authors have previously characterised the ten possible dichloronaphthalenes and the two homonucleal trichloronaphthalenes; they have now all but completed the study of the remaining twelve trichloronaphthalenes, having converted them into sulphonic acids, &c., in order that it may be possible to characterise them beyond question.

Supplementary Notes on Madder Colouring Matters

E. Schunck and L. Marchlewski. Proc. Chem. Soc. 1893, [126], 169.

Many years ago (Phil. Trans. 1853, 72) one of the authors described under the name of rubiadin a yellow colouring matter obtained from madder. It is now shown that madder contains a glucoside of this substance, the preparation and properties of which are described. The glucoside crystallises in yellow needles melting at about 270°. On acetylation by Liebermann's method it yields a pentacetyl derivative. On treatment with baryta water it yields a dark red lake, one hydrogen atom being displaced by barium. On hydrolysis it is converted into rubiadin and ordinary dextrose—

$$C_{21}H_{20}O_9 + H_2O = C_{15}H_{10}O_4 + C_6H_{12}O_6$$

Rubiadin crystallises in lustrous yellow needles, melting at 290°. It very closely resembles purpuroxanthin, and is probably the corresponding derivative of methylanthracene.

The Constitution of Rubiadin Glucoside and of Rubiadin.

L. Marchlewski. Proc. Chem. Soc. 1893 [126], 169.

It is pointed out that of the five hydroxyl groups in rubiadin, one is phenolic, inasmuch as the glocoside yields dark red coloured monometallic derivatives; further, it is contended that probably glucose always exists in glucosides in the form of an anhydride of a heptahydric alcohol; a formula is assigned to the glucoside based on these arguments.

Assuming that rubiadin is derived from the same (β) methylanthracene as emodin, &c., it is pointed out that there are still three possible formulæ if rubiadin be regarded as a metadihydroxyanthraquinone—one homo- and two heteronucleal.

By heating a mixture of symmetrical metadihydroxybenzoic acid, paramethylbenzoic acid and sulphuric acid at 110°, the author has obtained a substance of the same composition and closely resembling rubiadin, but melting at 267°.

PATENTS.

Improvements in the Production of Azo Colours on Fibre.

B. Willcox, London. From the Farbenfabriken vormals F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 11,395, June 17, 1892.

In a previous patent (1891, No. 22,641A; this Journal, 1893, 258) a process was described whereby certain colours are obtained on the cotton fibre by first dyeing with colouring matters resulting from the combination of a tetrazo salt with Clèves α-naphthylamine-β-monosulphonic acid, or α-naphthylamine-orthomono-sulphonic acid, diazotising, and treating with a solution of a phenol or amine. In the present patent certain compounds are enumerated which may replace the sulphonic acids mentioned, the use of these compounds resulting for the most part in the production of blue and greenish-blue shades, though in certain cases, by varying the tetrazo salt, brown, violet, or greenish-black shades result.

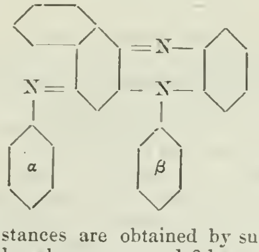
The compounds to be combined with the tetrazo salts are amido-naphthol, amido-naphthol ethers, amido-naphthol-ether-sulphonic acids, amido-naphthoxy-acetic acid, or amidonaphthoxy-acetic-sulphonic acid. The resulting tetrazo compounds may be either "symmetrical" or "mixed," according as two molecules of one of the above compounds, or one molecule of each of two different compounds, are combined with the tetrazo salts.

The colouring matters obtained on the fibre by diazotising the tetrazo compounds formed as above, and combining them with phenols, amines, &c., are here designated trisazo or tetrakisazo colouring matters according as they contain three or four azo groups.—R. B. B.

The Manufacture of a New Class of Basic Dyestuffs or Colouring Matters and of Sulpho Acids thereof, and of Materials or Intermediate Products relating thereto.

J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,138, May 27, 1892.

The colouring matters described are derivatives of the so-called eurhodines and eurhodoles, which are bodies allied to the indulines. The constitution of these colouring matters is best described by the aid of a diagram representing the formula of phenylrosinduline—



The new substances are obtained by substituting both or one of the phenyl groups α and β by methyl, ethyl, or the like, or by hydrogen, but β must always be replaced by an alkyl group. The methods for obtaining these new indulines may vary with the eurhodine or eurhodol used, or with the group to be introduced or substituted, and some of the details are given in the specifications below. As a general example, homo - eurhodine, $C_{17}H_{13}N_3$ (obtained from the o-amido-azo compound of p-toluidine and α-naphthylamine), is heated with aniline and aniline hydrochloride, when phenyl-homo-eurhodine is produced. This, on subsequent alkylation, yields one of the new dyestuffs. By employing an alkylated α-naphthylamine or a eurhodine from an alkylated p-toluidine, the subsequent alkylation is dispensed with. All the dyestuffs obtained by any of these methods are basic, but those which contain a phenyl group at α can be sulphonated, and form acid colouring matters, some of which dye even shades. Another method for obtaining these sulphonic acids is to start from a sulphonated eurhodine such as may be obtained from β-hydroxynaphthoquinone-anil sulphonic acid and o-phenylenediamine, which yields phenyleurhodine sulphonic acid, and this, on alkylation, gives a sulphonic acid of one of the new colouring matters. As above mentioned, the details of the processes are described below.—T. A. L.

Improvements relating to the Manufacture of a New Class of Basic Dyestuffs or Colouring Matters, and of Materials and Intermediate Products relating thereto. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,138A, May 27, 1892.

This specification describes the preparation of three of the new colouring matters known as α-methyl-homo-eurhodine, α-β-methyl-homo-eurhodine, and β-methyl-homo-eurhodine. The first of these is prepared as follows:—About 10 kilos. of methyl-α-naphthylamine hydrochloride in 15 kilos. of phenol are heated on the water-bath to 90° C. and 10 kilos. of *p*-amido-azo-toluene are added. The temperature rises spontaneously to about 170°, and after cooling to 100° the melt is washed with dilute caustic soda to remove the phenol and is purified by dissolving in dilute hydrochloric acid and precipitating the α-methyl-homo-eurhodine as hydrochloride, by the addition of strong hydrochloric acid to the filtered solution. This is then dissolved in water, precipitated with ammonia, treated with cold dilute acetic acid, filtered, and boiled, when the α-methyl-homo-eurhodine separates almost completely in the form of yellow needles. On heating this substance with methyl iodide and methyl alcohol under pressure to 150° it is converted into α-β-methyl-homo-eurhodine, which dyes cotton mordanted with tannin and silk orange-red shades. The β-methyl-homo-eurhodine is prepared by heating 10 kilos. of the azo dyestuff from diazotised sulphanilic acid and methyl-*p*-toluidine, with 50 kilos. of phenol to about 95° C. About 9 kilos. of α-naphthylamine are then added, when the temperature rises spontaneously. After it has fallen below 100° the melt is washed with dilute caustic soda to remove the phenol, extracted with dilute hydrochloric acid, and precipitated from the filtered solution by adding strong hydrochloric acid. It is purified by dissolving in water, saturating with ammonia, and precipitating the hydrochloride from the filtered solution by the addition of hydrochloric acid. The colouring matter so obtained dyes bright yellowish-red shades on cotton mordanted with tannin and on silk.

—T. A. L.

Improvements relating to the Manufacture of Sulpho-Acids of a New Class of Basic Dyestuffs or Colouring Matters, and of Materials and Intermediate Products relating thereto. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,138B, May 27, 1892.

As already mentioned, the sulphonic acids of these new colouring matters may either be obtained by sulphonating those compounds which contain a phenyl group at the position α, or else by using a sulphonated constituent for the condensation. The substance employed for the latter process is hydroxy-naphthoquinone-anil sulphonic acid, which is prepared by dissolving 10 kilos. of β-naphthoquinone in about 250 kilos. of alcohol and adding 10 kilos. of sodium sulphanilate in 25 litres of water. After stirring for about 12 hours the sodium salt of hydroxy-naphthoquinone-anil sulphonic acid is filtered off. The free acid is prepared by dissolving the sodium salt in 300 litres of boiling water and adding sufficient acetic acid to make the solution strongly acid. After filtering, the free acid crystallises from the filtrate on adding 100 kilos. of brine. For the preparation of what is called α-*p*-sulpho-benzene-eurhodine about 35 kilos. of the above sodium salt are dissolved in 900 litres of hot water and mixed with 11 kilos. of *o*-phenylene diamine dissolved in 100 kilos. of 30 per cent. acetic acid. After heating for about four hours on the water-bath the condensation product separates out in a crystalline form. It can be purified by dissolving in water and precipitating with salt. In order to convert it into the methyl derivative it is heated with methyl alcohol and methyl iodide to about 160° C., and then yields α-*p*-sulphobenzene-β-methyl-eurhodine. If in place of the *o*-phenylene diamine above mentioned methyl-*o*-tolylene diamine is employed, the product is a monosulphonic acid of α-phenyl-β-methyl-homo-eurhodine. This acid may be further sulphonated by means of fuming sulphuric acid containing 23 per cent. of SO_3, and then forms a sulphonic acid readily soluble in hot water, which dyes wool evenly from an acid-bath. More energetic sulphonation yields sulphonic acids which are readily soluble in cold water.—T. A. L.

Improvements relating to the Manufacture of a New Class of Basic Dyestuffs or Colouring Matters and of Sulpho-Acids thereof, and of Materials and Intermediate Products relating thereto. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,138C, May 27, 1892.

The principal colouring matters obtained according to this specification are phenyl-homo-eurhodine, its methyl derivative and sulphonic acids thereof. Phenyl-homo-eurhodine is prepared by mixing 10 kilos. of the hydrochloride of homo-eurhodine, $C_{17}H_{13}N_3$ (obtained from the *o*-amido-azo compound of *p*-toluidine and α-naphthylamine), with 5 kilos. of aniline hydrochloride and 20 kilos. of aniline for two hours to about 150° C. The melt is then poured into water, saturated with caustic soda, and the unused aniline driven off with steam. The crude phenyl-homo-eurhodine which remains behind can be purified by crystallisation from an alcoholic phenol solution, and then melts at 230° C. It dissolves in concentrated sulphuric acid with a green colour, but is scarcely soluble in boiling water containing a little acid. On methylation this compound forms an induline, $C_{21}H_{19}N_3$, of which the hydrochloride is readily soluble in dilute hydrochloric acid. This colouring matter dyes cotton mordanted with tannin and silk red. The same dyestuff is also obtained by condensing hydroxy-naphthoquinone-anil with methyl-*o*-tolylene diamine in an acetic acid solution. In addition to the method given above, the induline, $C_{24}H_{19}N_3$, can be prepared from the homo-eurhodol, $C_{17}H_{12}N_2O$ (Witt, Ber. **19**, 441; this Journal, 1886, 320), by heating it with aniline and aniline hydrochloride and purifying and methylating the product as above. By the use of lower homologues, such as the eurhodine, $C_{16}H_{11}N_3$ (Ber. **23**, 845 and 2452; this Journal, 1890, 602 and 934), or the eurhodol, $C_{16}H_{10}N_2O$ (Ber. **23**, 2455), the corresponding homologous indulines are obtained, which can be alkylated as already described. The induline, $C_{24}H_{19}N_3$, on sulphonation with sulphuric acid containing 95 per cent. of H_2SO_4 at 100° C., yields a sulphonic acid which is almost insoluble, even in boiling water. A soluble sulphonic acid is obtained by further sulphonation with fuming sulphuric acid containing 23 per cent. of SO_3. The acid so formed dyes wool a bright red, yellower in shade than that given by azo-carmine.—T. A. L.

Improvements in the Manufacture of Dihydroxynaphthalene Sulpho-Acids. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 11,522, June 20, 1892.

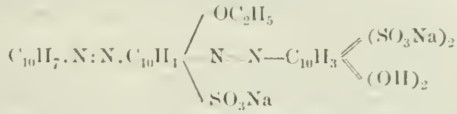
By heating 1·4-α-naphthylamine sulphonic acid with strong soda-lye, ammonia is given off and 1·4-α-naphthol sulphonic acid is obtained. In a similar manner the α-naphthylamine disulphonic acid II. of Ger. Pat. 41,957 of 1886 is decomposed by fusion with alkalis yielding α-naphthol disulphonic acid (Ger. Pat. 57,014 of 1889). The reaction does not, however, take this course with all α-naphthylamine sulphonic acids, as certain others on fusion with alkalis like the 1·5-α-naphthylamine sulphonic acid split off the sulphonic acid group and yield either amido-naphthol or amido-naphthol sulphonic acids. It has, however, been discovered that the elimination of the amido or sulphonic acid group depends upon the concentration of the soda-lye, and that if a very dilute lye be used the amido group is replaced by hydroxyl. Operating in this way the patentees have obtained from 1·8-amido-naphthol-3·6-disulphonic acid the 1·8-dihydroxy-3·6-naphthalene disulphonic acid, which is known as the chromotrope acid. About 15 kilos. of 1·8-amido-naphthol sodium disulphonate are dissolved in 150 kilos. of soda-lye containing 5 per cent. of soda and heated in an autoclave for eight hours to 265° C. under a pressure of about 22·5 atmospheres. The ammonia is then driven off by boiling, and the acid sodium salt of the dihydroxynaphthalene sulphonic acid precipitated by adding hydrochloric acid. It is not necessary to separate the amido-naphthol disulphonic acid, but the crude melt obtained by fusing α-naphthylamine trisulphonic acid with caustic alkalis according to Eng. Pat. 13,443 of 1890 (this Journal, 1891, 760) may be suitably diluted and heated under pressure as above. Another method of obtaining the same acid is by heating the alkaline salts with water under pressure. The acid can also be obtained by subjecting to either of the above treatments the corresponding diamidonaphthalene disulphonic acid, which is the product obtained by dinitrating and reducing the 2·7 or 3·6-naphthalene disulphonic acid.—T. A. L.

The Manufacture of New Colouring Matters. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 11,533, June 20, 1892.

This is an extension of Eng. Pat. 5112 of 1892 (this Journal, 1893, 259), and refers to the production of colouring matters from the so-called thio-condensation products of *p*-toluidine, *m*-xylidine, and ψ-cumidine, and their sulphonic acids, excluding, however, primuline, as certain of these derivatives have already been described in Eng. Pat. 10,448 of 1890 (this Journal, 1891, 633). Instead of employing Clève's α-naphthylamine-β-sulphonic acid as described in the first-named patent, it has now been found that other naphthylamine compounds can be used providing that the products obtained after combination with the diazotised thio compounds are capable of further diazotisation. The following intermediate bodies may be employed: α-naphthylamine-*o*-sulphonic acid, amido-naphthols, amido-naphthol ethers, amido-naphthol sulphonic acids, amido-naphthol ether sulphonic acids, amido-naphthoxyacetic acids, and amido-naphthoxyacetic sulphonic acids. The range of shades varies from greyish-green, through pure green, to greenish-black. The following quantities are given for preparing a colouring matter which dyes unmordanted cotton green from an alkaline bath. The diazo-compound from 37 kilos. of dehydrothio-*m*-xylidine sodium sulphonate and 7 kilos of sodium nitrite is combined in a hydrochloric acid solution with 18·7 kilos of α-amido-β-naphthol ether and sodium acetate is added to complete the reaction. The solution is then made alkaline and the amido-azo compound, which has the following constitution—

$$NaO_3S.C_{16}H_{13}(NS).N = N.C_{10}H_5(NH_2)(OC_2H_5),$$

is filtered off, suspended in water, diazotised by adding 7 kilos. of sodium nitrite, and then hydrochloric acid slowly. After about 24 hours the diazo compound is filtered off and added to a solution containing 26·2 kilos. of sodium-1·8-dihydroxynaphthalene-α-sulphonate, and 50 kilos. of sodium acetate, made moderately acid by means of acetic acid. In order to complete the reaction the solution is heated to about 60°, made alkaline, the colouring matter salted out, filter-pressed, and dried. Some other examples of the ways in which this invention may be carried out are mentioned, and the specification then proceeds to the description of disazo colouring matters for wool, as mentioned in Eng. Pat. 22,641 of 1891 (this Journal, 1892, 1001), by substituting for the Clève acids there described the various amido-naphthols and their derivatives mentioned above. Certain products derived from amido-naphthol ethers are not claimed, as these have already been described in Eng. Pat. 13,665 of 1889 (this Journal, 1890, 854), Eng. Pat. 3397 of 1890, and Eng. Pat. 5984 of 1891 (this Journal, 1892, 345). The colouring matters described in Eng. Pat. 7067 of 1889 (this Journal, 1890, 385) are also disclaimed. The following example illustrates the formation of a dyestuff starting with α-naphthylamine. About 14·3 kilos. of α-naphthylamine are diazotised, and the solution added to 28·9 kilos. of α-amido-β-naphthol-ethyl ether δ-sulphonate of sodium, and 30 kilos. of sodium acetate dissolved in water. After several days the mixture is heated to about 70° C., made alkaline, and the amido-azo compound filtered off It is then suspended in water, diazotised with sodium nitrite and hydrochloric acid, and added to a solution of 36·4 kilos. of 1·8 dihydroxynaphthalene-α-disulphonate of soda and 72 kilos. of sodium acetate together with a small quantity of acetic acid. After 24 hours the whole is heated to 60° C., made alkaline, and the dyestuff salted out, filter-pressed, and dried. It has the constitution—



$$C_{10}H_7.N:N.C_{10}H_4\left\langle\begin{array}{l}OC_2H_5\\ N=N—C_{10}H_3\left\langle\begin{array}{l}(SO_3Na)_2\\(OH)_2\end{array}\right.\\ SO_3Na\end{array}\right.$$

and dyes wool green from an acid-bath.—T. A. L.

The Manufacture and Production of Naphthalene Sulpho-Acids. B. Willcox, London. From "The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 11,865, June 25, 1892.

The process depends upon the fact that the amido group of aromatic amines can be replaced by the group SH by the action of xanthates on diazotised aromatic amines. The first product is a xanthate, which by the action of an alkali gives the corresponding sulphhydrate. The compounds so formed yield sulphonic acids on oxidation. Diazotised naphthylamine is in this manner converted into naphthylsulphhydrate, $C_{10}H_7SH$. This substance on oxidation, even by contact with air, gives the corresponding sulphide, so that these latter compounds are always formed as by-products. Both substances, however, yield sulphonic acids on oxidation. By means of this new method of synthesising sulphonic acids several new sulphonic acids have or can be obtained. The general method to be employed is described in the following example illustrating the production of 1·4-naphthalene disulphonic acid from naphthionic acid. Diazotised α-naphthionic acid is treated with potassium xanthate and the resulting α-xanthate of naphthalene sulphonic acid is heated with alkalis as described in J. Prakt. Chem. **41**, 219, the resulting compound being the potassium salt of dinaphthyldisulphide disulphonic acid, $KO_3S.C_{10}H_6.S_2.C_{10}H_6.SO_3K$. About 55·4 kilos. of this salt and 15 kilos. of sodium carbonate are dissolved in 600 litres of water, and a solution of 52·5 kilos. of potassium permanganate in 1,000 litres of water is run into the cold liquor until the latter acquires a permanent red colour. A small quantity of alcohol is then added, and, after boiling, the manganese dioxide is filtered off, the filtrate neutralised with hydrochloric acid, evaporated, and mixed with a solution of barium or calcium chloride. In this way a sparingly soluble barium or calcium salt is obtained, which is decomposed by boiling with sodium carbonate, yielding the sodium salt of naphthylene disulphonic acid, which on fusing with alkalis gives α-naphthol-*p*-sulphonic acid. In a similar manner other sulphonic acids of naphthalene may be obtained from the various naphthylamine sulphonic acids.—T. A. L.

The Manufacture and Production of New Basic Colouring Matters. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 11,876, June 25, 1892.

These colouring matters are derivatives of the oxazines, of which Meldola's blue (New blue R), obtained by the action of nitroso-dimethyl aniline on β-naphthol, is a typical example. These compounds are condensed with alkylated diamido benzhydrols, and the resulting product can be subsequently oxidised to form other dyestuffs. The following example is given for the production of these colouring matters. A solution of 31 kilos. of Meldola's blue in 250 kilos. of alcohol is gradually treated with 27 kilos. of tetramethyl-diamido-benzhydrol and the temperature raised to 70° C. The melt is then poured on to ice, the basic condensation product filtered off, dissolved in a large quantity of water containing a small quantity of hydrochloric acid, and, after filtering, the dyestuff is precipitated by the addition of zinc chloride and salt, and gives blue shades on mordanted cotton. In order to oxidise this product, 6·4 kilos. are dissolved in 25 kilos. of 50 per cent. acetic acid and 3·4 kilos. of 33 per cent. hydrochloric acid. After cooling, 7·9 kilos. of a 30 per cent. lead dioxide paste and 15 litres of water are added, and the lead is subsequently precipitated with 1·1 kilos. of sulphuric acid of 66° B. About twice the quantity of water is then added, the lead sulphate filtered off, and the dyestuff precipitated by means of brine and zinc chloride. The colouring matter dyes blue shades on cotton mordanted with tannin. Allied compounds may be obtained by using other alkyl derivatives of diamido-benzhydrols or by employing other oxazines. As regards the latter, it is not necessary to use the finished dyestuff, but the crude product obtained in the condensation may be employed. For printing purposes the oxazine and the alkylated diamido-benzhydrol may be mixed in an acetic acid or alcohol solution and this used directly for printing. The condensation takes place during the subsequent steaming, the colour being formed on the fibre.—T. A. L.

Manufacture of Lactyl Derivatives of Methylaniline, Ethylaniline, Paranisidine, and Paraphenetidine. C. D. Abel, London. From C. F. Boehringer and Söhne, Waldhof, Baden. Eng. Pat. 12,166, June 30, 1892.

These lacto-derivatives are obtained by heating the lactates of the bases at 150°—180° C. until no more aqueous vapour separates from the fused mass. The products are then purified by crystallisation. Lact-methylanilide melts at 87·5° C., lact-ethylanilide at 81·5° C., lact-paranisidine at 105·5° C., and lact-paraphenetidine at 117·5° C. These substances may also be prepared by heating the bases with lactic anhydride, lactide, or lactic acid esters at the above temperature. The lactates are conveniently formed by dissolving the base in the equivalent quantity of dilute sulphuric (or other) acid, mixing this with a hot or cold aqueous solution of calcium (or other metallic) lactate, and adding alcohol till the whole of the calcium sulphate is precipitated The lactates are then crystallised from the filtrates. With methyl- and ethyl-aniline an excess of the base should be used and this excess afterwards separated from the lactate formed, by steam distillation.—L. T. T.

Improvements in the Manufacture and Production of Anthraquinone Derivatives. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 12,579, July 7, 1892.

This is an extension of several specifications which refer to the oxidation of anthraquinone and its derivatives by means of sulphuric anhydride, manganese dioxide, and the like, yielding polyhydroxyanthraquinones which have in general been termed alizarin cyanines (see Eng. Pat. 1657 of 1892; this Journal, 1893, 142). It has now been found that when dissolved in concentrated sulphuric acid, anthraquinone and its derivatives can be oxidised and converted into alizarin cyanines by means of the electric current. By this means anthraquinone, alizarin, purpurin, and flavopurpurin yield hexahydroxyanthraquinone, whilst anthrapurpurin yields alizarin hexacyanin, and alizarin bordeaux first yields alizarin pentacyanin and then hexahydroxyanthraquinone. Although sulphuric acid suffices in the case of alizarin bordeaux, it is preferable in the case of the other derivatives to use a moderately fuming sulphuric acid. Simultaneous sulphonation takes place in the case of the polyhydroxyanthraquinones, but the sulphonic acid groups can be split off in a suitable manner as subsequently described. The oxidation is best performed at a temperature of 20°—50° C. A solution of 1 kilo. of flavopurpurin in 10 kilos. of fuming sulphuric acid containing 20 per cent. of anhydride is contained in a vessel which can be suitably cooled. The cathode is in the fuming sulphuric acid, and separated from the anode by a diaphragm. The strength of current employed is 6 ampères per square decimetre. The reaction is complete when the flavopurpurin has disappeared, and the liquid is then poured into water, and the sulphonated dyestuff precipitated with salt. In order to hydrolyse the sulphonic acid, 1 kilo. is heated with 10 kilos. of sulphuric acid (60° B.) for several hours to about 160° C., poured into water, and the precipitated dyestuff filtered off.—T. A. L.

The Manufacture and Production of New Alizarin Derivatives. B. Willcox, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 12,580, July 7, 1892.

An extension of Eng. Pat. 12,715 of 1890 (this Journal, 1891, 759), applying the methods of sulphonating there mentioned to the products described in Eng. Pat. 4871 of 1891 (this Journal, 1892, 513) and Eng. Pat. 13,677 of 1891 (this Journal, 1892, 740). As sulphonating agents, fuming sulphuric acid, sulphuric monochlorhydrin, or a mixture of sulphuric acid and metaphosphoric acid may be employed. By dissolving hexahydroxyanthraquinone, alizarin pentacyanin, or alizarin hexacyanin in fuming sulphuric acid containing 20 per cent. of anhydride and heating to about 100° C. until a sample dissolves in water to a clear solution, those substances are converted into their sulphonic acids, which are characterised by their behaviour to various reagents, such as sodium carbonate, ammonia, and concentrated sulphuric acid, and also by the different shades they give on wool mordanted with alumina or chromium salts. It has further been found that certain hydroxyanthraquinones which only contain a small number of hydroxyl groups can be converted into sulphonic acids of higher hydroxylated anthraquinones, either by oxidation and subsequent sulphonation, or else by sulphonating and then oxidising the sulphonic acids, the end products in both cases being the same. The following hydroxyanthraquinones can be employed for this purpose: alizarin bordeaux, hydroxyflavopurpurin, flavopurpurin, alizarin pentacyanin, hydroxyanthrapurpurin, and anthrapurpurin. The oxidation may be carried out as described in Eng. Pat. 4871 of 1891 and in Eng. Pat. 1657 of 1892 (see preceding abstract). It is to be noted that when the oxidation is effected at a low temperature, the products exist, not as colouring matters, but as hydroxyanthradiquinone sulphonic acids, which are extremely unstable, and are converted into the corresponding hydroquinones, *i.e.*, the hydroxyanthraquinone sulphonic acids, on allowing their aqueous solutions to stand, or directly, by heating them with reducing agents. The following method describes the preparation of alizarin hexacyanin sulphonic acid from anthrapurpurin sulphonic acid. 10 kilos. of anthrapurpurin are heated at 100° C. with 25 kilos. of fuming sulphuric acid containing 20 per cent. of anhydride, until a sample dissolves to a clear solution in water. After adding 300 kilos. of sulphuric acid (66° B.) the melt is oxidised by slowly adding 19 kilos. of 90 per cent. manganese dioxide at 30°—40° C. The whole is then poured into water and sodium bisulphite added until the colour of the solution changes from violet to red, indicating that the complete reduction of the alizarin hexacyanin quinone sulphonic acid to the alizarin hexacyanin sulphonic acid has taken place. The dyestuff is then separated by salting out. On hydrolysis by heating with 100 kilos. of sulphuric acid (60° B.) for six hours to 180° C. it yields, on pouring into water, alizarin hexacyanin. Other dyestuffs belonging to the alizarin cyanin series can be obtained from β-nitro-flavopurpurin and β-nitro-anthrapurpurin. The operations are carried out as described above and the products obtained dye wool mordanted with alumina salts blue, and with chromium salts greenish-blue shades. The oxidation of the flavopurpurin and anthrapurpurin, &c. into alizarin cyanines, as described in Eng. Pat. 1657 of 1892, can, it has now been discovered, be more easily and regularly carried out by employing the arsenic acid ethers of the colouring matters. As an example, 10 kilos. of anthrapurpurin are dissolved in 300 kilos. of sulphuric acid (66° B.), and 7·5 kilos. of dry powdered arsenic acid are added. The formation of the ether is complete as soon as a sample dissolves to a brownish-yellow solution in dilute soda-lye. About 17 kilos. of finely powdered 90 per cent. manganese dioxide are then slowly added at 45° C., and after the temperature ceases to rise the melt is poured into water and the dyestuff separated as already described in Eng. Pat. 1657 of 1892.—T. A. L.

Production of Blue Triphenylmethan Colouring Matters or Dyes. J. R. Geigy and T. Sandmeyer, Basle, Switzerland. Eng. Pat. 12,720, July 11, 1892.

By condensing two molecules of diphenylamine monosulphonic acid with formaldehyde, diphenyldiamidodiphenylmethane disulphonic acid is obtained, which on oxidation in presence of one molecule of diphenylamine monosulphonic acid yields triphenylpararosaniline trisulphonic acid, which is known as "Crystallised Blue." 8·1 kilos. (= 3 mols.) of dry sodium diphenylamine sulphonate are dissolved in 100 litres of water and heated at 100°—105° C. under an inverted condenser with 10 litres of hydrochloric acid and 0·75 kilos. (= 1 mol.) of a 40 per cent. solution of formaldehyde for about half an hour. A solution of 16 kilos. of a 47 per cent. solution of ferric chloride and 100 litres of water is then gradually added to the boiling solution. When the oxidation is complete, the colouring matter crystallises out in small bronzy needles dissolving in water with a bright blue colour. After washing, the crystals are dissolved in sodium carbonate solution and precipitated from the filtered solution by means of hydrochloric acid. Crystallised blue is the symmetrical trisulphonic acid of triphenylpararosaniline, and dyes a pure blue shade brighter than those produced from other triphenylpararosaniline derivatives. The neutral sodium salt obtained by evaporating a neutral solution of the acid in caustic soda is known in commerce as "Helvetia Blue." A colouring matter of identical constitution may be obtained by oxidising methyldiphenylamine sulphonic acid with two molecules of diphenylamine sulphonic acid, in this case the carbon of the methyl group forming the methane carbon atom of the triphenylmethane derivative.
—T. A. L.

Improvements in the Manufacture of Mordant Dyeing Colouring Matters. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 13,147, July 18, 1892.

This specification relates to improvements in the process described in Eng. Pat. 19,589 of 1891 (this Journal, 1893, 253). In the example there given, 1·4′-dinitroanthraquinone was treated with fuming sulphuric acid containing 40 per cent. of SO_3. Instead of this, an acid containing only 12 per cent. of anhydride is employed, and the colouring matter so obtained is subsequently treated as described in the above-mentioned patent. In this way a product is obtained different also from that described in Eng. Pat. 19,588 of 1891, in which the soluble product obtained by the action of fuming sulphuric acid is without isolation treated with concentrated sulphuric acid. The details of the present invention are as follows:—About 10 kilos. of 1·4′-dinitroanthraquinone are mixed with 100 kilos. of fuming sulphuric acid containing 12 per cent. of SO_3, and heated for $1\frac{1}{2}$ to 2 hours to 160° C. A soluble colouring matter is thus produced which dissolves to a violet solution in water. The melt is then dissolved in water, precipitated with salt, filtered off, and dried. It forms a shining black powder, dissolving in sodium carbonate solution with a violet blue, in caustic soda with a blue, and in concentrated sulphuric acid with a violet colour. One kilo. of the dry colour is mixed with about 10 times its weight of ordinary concentrated sulphuric acid (containing 95 per cent. of H_2SO_4) and heated for about five hours to 130° C. until no further conversion into the insoluble colouring matter takes place. The dyestuff is then precipitated by pouring into water and well washed. It gives violet-blue shades on wool mordanted with chromium salts, and dissolves in concentrated sulphuric acid and caustic soda to a blue solution. The dye appears to be a mixture, but can be employed without further purification. In addition to the 1·4′-dinitroanthraquinone, α-dinitroanthraquinone and the crude mixture of nitroanthraquinones obtained by energetically nitrating anthraquinone may be treated according to this invention.—T. A. L.

Production of a Red Azo Colouring Matter. O. Imray, London. From "The Society of Chemical Industry in Basle," Basle, Switzerland. Eng. Pat. 13,475, July 23, 1892.

Benzidine is converted into its mono-nitro derivative by the action of one equivalent of nitric acid and sulphuric acid yielding *o*-nitro-*p*-diamidodiphenyl. This base is converted into its tetrazo compound and combined with one molecule of salicylic acid, and afterwards with one molecule of α-naphthol-*p*-sulphonic acid. A sparingly soluble scarlet-red azo colouring matter is obtained which dyes wool from an acid-bath in shades fast to air, soap, fulling, chlorine, and sulphurous acid. The order of the combinations must not be varied, as the isomeric dyestuff is of little value. Wool mordanted with chromium salts is dyed a dark-red shade. A similar dyestuff is obtained by substituting *o*-cresotic acid for the salicylic acid.—T. A. L.

Production of Dioxynaphthoic-mono-sulpho Acid and of its Salts. O. Imray, London. From "The Society of Chemical Industry in Basle," Basle, Switzerland. Eng. Pat. 14,161, August 5, 1892.

This acid is obtained from the β-naphthol carboxylic acid melting at 216° C. of Eng. Pat. 9612 of 1889 (this Journal 1890, 609) by converting it into a disulphonic acid, which on heating with caustic soda yields the new acid. About 10 kilos. of β-naphthol carboxylic acid melting at 216° C. are dissolved in 40 kilos. of fuming sulphuric acid containing 24 per cent. of SO_3 at 100°—120°. The temperature is then kept at 100°—160° for 2—3 hours until the reaction is complete. The melt is then poured into water, treated with lime, and the lime salt converted into the sodium salt, which on evaporation separates as a crystalline mass. About 20 kilos. of this salt are then heated with 40 kilos. of caustic soda and 10 litres of water for 2—3 hours at 210°—220° C., and finally at 230°—260° C. On treating the finished melt with warm dilute hydrochloric or sulphuric acid, the acid sodium salt of the new dihydroxy-carboxy-naphthalene monosulphonic acid separates in light yellowish needles and is purified by crystallisation from water. On addition of barium chloride to a solution of the acid sodium salt the acid barium salt crystallises out, having the composition $[C_{10}H_4(OH)_2.CO_2H.SO_3]_2Ba + 4H_2O$. The free acid is obtained by decomposing this salt with sulphuric acid. Aqueous solutions of the alkaline salts of the acid have a yellowish-green fluorescence. They give dark indigo-blue tints with ferric chloride and an intense yellow-orange colouration with chloride of lime. The acid is intended for use in the production of colouring matters.—T. A. L.

Production of Azo Colouring Matters. O. Imray, London. From "The Society of Chemical Industry in Basle," Basle, Switzerland. Eng. Pat. 14,253, August 6, 1892.

The colouring matters referred to are obtained by combining various diazo or tetrazo compounds with the sulphonic acid of dihydroxynaphthalene carboxylic acid described in the preceding abstract. Three methods for obtaining these colouring matters are given. (1.) One molecule of a tetrazo compound is combined with two molecules of the new acid in an alkaline solution, or with one molecule of the acid and one molecule of any amine, phenol, or their sulphonic or carboxylic acids. These colouring matters dye unmordanted cotton in shades varying from red, through violet, to black. (2.) The diazo compounds from *p*-amido-acetanilide and its homologues or from 1·4-amido-naphthyl-oxamic acid are combined with the new acid and the resulting compound saponified, when after diazotisation it can again be combined with the same acid or with other components. These colouring matters dye unmordanted cotton and wool, and can also be employed for wool mordanted with chromium salts. (3.) The amido-azo compounds obtained by combining diazotised aromatic amines or their derivatives with α-naphthylamine can, after diazotisation, be combined with the new acid and yield valuable blue-black or black colouring matters for wool.—T. A. L.

The Manufacture and Production of Greenish-Blue Mordant Dyeing Colouring Matters. J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,246, August 24, 1892.

This is an extension of Eng. Pats. 19,588 and 19,589 of 1891 (this Journal, 1893, 257, 258), which describe the production of mordant dyeing colouring matters from certain dinitro-anthraquinones. Colouring matters soluble in water are obtained by these processes as intermediate products. By heating these substances with ammonia under pressure colouring matters are obtained closely resembling those described in Eng. Pat. 19,589 of 1891. The ammonia may be replaced by fatty or aromatic amines giving in all cases greenish-blue colouring matters for wool mordanted with chromium salts.—T. A. L.

A Colouring Matter obtained from Logwood and the Process of producing same. A. E. Alexander, London. From H. P. Wells, New York, U.S.A. Eng. Pat. 2316, February 2, 1893.

The process consists in adding sodium or potassium nitrite to logwood extract in the proportion of 5 lb. of nitrite to every 100 lb. of the liquid extract of 51° Tw. The extract when dried down forms a solid mass which is sufficiently brittle to be ground to a powder. The colouring matter so obtained is said to be stronger than ordinary logwood extract.—T. A. L.

Erratum.—This Journal, 1893, 38, col. 2, 9 lines from top, for "are *scarlets*," *read* "and *scarlets*," &c.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Spontaneous Inflammation of Benzoline in Chemical Cleansing Works. M. M. Richter. Zeits. ang. Chem. 1893, 218—221.

The distillate at 70°—90° obtained in the rectification of crude petroleum (sp. gr. 0·705 – 0·710) is used in certain branches of the textile industries for the purpose of removing fatty matters, the goods (clothing, &c.) being saturated with the liquid by washing therein, and then dried by centrifugal machines, &c. With silk and woollen goods spontaneous inflammation of the benzoline vapour is sometimes observed, especially when the articles are removed from the vessel containing them; but this never occurs with cotton and linen fabrics. At low temperatures, *e.g.*, in winter, the action is more frequent than at higher ones. The author has satisfied himself that the cause of the inflammation is the development of electricity by friction of benzoline with the fabrics, wool thus becoming positively and benzoline negatively electrified. At −15° such electrification of benzoline takes place very readily; at 0° still with ease; at +15° only moderately; at +22° and upwards not at all. The inflaming spark is of the slow reddish nature, rather than of the rapid yellow character. He further claims to be able to prevent the development of electricity, and the consequent danger of spontaneous inflammation, by adding to the benzoline about 1 per cent. of a special fluid the nature of which is not made public as yet.—C. R. A. W.

Production of Jute and San Fibre in India. J. Soc. Arts, 1893, **41**, 789—791.

Jute is largely cultivated in the northern and eastern districts of Bengal, and, to a smaller extent, in the central districts of the province. It is grown also, although not extensively, in Assam. Jute seems to be capable of cultivation on almost any kind of soil. It is least successful, however, upon laterite and gravelly soils, and most productive upon a loamy soil or rich clay and sand. The finest qualities are grown upon the higher lands, upon which rice, pulse, and tobacco form the rotation. The coarser and larger qualities are grown chiefly upon mud banks and islands formed by the rivers. No special attention is paid to good seeds, nor do cultivators buy or sell their seeds. In the corner of the field a few plants are left to ripen and produce the seed that is sown broadcast the following year. The crop is considered to be in season whenever the flowers bloom, and to be past the season whenever the fruits appear. The fibre from plants that have not flowered is weaker than from those in fruit; the latter, though stronger, is coarser and wanting in gloss. The average crop of fibre per acre is over 1,200 lb., but the yield varies considerably, being as high as 4,000 lb. in some districts, and as low as 250 lb. in others. At present, as practised by the natives, the fibre is separated from the stems by a process of retting in pools of stagnant water. In some districts the crop is stacked in bundles for two or three days to give time for the decay of the leaves, which are said to discolour the fibre in the retting process; in others the bundles are carried off and at once thrown into the water. In some districts the bundles of jute stems are submerged in rivers, but the common practice seems to be in favour of tanks or roadside stagnant pools. The period of retting depends upon the nature of the water, the description of fibre, and the condition of the atmosphere, and it varies from two to twenty-five days. The operator has, therefore, to visit the tank daily to ascertain if the fibre has begun to separate from the stem. This period must not be exceeded, otherwise the fibre becomes rotten, and almost useless for commercial purposes. The bundles are made to sink in the water by placing on them sods and mud. When the proper stage has been reached the retting is rapidly completed. The labourer, standing up to his waist in the water, proceeds to remove small portions of the bark from the ends next the roots, and grasping them together, strips off the whole from end to end without breaking either stem or fibre. Having brought a certain quantity into this half-prepared state, he next proceeds to wash off, which is done by taking a large handful, swinging it round his head, dashing it repeatedly against the surface of the water, and drawing it through the water towards him so as to wash off the impurities; then with a dexterous throw he spreads it out on the surface of the water, and concludes by carefully picking off all remaining black spots. He then wrings it out so as to remove as much water as possible and hangs it up on lines prepared on the spot to dry in the sun. There are in India 26 jute factories, 8,101 looms, and 161,845 spindles, which give employment to 61,915 persons, and consume 2,869,088 cwt. of jute. They are almost exclusively employed in the gunny bag or cloth trade, a few only doing business in cordage, floor cloth, or other manufactures.

San or sunn is grown by itself, or at times is raised in strips on the margins of fields, and is never cultivated as a mixed crop. It is usually sown in June or at the beginning of the rains, and cut at the close of the rainy season—about the 1st of October. It requires a light, but not necessarily rich, soil, though it cannot be grown on clay. It is believed by cultivators to improve the soil; and as it is supposed to refresh exhausted land, it is considered a good preparatory crop and is grown as such, every second or third year, in fields required for sugar-cane and tobacco. Ordinarily the crop is harvested after the flowers have appeared, but the plants are frequently left on the field until the fruits have begun to form, and sometimes until they are ripe. There is a great difference of opinion as to whether the crop should be dried before being steeped, or carried at once to the retting tanks. When stripped of the leaves, which are highly esteemed as manure, the stalks are made up into bundles and placed upright for a day or two in water a couple of feet deep, since the bark on the butts is thicker and more tenacious than that on the upper portion, and, therefore, requires longer exposure to fermentation. The bundles are then laid down lengthwise in the water, and kept submerged by being weighted with earth. It can generally be ascertained when the retting is complete by the bark of the lower ends of the stems separating easily; but too long fermentation, while it whitens, injures its strength. Having discovered that the necessary degree of retting has been attained, the cultivator, standing in the water up to his knees, takes a bundle of the stems in his hand and thrashes the water with them until the tissues give way and the long clean fibres separate from the central canes. When the fibre has been separated and thoroughly washed, it is the usual custom to hang it over bamboos to be dried and bleached in the sun. When dry it is combed, if required for textile purposes or for nets and lines; but if for ordinary use for ropes and twines, it is merely separated and cleaned by the fingers while hanging over the bamboo. The output per acre of san fibre ranges from 150 to 1,200 lb., but the estimated average is 640 lb. to the acre. The chief purpose for which san is utilised at the present day is the manufacture of a coarse cloth or canvas, used principally for sacking. A large amount of the fibre is used in the native cordage trade, for which it is stated to be well adapted, and considerable quantities of the fibre are also consumed by the European rope makers in India. The waste tow and old materials are made into paper. In many districts paper is regularly manufactured of this material, and large quantities are used by the Indian paper mills. In some parts of India the seeds of the san are collected and given to cattle. The plant itself is found to be very nourishing, causing cows to give a larger supply of milk.

The Composition of a Specimen of Jute Fibre produced in England. Andrew Pears, jun. Proc. Chem. Soc 1893, [126], 165.

The author succeeded in securing a normal growth of the jute plant (*Corchorus capsularis*) in a "hot house" of average temperature, 65° F. The stems, 5 ft. in length, and branched, were cut down after maturation of the seed, which has since been germinated for growth during the current year. The stem-fibre was separated after retting in tepid water, and was exhaustively investigated. It showed the characteristic behaviour of lignocelluloses, but with important variations in degree; the most marked difference observed was in ultimate composition, the carbon percentage being only 43 as against 46—47 in the normal fibre. From the results given in full in the paper, it is shown that the factors of lignification induce variations in chemical composition, within wide limits, at the same time that the general constitutional type is preserved. Lignification may, in fact, be regarded as a gradual passage from "saturated" to "unsaturated" compounds, and as the result of the splitting off of water and carbon condensation, the specimen in question representing the earlier phases of such transition or evolution.

PATENT.

Improvements in and connected with the Cleansing and Bleaching of Wool, Hair, Silk, Cotton, Flax, and other Vegetable or Animal Fibres or Fabrics, the Recovery of Bye-Products such as Oil and Fat contained in such Fibres or Fabrics, and the Recovery of the Whole or Part of the Ingredients used in the Process. C. A. Sahlström, London, and E. Parr, Isleworth. Eng. Pat. 10,612, June 3, 1892.

The large metal vessel in which the cleansing takes place is connected by pipes with a vacuum apparatus, and a pressure pump. Other pipes serve to introduce steam or air currents, and for the removal of spent liquors and separated fat. The material in the vessel is covered with a solution of soap, borax, &c., and the vacuum applied. The pressure is regulated as desired, and steam or air may be caused to pass through the vessel.

The soap is oxidised by passing a current of air through the spent liquor, and it may then be separated by filtration. The fat (lanolin) is recovered by passing the liquor through a machine similar in construction to a cream separator.—R. B. B.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

The Decomposition of Alkaline Aluminates in Presence of Alumina. A. Ditte. Comptes rend. **116**, 1893, 183—185.

A solution of potassium or sodium aluminate containing an excess of alkali is fairly stable, and may be preserved in a closed vessel for months without any of the alumina separating. On the other hand, a solution of the crystallised aluminate, or one formed by adding to a salt of aluminium, potassium or sodium hydrate in amount just insufficient to dissolve the precipitate, gradually decomposes, the alumina appearing in the crystallised form $(Al_2O_3.3H_2O)$ identical with the mineral *gibbsite*. The first step in the reaction is evidently the precipitation of a small amount of amorphous alumina, together with the liberation of the corresponding quantity of alkaline hydrate, the former being rapidly changed into the crystalline variety owing to its greater insolubility. The decomposition of the aluminate continues until the amount of alumina dissolved in the liquid corresponds exactly to the solubility of the crystallised hydrate in potash at the temperature of the experiment. Herein lies the explanation of the commercial process for the preparation of alumina from a solution of sodium aluminate by agitating it with a small amount of alumina already crystallised. —F. H. L.

The Process of Dyeing. G. Spohn. Dingl. Polyt. J. 1893, **287**, 210.

If cotton be dyed with inorganic colouring matters such as lead chromate or manganese bistre and the fibre be subsequently examined microscopically, the individual crystals of the colouring matter may be easily distinguished adhering to the colourless fibre; the colour is simply deposited and no chemical combination occurs. Asbestos may be dyed with these colours just as cotton is. The author considers that dyeing with organic colouring matters is a process of just the same nature as the foregoing; the application of a mordant, such as alumina, to cotton, and then dyeing in an alizarin bath, serves merely to produce the lake inside the fibre but not chemically combined with it. Pure alumina may be dyed with alizarin in just the same way as the mordanted cotton fibre, and asbestos, impregnated with alumina acquires the colour of the lake when dyed in an alizarin bath. It would thus seem that the fibre serves merely as a foundation for the deposition of the colouring matter which is bound to it only by mechanical or molecular force.—W. J. P.

PATENTS.

Improvements in Apparatus for Treating Fibrous Materials with Dye or other Liquors. R. Shaw, Manchester. Eng. Pat. 10,267, May 30, 1892.

The principal feature of the apparatus described is that the liquor is drawn up from the dye-vat into and by means of a suction chamber. The material is placed on a tray below this chamber, and the dye-vats, which are provided with wheels, are run on to a platform or lift. This is raised until the tray and the goods upon it are immersed in the vat. The action of the suction chamber is to draw up the liquor through the material. By means of suitable ejectors the liquor is then run off from the suction chamber and forced back again into the dye-vat through the goods, the operations being repeated as often as may be necessary.

It is claimed that the apparatus is specially suited for the dyeing of cops.—R. B. B.

A Process for Purifying Bleaching Liquor. E. Hermite, E. J. Paterson, and C. F. Cooper, Dalston, Middlesex. Eng. Pat. 10,517, June 2, 1892.

The liquor that has been used for bleaching under electrolytic action, is cleared from organic impurities by agitation with ferric chloride solution, followed by addition of magnesium hydroxide in a moist or "gelatinous" state, as obtained by precipitation. The liquor, when cleared by settling, is run off from the mixing tank for use. To obtain ferric chloride as nearly neutral as possible, for the purposes of the invention, it is preferred to add electrolytically-produced bleaching liquor in suitable proportion to ferrous chloride solution. Or the reagent may be "obtained by electrolytic action on a solution of iron protochloride."
—E. S.

Improvements in Dyeing or Printing Fibres Black, or Shades approaching thereto, with Aniline, its Homologues, or Derivatives. W. J. S. Grawitz, Nogent-sur-Marne, France. Eng. Pat. 11,027, June 11, 1892.

In the production of aniline black, when a chlorate is used as the oxidising agent, the fibre is often liable to become tendered. This is to be prevented by using along with the chlorate a certain proportion of a soluble ferro- or ferricyanide. In order to obtain a good black a small quantity of a vanadium compound is also added.

By way of example, a bath may be prepared containing—

	Grms.
Aniline salt (hydrochloride)	1295
Potassium ferrocyanide	795
Sodium chlorate	335

and made up with water to 13 litres.

The vanadium salt is best applied by impregnating the material with it previous to entering the above bath. If added at the same time as the other ingredients, it tends to form insoluble compounds with the ferro- or ferricyanides. With the quantities given above, 2—5 grms. of vanadate of ammonium would suffice.—R. B. B.

Improvements in Dyeing and Printing with Azo Dyestuffs. B. Willcox, London. From the Farbenfabriken vorm. F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 11,529, June 20, 1892.

This patent refers to the discovery that certain azo colouring matters containing the carboxyl and hydroxyl groups, either in the same or different benzene or naphthalene nuclei, yield insoluble chromium lakes, and can thus be made use of in printing and dyeing; and further, that this is the case even when the solubility of the colouring matter is increased by the presence of the sulphonic group.

In the printing process the colouring matters, mixed with chromium salts and thickening, are printed on the material, which is then steamed, malted, and soaped.

In dyeing the chromium mordant is either applied first, or chromium fluoride is used in a single bath with the dyestuff.

Examples of the colouring matters obtained by various combinations are given. Among them are the following:—

Diazotised amido-benzoic acid with various dihydroxynaphthalenes, &c., gives shades varying from yellowish-red and dark orange to black.

Diazo-sulpho-salicylic acid yields with the naphthols, naphthol-sulphonic acids, and dihydroxy-naphthalenes red, bluish-black, and black colouring matters.

Diazotised phthalic acid with naphthols and naphthol-sulphonic acids produces reddish-orange, brownish-red, and black dyestuffs.—R. B. B.

An Improved Bleaching Process for Yarns, Piece Goods, and other Materials. C. D. Abel, London. From O. Keferstein and O. Keferstein, jr., Anstalt, Germany. Eng. Pat. 629, January 11, 1893.

In this process the material is alternately immersed in weak bleaching powder solutions and exposed to the action of artificially prepared ozone in a special chamber. The operations are repeated as often as required. The ozone chamber brings about more speedily the reactions which usually take place during grass bleaching. The strength of the fibre is not injuriously affected by the process.
—R. B. B.

An Improved Machine for Dyeing Slivers or Similar Substances used in the Manufacture of Ribbons direct from the Combs, and for like Purposes. J. A. J. Florin-Leclercq, Roubaix, France. Eng. Pat. 955, January 16, 1893.

The slivers or ribbons coming from the comb bobbins pass between rollers, and by suitable mechanism the material is widened and flattened so that a band of uniform thickness is obtained. This band passes on to the printing rollers. One of these is of metal and fluted, the other, which carries the colouring matter, is smooth, coated with india-rubber, and therefore compressible. One side of the ribbon is thus printed and has uncoloured portions corresponding to the spaces between the projections of the fluted roller. A second pair of rollers serves to print the other surface of the ribbon in a similiar manner.—R. B. B.

Improved Process and Means for Dyeing Wood E. Edwards, London. From P. Jaeger, Esslingen, Germany. Eng. Pat. 1220, January 19, 1893.

The planks of wood are piled in layers with sawdust between every few layers. The sawdust has been previously mixed with the necessary colouring matters and chemicals. The whole is exposed in a suitable chamber to the action of steam for 10—14 days.—R. B. B.

Printing in Colours upon Textile Braids and Machine to carry out the Method. W. Webb, Luton. Eng. Pat. 3422, February 16, 1893.

This invention relates to a process for printing designs in one or more colours on textile braids, including straw and "chip" plaits. The braid is wound on feeding reels, and from these is conveyed between guide rollers to the printing rollers upon which the designs are carved. These are supplied by three ordinary inking rollers grooved in five sections to supply different colours if such are needed.
—R. B. B.

Erratum.—This Journal, 1893, page 517, col. 2, 20 lines from bottom. *for* "is requisite for laying" *read* "lays down."

VII.—ACIDS, ALKALIS, AND SALTS.

Distilling Apparatus, Steam Engines, and Consumption of Steam in Ammonia-Soda Works. H. P. Fassbender, Zeits. ang. Chem. 1893, 139—140.

I.—*Description of the Process.*

The main features of this process are so well known that the merest outlines of it need only be described. Brine holding in solution free ammonia is saturated with carbonic acid derived from lime kilns, whereby ammonium bicarbonate is produced, which reacts with the sodium chloride, forming ammonium chloride and sodium bicarbonate. The latter separates out, being insoluble or nearly so in the brine, and is transformed into soda by calcination. The mother liquor is heated with lime—the residue from the lime kilns—and the recovered ammonia is returned into the first part of the process, *i.e.*, passed into brine to yield the liquor which is to be "carbonated."

It is evident that various methods may be employed to carry out these reactions; thus, nearly dry ammonia may be passed into a highly-concentrated brine, which is immediately ready to be treated with carbon dioxide; or moist ammonia may be introduced into brine and the weak liquor has then to be run over solid salt to become saturated; or ammonia, saturated with aqueous vapour, may be cooled and the dilute ammonia solution brought together with salt, &c.

Furthermore, to prepare ammonia gas, the distilling apparatus may be heated with live steam from the boilers or with waste steam from the engines, thus introducing either a higher or a lower pressure than that of the atmosphere, into the apparatus. There is any number of such variations possible, the adoption of which will greatly depend on local circumstances and may therefore not be suitable for every works. Still, there exist some arrangements which will prove advantageous everywhere.

On following the course the ammonia is taking through the whole process, quantitatively controlling the changes it undergoes, the following figures may be safely depended upon, in the author's opinion, when the forms of apparatus to be described are chosen.

The brine prepared in the "absorber" contains 70 kilos. of NH_3 per cbm. This liquor is pumped into the top compartment but one of the precipitating column ("carbonator") whilst the top compartment receives $\frac{1}{6}$-cbm. of pure brine which serves to scrub the escaping gases. In the third compartment the two liquors are mixed, and the mixture may be considered, for all practical purposes, as being a solution containing 6 per cent. of ammonia, a very small quantity of which is carried away with the escaping gases.

All the following calculations are based on the fact of a liquor containing 6 per cent. of ammonia, 270 kilos. of salt per cbm., a certain quantity of carbonic anhydride, and 0·5 kilo. of ammonia in the form of ammonium sulphate (the sulphate being due to some calcium sulphate in the salt used). Therefore, all the percentages mentioned hereafter, being percentages of volume, refer to this liquor.

After the precipitation, the *ammonia* can be accounted for in the following way:—

(1.) About 0·9 per cent. of NH_3, in combination with carbonic anhydride, exists in the mother-liquor. This ammonia was determined by titration of the latter; therefore any alkali due to sodium bicarbonate held in solution is calculated as ammonia.

(2.) About 4·6 per cent. of ammonia are found in the mother-liquor in the form of ammonium chloride; this quantity was determined by examining the filtered mother-liquor and subtracting from it the quantity corresponding to the ammonium sulphate, which passes through all the operations unchanged.

(3.) About 0·5 per cent. are found in the gases escaping from the carbonator. This figure is found on subtracting 0·9 + 4·6 from 6 per cent.

The ammonia (see 1) passes on to the distilling apparatus; the quantity adhering to the bicarbonate is so infinitesimal that it may be neglected.

The ammonia (see 2) also passes for the greatest part, into the distillery; a smaller quantity adheres to the moist bicarbonate. This causes the calcined soda to test 97 to 99 per cent. instead of 100, and corresponds to 0·046 to 0·138 per cent. of NH_3, for which we may assume 0·08 per cent. This ammonia is recovered from the gases escaping the calcining apparatus by absorption in water, which serves afterwards for dissolving the salt.

The 0·5 per cent. mentioned (see 3) is recovered as follows: The gases escaping from the carbonator are scrubbed in a "washer," and give up 0·3 per cent. to brine, flowing from the washer into the absorber. The remaining 0·2 per cent. of NH_3 are scrubbed by means of water in a second washer and give up to it about 0·17 per cent. of NH_3. The water of this dilute solution serves for dissolving the salt, and helps in conjunction with the dilute ammonia solution recovered as sub. 2, to free the brine from calcium sulphate, or this ammonia simply remains in the brine as carbonate. The remainder of the ammonia, consisting of 0·03 per cent., is finally absorbed by acid, and recovered.

—J. L.

A convenient Method for the Preparation of Barium Permanganate. W. Muthmann. Ber. 1893, 26, 1016—1018.

Various practical inconveniences attend the preparation of barium permanganate—(*a*) by treating potassium permanganate with hydrofluosilicic acid and neutralising the filtrate with baryta water (Rousseau and Bruneau); (*b*) from barium manganate, prepared by fusion processes (Schafarik); and (*c*) by double decomposition of barium chloride and potassium permanganate (Böttger). The author finds that better results are obtained by acting on potassium permanganate with barium nitrate as follows:—100 grms. of the former salt and somewhat more than the equivalent quantity of the latter (140 grms.) are dissolved in 1½ litres of boiling water; 20 grms. of barium hydrate are then gradually added. A vigorous effervescence soon ensues, owing to liberation of oxygen; the whole is then warmed on the water-bath till no more gas is evolved, treated with 20 grms. more of barium hydrate, and finally kept hot for some hours until colorless, evaporated water being replaced from time to time. The precipitate that subsides consists of barium manganate with a little barium carbonate and manganese dioxide; it is washed by decantation five times successively with 5 litres of boiling water, and then filtered and washed 10 times more with boiling water. Finally, it is suspended in a litre of water and treated with a vigorous current of mixed steam and carbon dioxide. The former prevents the minute crystals of barium manganate from becoming covered over with the resulting barium carbonate and manganese dioxide, so as to hinder the decomposition brought about by the carbonic acid. After 10 hours the whole is filtered through asbestos, whereby a solution of pure barium permanganate is obtained.

By treating this with appropriate quantities of cœsium rubidium, or ammonium sulphate, &c., the corresponding alkaline permanganates are readily obtained. Ammonium permanganate solution breaks up on heating in accordance with the equation—

$$NH_4MnO_4 = MnO_2 + N + 2H_2O$$

when dry, the salt is extremely explosive by percussion.

—C. R. A. W.

Action of Metals on Nitric Acid. P. C. Freer and G. O. Higley. Amer. Chem. Journ. 15, 71—81.

At the outset the authors criticise the work of previous investigators on the same subject, and especially note the fact that nitric acid, of as low a specific gravity as 1·2, when entirely free from lower oxides of nitrogen, reacts with pure copper with the greatest readiness.

Their method of experiment consisted in passing the gases evolved from copper and nitric acid of sp. gr. 1·4 into sulphuric acid, and determining the total nitrogen by the nitrometer, and the nitrosyl sulphuric acid by potassium permanganate. They conclude that under the conditions adopted, the sole products of reduction are nitrogen, trioxide, and peroxide, in the proportion of 10 per cent. of the former and 90 per cent. of the latter. The equations given are $2Cu + 6HNO_3 = 2Cu(NO_3)_2 + N_2O_3 + 3H_2O$ and $2Cu + 8HNO_3 = 2Cu(NO_3)_2 + 4NO_2 + 4H_2O$. The effect of alteration of temperature upon the proportion of reduction products is very slight. Further, an experiment is quoted to show that the nitrogen trioxide and peroxide are not derived from the reduction of nitric acid by nitric oxide, but rather that this last substance is, when dilute acid is used, the product of secondary reactions (see this Journal, 1891, 204—206; also Phil. Trans. 1891, 204).

—V. H. V.

The Action of Steam on Ferric Chloride. G. Rousseau. Comptes rend. 116, 1893, 188—190. (Compare this Journal, 1892, 262.)

By heating concentrated solutions of ferric chloride in sealed tubes, various crystallised oxychlorides are produced; between 150° and 220° the yield consists of $2Fe_2O_3, Fe_2Cl_6, 3H_2O$; between 220° and 300°, $2Fe_2O_3, Fe_2Cl_6$;

and above 300°, $3Fe_2O_3$, Fe_2Cl_6 is formed. Higher temperatures could not be obtained owing to the breakage of the tubes. On heating the anhydrous chloride to a temperature of 260°—when it begins to volatilise—at one end of a combustion tube through which a current of carbonic anhydride saturated with moisture is passed, care being taken to keep the chloride vapour in excess, a few reddish-brown acicular crystals consisting of $2Fe_2O_3$, Fe_2Cl_6 are deposited at the other end of the tube if the temperature be kept between 275° and 300°, while between 350° and 400° the oxychloride is larger in amount, darker in colour, and consists of $3Fe_2O_3$, Fe_2Cl_6 The yield is at all temperatures the smaller, the greater the excess of the ferric chloride vapour, and from 400° upwards practically no compound is produced, unless the water-vapour is in excess, in which latter case hexagonal laminæ of hæmatite are deposited. This failure of reaction at higher temperatures is in all probability due to some reverse action taking place between the oxychloride and the liberated hydrochloric acid.—F. H. L.

Some remarkable Occurrences of Minerals in the Salt Deposits of Westeregeln. A. Naupert and W. Wense. Ber. **26**, 873.

In some of the now exhausted kainite deposits of the Consolidated Alkali Works at Westeregeln, a salt was frequently found, which was easily distinguished from kainite by its glassy appearance. On analysis it was found to be a potassium magnesium sulphate with 4 equivalents of water. It is therefore closely allied to *picromerite* (Schœnite) from which it differs by 2 additional equivalents of water. The following minerals are also found in the insoluble residues, mainly composed of *anhydrite*, obtained in the extraction of *Carnallite*:—*Magnesium Sulphoborite*, $3MgSO_4$, $2Mg_3B_4O_9$—Already a number of compounds of boric acid had been found in these potash deposits: *boracite, pinnoite, Ascharite*, &c. *Celestine*—No strontium compounds had hitherto been known to exist in these deposits. *Celestine* has now, however, been identified both in the kainite and the carnallite of Westeregeln. *Kieserite*.—Crystals of this mineral, which had already been observed by Precht in the Stassfurt deposits, are also found in fair quantity in the carnallite residues of Westeregeln.—E. T.

Calculation and Statement of Analyses of Brine and Salt. J. and S. Wiernik. Zeits. f. ang. Chem. 1893, 43.

See under XXIII., *page* 626.

PATENTS.

Improvements in Obtaining Cyanides. R. L. Barr, Claremont, Renfrew, J. Macfarlane, Kelvinside, N.B., Dr. E. J. Mills, Glasgow, and S. Young, Kelvinside, N.B. Eng. Pat. 3092, February 17, 1892.

A mixture of an alkali or alkaline earth with some suitable form of carbon is heated in a retort through which carbon monoxide and ammonia gas, mixed or separate, are passed. The effluent gases may be again passed in, and so on repeatedly. The mixed gases may be obtained by aspirating carbon monoxide through ammonia solution, and the exhausting apparatus may be used to force the gases (which may be previously heated) through the retort under pressure. The gases may be derived from furnaces, shale retorts, ordinary gas works, and other sources, such gases being purified if necessary. A mixture of 100 parts potassium hydroxide (KOH) with 22½ parts carbon is specified as suitable for charging into the retort. The cyanide formed may be separated in any suitable way. When it is required to obtain a ferrocyanide, iron, in a divided state, is added to the charge.—E. S.

Improvements in the Method of and Apparatus for Distilling, Separating, and Concentrating Acids or Mixed Liquids, and for Treating Substances in Solution. E. J. Barbier, Paris. Eng. Pat. 11,705, June 22, 1892.

The liquid to be treated is run from a trough into the highest of a series of basins arranged step-wise, so that the flow is continuous. Each basin rests on a plate, which may be perforated to admit passage of heating gases, and which is formed with draining channels, any flow from which shows if a basin is broken. The heating chamber containing the evaporating troughs or basins has doors along the side, and has superposed domes or covers of invulnerable material, arranged in pairs to form narrow condensing chambers, separated by spaces for air circulation. The vapours enter the inner chamber by perforations, and pass into the outer chamber (which may have baffle-plates) through suitable pipes. The condensed liquid flows off by channels in which the covers rest; and the uncondensed vapours and gases go to a coke or flint-charged tower provided with baffle-plates, and then to a chimney which produces the required suction. The liquid concentrated by flow along the series of basins passes into a vessel (the "mixing evaporator") surmounted by a large pipe to lead any vapours back to the condensing chambers, and is then admitted by a valved outlet to a cooling vessel. The liquid is then taken to another side of the furnace, having a series of basins and condensing covers as at first, but smaller; or a single cover may be used.

The apparatus is shown in a form specially adapted to separating a mixture of sulphuric and nitric acids, having the mixing evaporator placed to the rear and above the concentrating furnace, into which evaporator the mixture is fed, simultaneously with the vapours off the acid being concentrated. These vapours are led into the bottom of the vessel by an injecting device fed with hot air under pressure. The nitric vapours are led into a battery of condensers, and thence to a tower. The sulphuric acid, now nearly free from nitric acid, after passage through an intermediate reservoir, is finally denitrated and concentrated by flow through the series of basins in the furnace, a little sulphurous acid being passed in if necessary.—E. S.

Improvements in the Manufacture of Carbonic Acid Gas. H. S. Elworthy, Stratford, Essex, H. Lane, Birmingham, and J. Pullman, London. Eng. Pat. 12,155, June 30, 1892.

A mixture of a metallic oxide, as "copper oxide," for instance, with "carbon or carbonaceous matter in a solid, liquid, or gaseous condition," is heated in a retort, and the mixture of carbon dioxide and monoxide produced, is passed through vessels containing some powerful oxidisers, such as sulphuric acid and potassium permanganate or heated metallic oxides. The carbon monoxide present is thus oxidised, and "the whole of the gas becomes a homogeneous and pure carbonic acid." The residue of metal and carbon resulting from the first operation is heated, while a current of air or of steam is passed over, hydrogen being produced and saved in the latter case. The mixture of regenerated metallic oxide and carbon is then ready to be again used.—E. S.

Improvements in the Manufacture of Sulphuric Acid. E. J. Barbier, Paris. Eng. Pat. 12,726, July 11, 1892.

The gases from a pyrites or sulphur burner pass into a chamber having a fireplace below the lowest of a series of basins, arranged step-wise, receiving the sulphuric acid which collects in basins below a number of towers, connected alternately top and bottom, and through which the gases from the burner pass, after traversing and assisting to heat the chamber. The towers, except those farthest from the burner, which are arranged as Gay-Lussac towers, and receive a spray of water at the top, are charged with blocks of sandstone, flint, or other invulnerable material, massed chiefly in central parts, and above is a pipe from which is distributed into each, by means of cocks that can be regulated at will, a mixture of sulphuric and nitric acids. Air is admitted to the towers directly into the first of them; or it is passed into the concentrating chamber to mix with the sulphurous fumes coming from the burner, and with the nitrous gases arising from the mixed acids there concentrating, thence to pass into the towers. Fire gases from the furnace pass under all the evaporating basins arranged under the reaction towers. Steam may be injected into one or more of the towers.—E. S.

Improvements in or Connected with Evaporating or Concentrating Apparatus. F. W. Scott and F. W. Scott, jun., London, and E. G. Scott, Liverpool. Eng. Pat. 13,103, July 16, 1892.

See under I., *page* 585.

The Manufacture of Ferric Chloride. J. H. Kidd, Manchester. Eng. Pat. 12,985, July 15, 1892.

Ferric oxide or hydroxide is mixed in proportions to form a thin paste with a nearly saturated solution of calcium chloride, and sulphuric acid, or an acid sulphate, is added in just sufficient proportion to form calcium sulphate. The ferric oxide is dissolved by the hydrochloric acid formed, and the ferric chloride solution produced is "locked or contained" in the hard cake into which the paste consolidates. The product may be applied in this form direct to some purposes, as for the purification of sewage; or if ferric chloride solution is wanted, the cake may be placed in water, when the chloride dissolves out, leaving the calcium sulphate as a spongy mass.—E. S.

Improved Bleaching Compound. H. Y. Castner, London. Eng. Pat. 13,411, July 22, 1892.

A "soda bleach" is prepared by mixing sodium peroxide (Na_2O_2) with an equivalent quantity of a neutral anhydrous salt, such as magnesium sulphate or chloride; or a mixture of two salts, as magnesium chloride and calcium chloride, may be used. The compound is stated to be stable in closed packages. It is preferred to use a slight excess of the peroxide in the preparation, so that it may have in solution an alkaline reaction. When the compound obtained by mixing magnesium sulphate with sodium peroxide is dissolved in water, the reaction occurring is expressed by the following formula:—

$$4\,MgSO_4 + 4\,Na_2O_2 + 7\,H_2O =$$
$$4\,Na_2SO_4 + (MgO(HO)_2\,3\,Mg(HO)_2) + 3\,H_2O_2$$

The formula given when magnesium chloride and calcium chloride are mixed with the peroxide to form the soda bleach which is dissolved in water, is:—

$$4\,MgCl_2 + CaCl_2 + 5\,Na_2O_2 + 15\,H_2O =$$
$$(MgO(HO)_2\,3\,Mg(HO)_2)(CaO_2\,8\,H_2O) + 10\,NaCl + 3\,H_2O_2$$

Such solutions may be used warm.—E. S.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

PATENTS.

Process of Producing Designs in Burnished or Liquid Gold or Colour upon Glazed and other Ware, and Apparatus therefor. T. Holt, Stoke-on-Trent. Eng. Pat. 10,727, June 7, 1892.

By this invention a design in gold is transferred on to a glazed surface by means of a stamp having incisions cut in the broader part of the design which enable the stamp to pick up sufficient gold from a pad, the gold being afterwards deposited upon the glazed ware. The stamp is termed by the inventor the "cellular" rubber stamp from the manner in which the incisions are made.—V. C.

Improvements in and connected with Jacketted Glass Tubes and Glass Vessels. Wm. Seume, Dresden. Eng. Pat. 5518, March 11, 1893.

The invention consists in the following improvements in the manufacture of glass tubes jacketted with stronger or tougher material:—*first*, the glass in the course of its manufacture is cooled very slowly and is subsequently treated in suitable liquids, which are caused to boil, so that it is capable of resisting the effects of changes of temperature; *secondly*, the (inner) glass tube is provided with annular ridges or collars so as to make firmer connection with the outer tube; and *thirdly*, in joining tubes end to end, a packing substance is used containing a mixture of asphalt and silicates between the spigot end and the socket end, the glass of the two ends for the sake of a better hold being also roughened.—V. C.

Improvements in Apparatus for Moulding Glass Pipes and Tubes. W. P. Thompson, London. From R. G. Guptill. Eng. Pat. 6947, April 4, 1893.

The apparatus is of the class known as "hand machines." A mould is mounted at an adjustable height upon a vertical frame which also carries the core which is raised and lowered by a friction clutch mechanism. The mould is closed at its lower end by a removable pivoted plug, which is retained in position by spring arms. When the core reaches the bottom of the mould it engages the spring arms and the plug is thus automatically released. It has heretofore been difficult to determine the exact moment when the glass has cooled to the proper extent for withdrawing the core, and in some cases a portion of the pipe would be withdrawn with the core on account of such a mistake. This is now prevented by having a groove inside the mould just below the top of the pipe, thus preventing any part of the moulded pipe from being drawn out with the core.

When glass pipes of different sizes are required the core and the mould can be changed, since the different parts of the apparatus are removeable and adjustable.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

United States Pitch-pine Industry. J. Soc. of Arts, 1893, 41.

The probable length of time that the pitch-pine forests will hold out, will doubtless be of value and interest to the principal dealers in this great article of trade. The pitch-pine trees of the Southern States are of spontaneous growth, and especially indigenous to those sandy soils near to the water of the Gulf and Atlantic coasts, and, therefore, hardly any attention is given to the culture of these trees. It is believed that the pine wood of the Southern States is coming more and more to the front, and that it is the most valuable wood of the country for mercantile purposes. There are about ten species of mercantile pine in the Southern States: the white pine and pitch-pine, the scrub or spruce-pine, the sand-pine, the pond-pine, the cedar-pine, and the long-leaf, short-leaf, loblolly, and Cuban pines, which are the principal varieties in general use. Thus the long-leaf pine is also called yellow pine, hard-pine, pitch-pine, and various other names, but the settled name of this species of wood for commercial purposes at Pensacola is pitch-pine, and this quality of wood forms the largest if not the entire bulk of the shipments of pine wood from Pensacola. The short-leaf is called the old field and spruce-pine, the loblolly, fuel-swamp, sap-pine, and Virginia pine. The most important of these woods—the long-leaf pine—grows in the Atlantic and Gulf States, at some distance from the coast, covering a belt of about 125 miles in width. Next in importance to the long-leaf pine—pitch-pine—is the short-leaf pine and this is more widely distributed than any of the other growths of pine. It is the predominating growth in some of the Southern States, and it covers immense areas to the exclusion of almost every other tree. In Florida the short-leaf pine is found along the northern border of the State. In Western Florida, nearer to Pensacola, it approaches the Gulf within 25 miles. It is said that the short-leaf pine gives from 3,500 feet to 4,000 feet, board measure, per acre. A rough estimate places the possible standing timber of this species, distributed throughout the Southern States, at about 160,000,000,000 feet board measure. The loblolly pine is found only in the northern part of Florida, and the Cuban pine is found principally in Florida and along the Gulf coast. It grows mainly on the so-called pine flats or pine meadows. About 12 years ago the official estimates of the merchantable pine timber standing in the Southern States gave a probable quantity of 225,000,000,000 feet. Since that time there has been an enormous quantity of timber cut, but the amount standing now is estimated as follows:—Long-leaf and Cuban pine, 232,000,000,000 feet; short-leaf pine 160,000,000,000, and loblolly pine, 102,000,000,000 feet making a total of 494,000,000,000 feet, board measure. The long-leaf pine is known to be superior to all the other species in strength and durability. In tensile strength it is said to approach, and perhaps surpass cast iron. In cross-breaking strength it rivals the oak, requiring, it is stated, 10,000 lb. pressure per square inch to break it. In stiffness, it is superior to oak by from 50 to 100 per cent. It is best adapted, and much used, for the construction of heavy work in shipbuilding; the inside and outside planking of vessels, taking the deals and planks of the best quality. For house-building it is used almost entirely in the district of Pensacola and in buildings for railroads, rail-road cross-ties, viaducts, and trestles, this wood is foremost. The finer grades and the "curly" woods are very much used for the timber work in the best dwellings. The hardness of this wood especially fits it for planks and flooring. The finer grades of curly-pine are used for the manufacture of furniture, and it is said that for bedsteads it is admirably adapted, as the resinous wood prevents the inroads of insects and similar pests. The resinous products of pine wood supply many parts of the world with pitch, resin, and turpentine. And, contrary to opinion formerly held in this respect, it is said that the tapping of the pine tree for turpentine strengthens, instead of weakens, the wood. The Cuban pine is like the long-leaf pine. The short-leaf pine is a softer wood, and is more easily worked. This wood is admirable for house work. The loblolly pine is suited for rougher work than the other two species, but it is not so strong, and it will not last so long as the others. It is stated, in a recent report of the United States Department of Agriculture, that in respect of the pine forests of the Southern States, the supply is good for 50 years to come.

PATENTS.

A Process of Manufacture of Artificial Marble. H. A. Majewski and W. Beyenbach, Berlin, Germany. Eng. Pat. 9974, May 26, 1892.

Gypsum in the shape of a block or of any other desired form is deprived of 70—80 per cent. of "the moisture it contains," burnt, and immersed in a strong solution of potassium sulphite and of any other suitable salt such as alum, ferrous sulphate, ferric sulphate, or manganous sulphate. The salts thus introduced into the pores of the gypsum are allowed to crystallise by placing the block in a room heated to about 30° C. In case the block be thick, longitudinal perforations may be made in it, and the block immersed so that the liquid is in contact with its surface, suction being applied to the other end. The product is said to be equal to marble in beauty and durability.—B. B.

Improved Treatment of the Solid Deposit or Sludge from Sewage for the application thereof to the Manufacture of Cement and other purposes. W. Webster, Lee, Kent. Eng. Pat, 11,765, June 23, 1892.

Sewage sludge is mixed with ordinary cement-making materials, and dried and burnt in the usual way. The defecation of sewage may also be aided by the addition of "Portland cement or fluxed lower grey chalk in the proportion of 10 grains per gallon of sewage containing 38 grains per gallon of solid matter." The burning of the cementitious matter may be effected by block fuel made of sludge incorporated with coal or coke breeze.—B. B.

Improvements in the Manufacture of Plaster. J. C. Bloomfield Leggs, Fermanagh, Ireland. Eng. Pat. 13,602, July 26, 1892.

Hydraulic lime is mixed with 5 per cent. of gypsum by volume and is then incorporated with an equal measure of sawdust. The resulting composition can be used as house plaster, and is said to be lighter and stronger than ordinary plaster. It may be rendered "fire-proof" by the addition of 1 lb. of tungstate of soda to each 100 gallons of water used. Sulphate of zinc or other similar salt may be substituted for the tungstate of soda.—B. B.

Process for the Manufacture of Artificial Building and other Stone. K. S. Meyer, Löbtau, Germany. Eng. Pat. 21,640, November 26, 1892.

Four parts by measure of "sand, flint, pebble stones, granite, and marble," &c., of about the size of peas, are mixed with one part by measure of magnesite previously made into a paste with water. The mass is moulded, left in the mould for two days and then allowed to remain in the open air until thoroughly dry. The magnesite is said to act and is claimed as the binding material, and the mixture to be suitable for the production of hollow ware as well as of solid slabs.—B. B.

X.—METALLURGY.

The Behaviour of Phosphoric Acid in the Blast Furnace and the Influence of Phosphorus on the Composition of the Resulting Cast-Iron. N. Kjellberg. Dingl. Polyt. J. 1893, **287**, 207.

With the help of a small experimental blast furnace, the author has conducted a series of experiments with the object of tracing the phosphorus originally present in the iron ore to the resulting pig-iron and slag. The ores used were hæmatite and magnetite. If the ore contains not more than about $1\frac{1}{4}$ per cent. of phosphorus, 90—95 per cent. of the phosphorus is found in the cast-iron and only 5—10 per cent. in the slag; the result is affected neither by the temperature of firing nor by the amount of silicon in the slag. If the ore contains more than $1\frac{1}{4}$ per cent. of phosphorus, the latter becomes distributed between the iron and the slag, the amount of phosphorus in the slag increasing with the amount in the ore. Both the temperature of smelting and the percentage of silicon in the slag begin to influence considerably the reduction of the phosphoric acid; the influence is the greater the more phosphorus the ore contains. With an ore containing up to 3·5 per cent. of phosphorus, the greater part of the latter goes into the iron, the slag absorbing the minor portion. If the slag be basic and poor ore containing 2·5—3·5 per cent. of phosphorus be used, 40—50 per cent. of the phosphorus in the charge is found in the slag, and if the temperature of smelting be high and the slag acid, up to 95 per cent. of the phosphorus may be taken up by the cast iron. No volatilisation of phosphorus occurs in the blast furnace with ores containing up to 3·6 per cent. of that element. An increase in the amount of phosphorus in the cast iron is accompanied by a decrease in the percentage of carbon; this, however, does not seem to occur until the iron contains some 3 per cent. of phosphorus. The two ores richest in phosphorus (6—7 per cent.) experimented upon, gave cast iron which contained inappreciable quantities of graphite, and was quite white, showing large brilliant crystalline faces. As the quantity of phosphorus in the iron increases the percentage of silicon also diminishes until finally the iron contains no silicon; cast iron containing more than 4 per cent. of phosphorus smelted with charcoal, ordinarily contains no more silicon than steel, and can only be made to take up a few tenths per cent. of the element by careful firing with an acid slag. The cast irons richest in phosphorus (6—7 per cent.) were so brittle that a light blow with a hammer sufficed to break them into several pieces.

The following conclusions of practical value may be drawn from the experiments:—(1.) Ores containing 0·25, 0·50, 0·75, and 1·0 per cent. of phosphorus and 50 per cent. of iron give, in the blast-furnace, cast iron containing about 0·50, 1·0, 1·4 and 1·9 per cent. of phosphorus respectively. (2.) If it be required to obtain cast iron with not more than 0·6 per cent. of phosphorus, for use in the Martin basic conversion process, from ores containing some 60 per cent. of iron, the ore must not contain more than 0·4 per cent. of phosphorus. (3.) For the reduction of pig iron for casting, with up to 1 per cent. of phosphorus, the ore must not contain more than 0·6 per cent. of phosphorus if it contain 60 per cent. of iron. (4.) For obtaining cast iron containing at least 2 per cent. of phosphorus for subsequent use in the Thomas process, the ore should not contain less than 1·6 per cent. of phosphorus if it be admitted that $\frac{3}{4}$ of the phosphorus in the ore is reduced.—W. J. P.

The Calculation of Lead Blast-Furnace Charges. H. Van F. Furman. School of Mines Quarterly, **14**, **2**, 1893, 134—148.

Many points have to be taken into consideration in the calculation of a lead blast-furnace charge, which must be made with due consideration of (1) the production of a slag good both from the metallurgical and economic standpoint; (2) the nature of the ore in hand and that of future supplies; (3) the presence of an adequate amount of lead in the charge and the production of bullion of the required grade; (4) the presence of such elements as sulphur and arsenic other than those normally existing in the slag and bullion; (5) the size of the charge—1,000 lb. being a convenient amount in modern practice.

Experience has shown that the following are good slags for use under the conditions mentioned below:—

—	Typical Slags. Per Cent.			
	SiO_2	FeO	CaO	ZnO
A	35	28	28	..
B	34	34	24	..
C	34	34	17	7
D	30	40	20	..
E	30	48	12	..
F	28—30	54	6	..

A has been used in Utah and elsewhere for ores containing a good deal of alumina; it cannot be made successfully with impure ores having a high percentage of zinc.

B is more fusible and works faster than A, and like it cannot be used with ores containing much zinc.

C is adapted for zinciferous ores, and is similar to B, with the substitution of zinc for lime.

D and E were freely used when ores containing much iron were smelted, but are now less frequently employed owing to the scarcity of iron in the ores at present worked.

F is not so good as those already described and is only available when much iron and little silica are present.

It will be observed that the main constituents SiO_2, FeO, and CaO (or ZnO) amount to 90 per cent. of the weight of the slag, a relation holding good in most cases save where much Al_2O_3 is present. MnO up to 7—8 per cent. may be considered equivalent to FeO and MgO; and BaO up to 4—5 per cent. as replacing CaO An excess of MnO tends to carry silver into the slag, and much MgO or BaO gives an infusible and pasty product liable to cause trouble in the furnace. The calculation of the amount of iron ore and limestone to be added to any given ores of known composition to produce any one of these slags is easily effected. Thus let A = pounds of SiO_2 in the total ores; B = pounds of FeO in the total ores; C = pounds of CaO in the total ores; d = per cent. of SiO_2 which the iron ore added as a flux contains; e = per cent. of SiO_2 which the limestone added as a flux contains; f = per cent. of FeO in the iron ore; l = per cent. of CaO in the limestone; X = pounds of iron ore required; Y = pounds of limestone required.

Then for slag A—

$$\frac{28}{35}(A + Xd + Ye) = B + Xf \quad (1)$$

and—

$$C + Yl = B + Xf \quad (2)$$

solving which simultaneous equations we obtain—

$$X = \frac{4Al + 4Be - 4Ce - 5Bl}{5fl - 4ef - 4dl}$$

and by the substitution of the value thus found in (2) Y can also be found.

The method of calculation for the remaining slags is similar and need not be detailed. Examples of calculations of charges of mixed ores, regard being had to the additional silica, alumina, and lime introduced by the ash of the coke used in smelting, are given in the paper.—B. B.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electrolytic Separations. E. F. Smith and J. C. Saltar. Jour. Anal. and App. Chem. **7**, 128—133.

1. *Separation of Copper from Bismuth.*—From experiments made in the laboratory of the University of Pennsylvania, it would appear that Smith and Frankel's method (Amer. Chem. J. **12**, 434) is the only satisfactory one by which copper and bismuth can be separated electrolytically, viz., by electrolysing a citrate solution of the metals in the presence of a known amount of potassium cyanide. In Smith's *Electro-chemical Analysis* it is stated that copper cannot be separated from bismuth in the presence of free nitric acid, but in the most recent edition (3rd edition) of Classen's "*Analyse durch Elecktrolyse*" the statements appear that "by the action of a current of the before mentioned strength the copper is separated free from bismuth" (p. 144) and "the separation can however be effected from the solution containing free nitric acid" (p. 123).

To clear up any doubt on this point that these conflicting statements raise, numerous experiments were made, and are described, which show that from a nitric acid solution containing both copper and bismuth, the copper deposited by an electric current is always contaminated with bismuth.

2. *Separation of Lead from Bismuth.*—From a nitric acid solution containing these metals, it was found that the peroxide of lead deposited on the positive pole was always mixed with bismuth peroxide.

3. *Separation of Copper, Lead, and Bismuth.*—From a nitric acid solution of these three metals it was found that the deposit of copper always contained bismuth, whilst with a larger quantity of bismuth present in the solution, the last-named metal was found to be deposited both with the copper and also with the lead dioxide on the positive pole.
—H. S. P.

The Electrolytic Separation of Palladium and Platinum from Iridium. Edgar F. Smith. Amer. Chem. Jour. **14**, 435—437. (See this Journal, 1890, 898—899; and 1892, 61).

Both palladium and platinum may be electro-deposited from solutions in the presence of an excess of alkaline phosphates and free phosphoric acid. The experiments here given show that they may be separated without difficulty from iridium by electrolysis in solutions of these metals in the presence of an alkaline phosphate or free phosphoric acid. A bath and treatment that gave satisfactory results was as follows:—15 cc. palladium solution (= 0·1458 grm. of metallic palladium) were added 10 cc. of an iridium solution (= 0·1200 grm. of metallic iridium), 40 cc. of disodium phosphate (sp. gr. 1·0358), 5 cc. of free phosphoric acid (sp. gr. 1·47), and 200 cc. of water. The current that acted during the night upon this solution liberated 2 cc. of electrolytic gas per minute. The deposited metal was quite adherent, and weighed 0·1449 grm. The corresponding platinum bath also gave good results. Rhodium is another member of the platinum group which has been completely separated by the current from an acid phosphate solution, but as yet it has not been possible to separate it in this manner from iridium.—G. H. R.

PATENT.

Improvements in or Relating to the Sterilisation of Milk. A. J. Boult, London. From F. Jas. Haarlem and C. Henny, Sloten, Holland. Eng. Pat. 8505, April 27, 1893.

See under XVIII., *page* 616.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Linseed Oil. De Negri and Fabris. Ann. del. Lab. Chim. Centr. delle Gabelli, 1891—92, 234—248.

After a résumé of the methods of manufacture and processes of purification of linseed oil, the authors give the following data:—

Specific gravity at 15° C.	0·9342
Fatty acids { Point of fusion	20°—21° C.
„ solidification	16°—17° C.
Temperature rise	122°—126° C.
Iodine number	158·7—159·78
„ „ of fatty acids	159·85
*Saponification number	190·2—192·7

Heydenreich's reagent produces an orange colouration with brown striæ, and those of Hauchecorne and Brullé a reddish-brown, the oil remaining liquid.

Linseed oil is frequently adulterated with siccative and non-siccative oils, as also with mineral and animal oils and resins.

Colza and cotton-seed oil can be recognised by the lowering of the iodine number and the temperature rise; the latter oil also gives a black colouration with silver nitrate. It is, however, much more difficult, if not impossible, to detect the presence of other siccative oils, such as those of poppy and hemp. Animal oils can be detected by their odour, as also by the addition of a mixture of nitric and sulphuric acids, which give an intense red colouration with fish-oil. The adulteration with mineral oils and resins can be readily discovered by the process of saponification, when these substances rise to the surface.

In conclusion, the authors give an historical account of the investigations of other writers and discuss the results obtained.—V. H. V.

Oil of Pine. De Negri and Fabris. Ann. del. Lab. Chim. Centr. delle Gabelli, 1891—92, 212—214.

The seeds of various species of conifers contain a fatty oil which is used in commerce, though not found in any large quantity. Then the seeds of *Pinus Sylvestris* contain 25—30 per cent. of a brownish-yellow oil, possessing to a slight degree the odour and taste of turpentine; it is used in the manufacture of varnishes and as a combustible. The oil is very sparingly soluble, even in boiling alcohol; it dries very slowly. The following data are given:—

Specific gravity at 15° C.	0·9215
Point of solidification	—18° C.
Fatty acids { Point of fusion	17°—19° C.
„ solidification	10°—16° C.
Iodine number	118·9—120·06
„ „ of fatty acids	121·5
Saponification number	191·27

The oil gives an orange-red colouration with Heydenreich and Brullé's reagents, and a rose with Hauchecorne's reagent.—V. H. V.

Oil of Grape-Seed. De Negri and Fabris. Ann. del. Lab. Chim. Centr. delle Gabelli, 1891—92, 225—228.

In order to extract this oil, grape-seeds are air-dried, crushed and pulverised, and then subjected to pressure; its production is practised in some parts of Germany, France, and also Italy; the yield varies from 10 to 20 per cent., according to the quality of the grape, method of culture, climate, and other conditions. The oil is of a bright yellow colour, turning brown after some time; on exposure it slowly becomes rancid; it is readily soluble in its own volume of glacial acetic acid at 70°, moderately soluble in alcohol.

Horn (Staz. agrarie **22**, 217) has recently shown that this oil resembles castor oil, and may probably be substituted for it in the making of Turkey-red oils. The following data are given:—

Specific gravity at 15° C.	0·936
Point of solidification	−10° C. to −12° C.
Fatty acids { Point of fusion	23°—25° C.
„ solidification	18°—20° C.
Temperature rise	52° C.
Iodine number	65·8
„ „ of fatty acids	98·9
Saponification number	178·5

The oil gives an intense orange colouration with Brullé's and Hauchecorne's reagents, and a reddish-yellow with that of Heydenreich.

The saponification number resembles that of the oils from the *Cruciferæ* in being very low. The oil in question also resembles these oils in containing the glyceride of erucic acid.—V. H. V.

Butter of Cacao. De Negri and Fabris. Ann. del. Lab. Chim. Centr. delle Gabelli, 1891—92, 258—263.

The butter of the cacao (*Theobroma Cacao*) is now generally obtained as a by-product in the manufacture of chocolate. It is of a yellowish-white colour, unctuous to the touch, soluble in ether, benzene and acetic acid; it consists of the glycerides of stearic, oleic, palmitic, and arachidic acids. The following data are given:—

Point of fusion	28°—30° C.
„ solidification	21·5°—23° C.
Fatty acids { Point of fusion	48°—50° C.
„ solidification	45°—47° C.
Iodine number	35—62
„ „ of fatty acids	39—1
Saponification number	193·55

Cacao butter is frequently adulterated with animal fat stearic acid, soap, wax, paraffin, and oil of almonds. The presence of paraffin can readily be ascertained by saponifying with alcoholic potash, and then warming with acetic anhydride, when the paraffin rises to the surface and solidifies on cooling.

Stearic acid can be estimated by the ordinary process of alkalimetry, using phenolphthaleïn as an indicator, the slight acidity of the butter not introducing any serious error. The presence of soaps and animal fats can best be recognised by the methods proposed by Björkland and Hager, the latter of whom has also devised a convenient process for the separation of the butters of the cacao and cocoa-nut by the greater solubility of the latter in various solvents, such as amyl alcohol and petroleum.—V. H. V.

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* By the "saponification number" is meant the number of milligrms. of KHO required to saponify 1 grm. of oil.

Oil of Maize. De Negri and Fabris. Ann. del Lab. Chim. Centr. delle Gabelli, 1891—92. 222—225.

In the manufacture of alcohol from maize the seeds are first subjected to saccharification, the germs removed, and the oil extracted from them by pressure; a further quantity is also extracted from the vinasses. Thus obtained the oil is of a golden-yellow colour, without taste or odour; it is composed of oleïn, palmitin, and stearin, besides a small quantity of an ethereal oil. It has been recommended by Heinitsh as a substitute for olive oil in the preparation of ammoniacal and lead liniments and of ointments. The following data are given :—

Specific gravity at 15° C.		0·9218
Fatty acids	Point of fusion	18°—20° C.
	„ solidification	13°—16° C.
Temperature rise		84° C.
Iodine number		112·1
Saponification		190·1

The oil gives an orange coloration with Heydenreich's and Brullé's reagents, and a red with Hauchecorne's reagent.—V. H. V.

Oil of Poppy-Seed. De Negri and Fabris. Ann. del Lab. Chim. Centr. delle Gabelli, 1891—92. 214—219.

Poppy-seeds contain from 50—60 per cent. of oil, 30—40 per cent. being extracted in the first operation of pressure (*huile blanche*) and 22—25 per cent. in the second (*huile rouge*). The former is used as an article of food, especially in the north of France and some districts of Germany.

The following data are given, which are practically identical with those of former observers :—

Specific gravity at 15° C.	0·927
Point of fusion of fatty acids	20°—21° C.
Temperature rise	87°—88·5° C.
Iodine number	136·82—137·55
„ „ of fatty acids	139
Saponification number	193·4—193·8

The oil gives an orange colour with Brullé's reagent, a reddish-brown with that of Heydenreich, and a dirty yellow with that of Hauchecorne.

The authors criticise the various methods which have been proposed to detect the sophistication of olive oil with poppy-seed oil, which is frequently practised in France; they conclude, however, that the method and reactions proposed are far from being specially characteristic of the poppy as distinguished from other siccative and seed oils in general.—V. H. V.

Butter of Cocoa-Nut. De Negri and Fabris. Ann. del Lab. Chim. Centr. delle Gabelli, 1891—92, 263—269.

Cocoa-nut butter is put upon the market either under its own name or as *vegetaline* and *lactine;* it is used for the adulteration of cacao - butter and of milk - butter. To avoid the tendency to become rancid cocoa-nut butter is digested with alcohol and animal charcoal by the method proposed by Schlenk; it consists mainly of the glycerides of caproic, caprylic, palmitic, and stearic acids. It is white or slightly yellow, soluble in ether, chloroform, and boiling alcohol, readily saponified by alcoholic potash, and the soap can be salted out.

The following data are given, which do not differ greatly from those of previous observers :—

Point of fusion		23°—28° C.
„ solidification		14°—20° C.
Fatty acids	Point of fusion	25°—27° C.
	„ solidification	16°—18° C.
Iodine number		8—8·5
„ „ of fatty acids		8·62—8·92
Saponification number		253·3—262

The butter gives yellow colourations with the reagents of Heydenreich, Hauchecorne, and Brullé, but no reactions with those of Bechi, Baudouin, &c.

The adulteration of ordinary with cocoa-nut butter is detected by the number of Reichert, since the proportion of volatile fatty acids in the latter is very small compared with that in the former; the oleo-refractometer and the solubility in acetic acid methods, have also been applied. On the other hand, the oil of the cocoa-nut (coprah) is adulterated with fatty animal oils; it is, however, easy to detect this fraud by the point of fusion, the iodine and saponification numbers, as also by the solubility in alcohol. Adulteration with seed-oils can be detected by the iodine number and the reagents of Hauchecorne and Brullé, while those of Bechi and Baudouin serve especially to detect the presence of cotton-seed and sesamé oils.—V. H. V.

The Amount of Cholesterol found in Train-Oils. W. Fahrion. Zeits. ang. Chem. 1893, 140—141.

The author has examined a number of train-oils with a view of determining their content of cholesterol; his results are tabulated below.

No.	Name of Oil.	Colour.	Unsaponifiable.
			Per cent.
1	Steam cod oil (medicinal)	Light yellow	0·61
2	„ „	Nearly colourless	0·64
3	„ „	Light yellow	0·98
4	Officinal cod liver oil	Reddish-yellow	0·54
5	„ „	Yellow	1·08
6	„ „	Light yellow	1·44
7	Commercial cod oil, yellow	Yellow	0·63
8	„ „	„	1·18
9	English cod oil	Yellowish-red	2·62
10	Brown cod oil	Brown	1·82
11	„	„	2·23
12	„	„	2·68
13	Swedish "3 Crowns"	„	1·40
14	Fish oil	Light yellow	0·61
15	„	Red	0·82
16	Fish oil (Levantine)	Yellowish-red	1·43
17	Japan fish oil	Yellow	0·56
18	„	Red	0·65
19	„	Brown	1·44
20	Sardine oil	Yellowish-red	0·62
21	„	Red	0·66
22	Train oil, Norwegian	Yellowish-red	0·65
23	„ „	Yellowish-brown, opaque.	1·26
24	„ „	Brown	1·37
25	Seal oil, Astrachan	Yellow	0·49
26	„ „	Yellowish-red	0·50
27	Shark oil	„ „	0·93
28	„	Yellow	1·24
29	„	Red	4·44
30	Shark oil, steamed	Light yellow	5·27

—J. L.

Lard. E. Spaeth. Zeits. ang. Chem. 1893, 133—136.

The author rendered the fat from different parts of hogs in order to ascertain whether the determination of the constants usually carried out in the analysis of fats would allow of the differentiation of those fats.

In the accompanying table the results are given, from which the conclusion has to be drawn that a lard must not be condemned as adulterated simply because its iodine value surpasses 60.

Fat taken from the		Specific Gravity at 100° C. Water at 15° C. = 1.	Melting Point of the Fat.	Melting Point of the Fatty Acids.	Iodine Absorption of the Fat.	Iodine Absorption of the Fatty Acids.	Free Acids required. Normal Alkali per 100 grms. Fat.	Free Acid calculated for Oleïc Acid.
			° C.	° C.			Cc.	Grms.
Back	of a hog 2 years old	0·8610	34·0	41·0	63·25	64·40	0·60	0·169
Kidneys		0·8608	39·0	42·0	61·15	63·05	0·45	0·141
Intestines		0·8601	36·0	41·5	62·90	64·40	0·75	0·211
Back	of a hog 6 to 8 months old	0·8620	33·5	41·0	62·95	64·0	0·80	0·225
Kidneys		0·8580	44·0	43·5	49·35	49·7	0·90	0·253
Intestines		0·8598	43·5	42·5	57·25	58·3	1·25	0·352
Back	of a hog 10 months old	0·8595	39·5	41·5	55·50	56·90	0·30	0·084
Kidneys		0·8593	40·5	42·0	55·88	57·10	0·35	0·098
Intestines		0·8580	46·0	42·0	50·60	52·20	0·75	0·211
Back	of a hog 6 months old	0·8603	31·5	39·5	60·10	61·80	0·45	0·141
Kidneys		0·8591	43·5	44·0	55·80	57·30	0·55	0·155
Intestines		0·8581	45·5	44·0	52·30	53·90	1·45	0·409
Back	of a hog 5 to 6 months old	0·8610	34·0	40·0	57·08	58·60	0·55	0·155
Kidneys		0·8589	44·5	43·0	50·20	52·60	0·60	0·169
Intestines		0·8588	47·0	43·5	51·75	53·30	1·60	0·451
Back	of a hog 6 to 7 months old	0·8604	32·0	39·0	63·61	64·80	0·65	0·183
Kidneys		0·8583	43·0	44·0	52·35	53·60	0·60	0·169
Intestines		0·8594	46·0	42·5	49·85	51·90	2·00	0·564
Back	of a hog 10 months old	0·8610	33·5	39·5	60·95	62·35	0·50	0·141
Kidneys		0·8587	47·5	44·0	46·60	47·20	0·55	0·155
Intestines		0·8586	47·0	43·5	47·60	48·20	1·05	0·296
Back	of a hog 6 to 7 months old	0·8608	33·0	39·0	61·20	62·50	0·50	0·141
Kidneys		0·8592	44·0	43·5	51·50	53·20	0·65	0·183
Intestines		0·8581	45·0	44·0	52·85	54·15	1·45	0·409
Back	Means of the above results	0·8607	33·8	40·0	60·58	61·90	0·54	0·152
Kidneys		0·8590	43·2	43·2	52·60	54·20	0·58	0·163
Intestines		0·8588	44·5	42·9	53·10	54·40	1·28	0·360

—J. L.

Soap: its Manufacture and Analysis. H. T. Vulté. School of Mines Quarterly, **13**, 243.

See under XXIII., *page* 630.

A new Method for detecting Cotton-seed Oil in Pig's Lard and Olive Oil, and the approximate estimation of Cotton-seed Oil in Lard. F. Gantter. Zeits. Anal. Chem. **32**, 303.

See under XXIII., *page* 629.

PATENTS.

Improvements in the Process of Making Soaps. R. H. F. Finlay, Willesden, Holywood, Ireland. Eng. Pat. 9432, May 18, 1892.

The improvements relate to the methods in which ammonia is used instead of caustic soda or potash for saponification. The ammonia soaps are obtained either by intermixing fatty acids with aqueous ammonia or by treating neutral fats with ammonia in a closed vessel under a pressure of about nine atmospheres. The ammonia soaps resulting in either case are subsequently converted into hard or soft soaps by treatment with sodium or potassium chlorides.—J. L.

Safety Arrangements for Floating and Stationary Inflammable Oil Storage Tanks. B. H. Thwaite, Liverpool. Eng. Pat. 12,860, July 13, 1892.

See under III., *page* 591.

Improvements in Apparatus for Filtering and otherwise Purifying Oil. C. H. Freyer, Bermondsey, Surrey. Eng. Pat. 19,745, November 2, 1892.

This invention is embodied in an apparatus for filtering oil; the essential part of the apparatus is the filter composed of an inner and outer mantle filled with wadding and perforated with holes.—J. L.

An Improved Apparatus for Extracting from Various Substances Matters Soluble in Volatile Solvents. C. A. Allison, London. From the Merz Universal Extractor and Construction Co., of New York. Eng. Pat. 6919, April 4, 1893.

See under I., *page* 586.

An Improved Process for the Extraction of Oleïn from Tallow. J. Soler, Paris, France. Eng. Pat. 7562, April 13, 1893.

The inventor dispenses with the use of presses for the separation of oleïn from tallow, by allowing the molten tallow to crystallise at a temperature between 25° and 35° C., when the stearin separates and the oleïn may be run off. The tallow may be previously treated in two separate vats with 1—3 per cent. of "manganese" and 0·2 to 0·5 per cent. of cream of tartar (Eng. Pat. 6955, 1892; this Journal 1892, 620). "A certain quantity of rock-salt is added to complete the dissociation of the fatty bodies, stearin, oleïn, glycerin, and margarin."—J. L.

Erratum.—This Journal, 1893, 528, col. 1, 17 lines from bottom, for "$C_{17}H_{83}COO$." *read* $C_{17}H_{33}COO$."

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Oil of Pine. De Negri and Fabris. Ann. del Lab. Chim. Centr. delle Gabelli, 1891—92, 212—214.

See under XII., *page* 606.

Gutta-percha. O. Oesterlé. Arch. Pharm. 230, 641.

Gutta-percha (preferably getah-pertcha) is a collective name applying to the product obtained by the induration of the milk sap of several different trees, of which the one formerly best known, *Isonandra Gutta* (Hooker), or *Palaquium Gutta*, has now almost disappeared, owing to the felling of the trees to obtain the juice, and their consequent destruction. According to Burck, several other species of *Palaquium* were employed in 1884 as sources of gutta-percha, notably *P. Borneense*, *P. Trenbii*, and *P. Leerii*. A somewhat similar juice is also yielded by other members of the sapotaceous family, but the products thus obtained from *Sideroxylon*, *Chrysophyllum*, and *Mimusops* are of little or no industrial value. The author has examined gutta-percha obtained from *P. Leerii*, and found it practically identical with the ordinary commercial article; it consisted of *gutta*, $(C_{10}H_{16})_n$; *alban*, $C_{40}H_{64}O_2$; and *fluavil*, $(C_{10}H_{16}O)_n$, the latter being present in larger quantity in some specimens than in others, and producing a corresponding deterioriating effect on the physical qualities of the mass; whereas an increased proportion of alban seems to be without this effect (this Journal 1892, 850; also 1893, 165).

—C. R. A. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Glove-Leather Manufacture. Reports from the Consuls of the United States, No. 150, 1893, 409.

Belgium.—Germany, France, Switzerland, Austria, Ireland, Holland, and Belgium supply the skins employed in the manufacture of gloves in the Antwerp and Brussels districts. The skins are generally purchased in the hair in the dry state, except when bought in remote parts, when they are transported salted. Sheep, lamb, kid, goat, and occasionally cross-bred skins are employed. The processes of depilation, tanning, and dyeing are practically identical with those adopted in Austria and described in this Journal, 1893, 386. Skins vary in price from 9 to 36 francs per dozen. The cost of tanning is from 2 to 6 francs per dozen.

France.—The preparation of skins of all kinds for fine gloves takes place chiefly at Paris, Annonay, Auxonne, Bordeaux, Lagny, Lyons, Le Vigan, Vernay, and St. Junien. These skins are supplied by nearly every country in the world. They are derived from sheep, goats, kids from three weeks to two months old, roebucks from 4—8 months, and lambs from 4—8 months. Cat and rabbit skins, admirably coloured, are made to imitate all kinds of furs. Rat skins are used chiefly for making thumbs. Dog skins are more of an English speciality. Ninety-five per cent. of the skins are bought in the dry state, and great care must be taken to insure their proper preservation. They must be shaken frequently to prevent fermentation and to destroy insects. Here again the processes are similar to those adopted in Austria. For dyeing, wood-colours are almost exclusively employed (95 per cent.). Aniline colours have given bad results up to the present. The brilliancy of the gloves is natural and depends mostly on the quality of the skins, on the care taken of their preservation in the raw state, and on the tawing.

Germany.—The supplies of skins used in the Berlin district are drawn from Europe, South America, and Russia. Lamb, kid, colt and calf are used, the two latter from Russia. The skins are generally bought in the dry, few in the salted state. In the Breslau district the skins are obtained from Russia, the Levant, Italy, Spain, France, Germany, Africa, Arabia and South America. The skins used are sheep, lamb, goat and kid. In the Kehl district there is a manufacturer of wash leather ("chamois") for army gloves. For this purpose the skins principally employed are doeskins, sometimes buckskins, average price 2 mks. per doeskin. After the usual depilation with lime the skins are put into the "sweller," containing a solution of lime, and here they expand, the pores becoming filled up. After being suspended in clear running water for a few hours and wrung out with sawdust by a hydraulic press, they are milled for 6—8 days with whale oil. Finally they are cleaned of surplus grease, washed, dried, stretched and drawn over a crescent-shaped iron until quite soft. In the Mannheim district, the supplies of skins partly dry, partly salted, are drawn from almost every quarter of the globe. All kinds of sheep, goat and kid skins are used. In cleansing them from chemicals used in depilation, salts of ammonia are largely used, but the composition of the solution is a trade secret.

Italy.—The skins used are sheep, goat, and kid, and the demand is almost entirely supplied by Italy itself. There is nothing special to note in the processes. Price for tanning skins 3 frs. per doz.

Russia.—Sheep, goat and kid skins are but little used. The bulk of fine gloves is made from foal skins, requiring much hard labour to make them soft and delicate. The experiment to produce them in France, Belgium and Germany, has failed, the workmen in those countries not possessing the necessary perseverance. In order to prepare the skins they are submerged for 5—6 weeks in a concoction of water, flour, eggs, alum and bran. No chemicals are added. They are then dressed by hand, by rubbing them over wooden blocks with a hand pin. This is the most difficult part of the process and requires great endurance and patience. Aniline dyes are seldom used, the majority of shades being obtained from dye-woods. Out of 500 foal skins from 12—1,500 gloves of best quality can be made, which is tantamount to 7½*d.*—8½*d.* per pair. Labour is very cheap.

Spain.—The skins generally used are those of young kids, they are bought ready tanned. To prepare them for dyeing, they are washed in clean water for 10—15 minutes, wrung out and then placed in another water containing the yolk of an egg for each two skins. After this operation, which softens the skin, it is wrung again, extended on the dye-bench, and treated with urine or a solution of ammonia. Both anilines and dye-woods are used. Russia leather is sometimes used, for which, after the usual depilation, the skins are macerated in a bath of fermented rye-flour for 2—3 days, then washed in running water. The tanning is performed by means of the bark of birch, pine or willow, in a decoction of which the skins are submerged and agitated twice a day for 2—6 weeks. After this they are cleaned, extended upon a table and impregnated by the empyreumatic oil obtained from birch bark, rubbing them until they are completely saturated. The hair side is then bathed with a solution of alum, then dried and a fluted cylinder passed over it. It is now ready for dyeing. The red colour of Russia leather is obtained by boiling sandalwood and logwood in limewater containing a small quantity of carbonate of potash and caustic soda, which infusion is poured into sacks formed by two skins (to be dyed) with the hair side inwards. The liquid is kept inside until it penetrates the skin.

Sweden.—No features of peculiar excellence are claimed for Swedish-made gloves, and skins are imported ready for use from Russia and Germany.—Edo. T.

Reply to Knapp's Criticism on the Theory of Tanning.

Von Schroeder and J. Pässler. Dingl. Polyt. J. 1893, **287**, 43—46, 238–239, 240, 258, 283, 300 and **288**, 143.

Knapp (this Journal, 1893, 297) has objected to the authors' experiments on the absorption of tannin by hide (*loc. cit.*) mainly on the ground that Reimer showed that the liquor left in the hide at the conclusion of the tanning process is very different in composition to the liquor in which the tanning has been conducted, so that the correction which the authors made for the tannin contained in the liquor left in their hide powder is inadmissible. The authors now point out that their experiments cannot be compared in this way with those of Reimer, who used strips of hide which retained some 25 per cent. of the liquor in which they were tanned; the authors' hide powder did not retain more than 1—1·5 per cent. Admitting that it is possible that this retained liquor contains no tannin, and that it amounts to 2 per cent. of the total liquor used, the authors recalculate their results and find that, although the absolute quantity of tannin absorbed is greater in each case, the relation between the quantities is hardly altered. The following line of figures shows the amounts of tannin (dry and ash-free) contained in 100 parts of the tanned hide powder (also dry and ash-free) calculated on the basis of the above assumption, and should be compared with the last line of the table on page 279 (this Journal, 1893) :—

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
33·6	48·5	71·5	83·4	80·6	76·1	68·2	69·3	68·7

The authors attribute the rest of Knapp's criticism to his having imperfectly studied their papers on the subject. To the foregoing Knapp replies, maintaining that Schroeder and Pässler have only proved that hide absorbs the same quantity of tannin from solutions of the same strength in the same time — a demonstration which can hardly be allowed to be fraught with practical importance. The reason why the tanner handles his hides in weak liquor and lays away in liquor of increasing strength is far more for the sake of the grain of the leather and for the proper exhaustion of the tannin than for obtaining the maximum absorption. Experiments with hide powder and tannin are held to be incomparable with the tanning of hides with bark. Knapp again appeals to Reimer's experiments (Dingl. Polyt. J. **205**, 143; **248**, 358, 457). Von Schroeder and Pässler now make a final rejoinder, stating that Knapp has entirely misunderstood the fifth table which they published in their original paper (Dingl. Polyt. J. 1892, **284**, 256 and 283; this Journal, 1893, 279). The practical bearing of their work has been fully acknowledged by the *Gerber-Courier*, where the writer agrees with their conclusions. Reimer's experiments are not *ad rem.;* they are concerned with mineral-tanning and not with bark-tanning. To this Knapp replies insisting that Reimer's experiments are concerned with general principles, and do not apply to mineral tanning exclusively. Von Schroeder and Pässler next publish *An Investigation of the Constituents of Various Hides*, the gist of which is as follows—

The German custom of estimating the produce of the tannery by subtracting the weight of the hide prepared for tanning from that of the finished leather is obviously fallacious unless it can be shown that the prepared hide invariably contains the same percentage of water. A far better method of attaining the same object would be afforded by a determination of the nitrogen content of the tanned hide, provided that (1) the nitrogen in the dry prepared hide were known, and (2) that no appreciable quantity of the hide substance were decomposed or dissolved during the tanning process. The second of these points will be dealt with in a later communication; the first is handled in this paper.

Prepared Hide.	Water in Prepared Hide.	In Anhydrous Hide.						
		Fat.	Ash.	Hide Substance.	In Fat- and Ash-free Hide.			
					N.	C.	H.	S.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Sweated ox-hide:								
(*a.*) Butt	68·25	0·26	0·33	99·41	17·88	50·51	6·43	0·20
(*b.*) Shoulders (*Hals*)	71·54	0·19	0·29	99·52	17·92	..	..	..
(*c.*) Belly	75·15	0·43	0·27	99·30	17·79	..	..	..
(*d.*) Whole hide	71·16	0·28	0·30	99·42	17·87	..	..	..
Limed ox-hide:								
(*a.*) Left butt	73·22	0·22	1·33	98·45	17·84	50·33	6·49	0·21
(*b.*) Right butt	73·27	0·25	1·11	98·64	17·85	..	..	..
(*c.*) Belly, shoulders	78·22	0·49	1·62	97·89	17·78	..	..	..
(*d.*) Whole hide	75·41	0·33	1·37	98·30	17·81	..	..	..
Horse-hide:								
(*a.*) Butt (*Spiegel*)	..	0·57	1·68	97·75	17·85	..	..	..
(*b.*) Middle (*Kern*)	..	0·87	1·56	97·57	17·93	50·20	6·44	0·22
(*c.*) Belly, shoulders	..	1·48	1·86	96·66	17·69	..	..	..
(*d.*) Whole hide	77·83	1·10	1·73	97·17	17·78	..	..	..

Prepared Hide.	Water in Prepared Hide.	In Anhydrous Hide.						
		Fat.	Ash.	Hide Substance.	In Fat- and Ash-free Hide.			
					N.	C.	H.	S.
Calf-skin I.	79·93	0·62	1·00	98·38	17·78	50·21	6·46	0·23
" II.	80·80	1·02	1·09	97·89	17·78	..	..	..
" III.	82·09	0·60	1·25	98·15	17·80	..	..	..
African kip	77·45	1·01	0·78	98·21	17·76	..	..	..
Bull's head	75·29	0·80	0·69	98·51	17·92	..	..	..
Bahia hide	61·88	0·31	0·26	99·43	17·83	..	..	..
Cow-hide (shoulders)	80·98	0·66	1·97	97·37	17·89	..	..	..
Camel-skin	77·04	1·10	2·40	96·50	17·67	50·02	6·43	..
Pig-skin	77·06	2·57	0·83	96·60	17·84	49·90	6·34	..
Sheep-skin								
(*a.*) Left side	..	6·97	1·17	91·86	17·15	..	..	..
(*b.*) Right side	..	6·98	1·20	91·82	17·05	..	..	..
(*c.*) Whole skin	88·59	6·98	1·19	91·85	17·10	..	..	..
Sheep-skin:								
(*a.*) Butt (*Kern*)	..	11·53	1·58	86·89	17·05	50·19	6·49	0·21
(*b.*) Shoulders (*Hals*)	..	7·60	1·50	90·90	17·06	..	..	..
(*c.*) Belly	..	4·97	1·74	93·29	17·16	..	..	..
(*d.*) Whole skin	..	8·13	1·64	90·24	17·10	..	..	..
Sheep-skin	..	9·66	1·47	68·87	17·18	..	..	..
Goat-skin:								
(*a.*) Left side	81·41	2·55	0·39	97·07	17·48	..	..	..
(*b.*) Right side	81·70	2·62	0·52	96·86	17·47	..	..	..
(*c.*) Whole skin	81·55	2·58	0·45	96·97	17·47	50·31	6·35	0·21
Deer-skin	84·58	1·11	1·52	97·37	17·41	50·34	6·38	..
Doe-skin	84·91	3·63	1·19	95·18	17·38	50·14	6·37	..
Cat-skin	74·04	31·42	2·81	65·77	17·05	51·10	6·51	..
Dog-skin	77·22	26·57	2·75	70·68	16·97	50·26	6·45	..
Rhinoceros-hide	69·34	0·08	2·08	97·84	17·98	50·29	6·39	..
Gelatin	..	..	..	..	17·72	49·91	6·35	0·50

From the percentages of water given in the following table it will be noted that the amount retained by the prepared hide (the stage at which it is weighed, just before being placed in the suspender) is much greater in such as have a spongy texture than in the firmer hides. The percentage differs in different samples, and in different parts, of the same hide; it is dependent also upon the previous treatment of the hide, those that have been limed retaining more moisture than those that have been sweated.

The fat is the carbon bisulphide extract of the prepared hide. It is very small in quantity in those hides which are bark-tanned. In sheep-skins the percentage is very much higher, and differs considerably with the individual.

Much of the ash is extraneous, and is derived from the limes during the unhairing process; the true ash is better seen in the sweated ox-hides.

The nitrogen determinations were made on the fat-freed portions by Wilfarth's modification of Kjeldahl's process. These numbers are regarded by the authors as the most valuable portion of their work, and they make the following generalisations thereon:—

The nitrogen content of the anhydrous, ash- and fat-free hide substance may be regarded as constant in animals of the same species, and in different parts of the same individual. In several species it is of the same, or approximately the same value, so that hides may be grouped in three classes:—

(1.) Kips, ox-hides, horse-hides, pig-skins, and camel-skins, with a mean of 17·80 per cent. of nitrogen.

(2.) Goat-skins, deer-skins, and doe-skins, with a mean of 17·40 per cent. of nitrogen.

(3.) Sheep-skins, dog-skins, and cat-skins, with a mean of 17·10 per cent. of nitrogen.

It thus becomes possible to calculate the proportion of tannin to hide-substance in a leather from a determination of its nitrogen, if the origin of the leather be known, and to judge whether the tanning is completed.—A. G. B.

Spermolepis Gummifera. Heckel and Schlagdenhauffen. Rép. de Pharm. 5 [3], 241.

The authors describe this plant as forming solid deposits of a tanno-resinous substance between the concentric zones of wood. This exudes from the surface of the trunk and branches of old trees, runs down cracks in the bark, and then spreads itself in thin shining black layers. It may also accumulate in small round drops, which dry quickly and present a brownish fracture. In parts these drops are transparent and of the colour of caramel. They are inodorous when fresh, have a very astringent taste, and crush between the teeth to a greyish dust, which sticks to the enamel. The astringent effect lasts for some time. When old the exudation exhales a disagreeable odour resembling that from a tannery. On analysis the substance was found to consist of gallotannic acid, 79 per cent.; woody matter, 5·9; albuminoid matter, 2·0; salts 0·1;

water, 13·0. In New Caledonia the tanno-resinous substance has been employed for tanning the skins of small mammals, but it does not appear as yet to have been utilised in the tanning industries generally. It suggests itself as affording a useful source of tannin.

PATENT.

Improvements in or relating to the Process of Tanning in the Manufacture of Leather. J. S. Sinclair, London. From J. D. Gallagher, New Jersey, U.S.A. Eng. Pat. 7732, April 15, 1893.

The tanning bath is prepared by dissolving one pound of chromic oxide in eight ounces of hydrochloric acid and then rendering the resulting chromium chloride basic by the addition of sodium carbonate until permanent precipitation begins. Three gallons of such concentrated solution are added to 100 galls. of water and a few more pounds of sodium chloride are added for the purpose of preventing the grain of the leather from drawing under the astringent effect of the chromic salt and to facilitate the tanning action. In this bath the skins are paddled for 10—48 hours, according to thickness; they are then washed in clean water and paddled in a bath containing finely-divided calcium carbonate or its equivalent, to neutralise any remaining trace of acid. All basic chromium salts, *i.e.*, such as contain "more than one equivalent of the metallic base to one equivalent of the acid," are covered by the claim.—A. G. B.

XV.—MANURES, Etc.

PATENTS.

Improvements in Manufacturing Manure from Sewage. J. Carter, London. Eng. Pat. 18,648, October 18, 1892.

The sewage is run into a circular precipitating tank, the details of the construction of which are duly claimed. The precipitants are powdered chalk, "with or without alum, burnt loam, or burnt clay, or sulphate of iron, or other chemicals." The sludge is received in sacks, where it is drained, and when dry is mixed with ashes, or burnt loam, or burnt clay, or old building rubbish, soda, resin, and soot. There are also claims for the adoption and use in the processes referred to of harrows, rollers, wash-mills, and sacks.—A. G. B.

Improvements in the Treatment of Hydrated Phosphates of Alumina and Iron for Obtaining an Improved Fertiliser. H. H. Lake, London. From A. M. Goodale, Waltham, Mass., and Marcia W. A. Spring, Portland, Maine, U.S.A. Eng. Pat. 6061, March 21, 1893.

The hydrated phosphates named in the title are heated in a suitable receptacle having an outlet for vapour, to a temperature varying from about 275° to 350° C., according to the amount of constitutional water present. The heat is carefully applied so as to be equable throughout, and when vapour ceases to be given off, which is ascertained by applying a suitable cold surface to the orifice and finding no deposition of water on such surface, further increase of heat is arrested. The process is stated to so modify the phosphates as to render them "*citrate soluble*," and thereby to fit them for direct application as fertilisers.—E. S.

XVI.—SUGAR, STARCH, GUM, Etc.

Microscopic and Chemical Examination of Durra (Sorghum Cernuum). M. Tortelli. Ann. del. Lab. Chim. Centr. delle Gabelli, 1891—92. 277—286.

In the last few years the admixture of the Durra starch with wheat starch has been practised on an extensive scale, but this is often regarded as a fraud by the Custom house authorities.

The *durra* is the fruit of a species of grass, which has received a variety of names from botanists, viz., Holcus Sorghum, Andropogon Sorghum, Sorghum Cernnums, &c. The grass is cultivated on a large scale in Egypt, Equatorial Africa, India, and China; it was apparently known to the Hebrews, as Ezekiel (chap. iv. 9) mentions the Dodan as a cereal from which bread is made. Its culture is not difficult, and does not differ greatly from that of maize.

Illustrations of the various sections of the glumes and caryopsis, as also of the starch granules, accompany the paper.

The following analytical results are given of the granules:—

	Per Cent.
Moisture	13·17
Substances soluble in water	6·16
Substances insoluble	80·67

The soluble portion consists of—

Maltose and dextrin	78·72
Vegetable albumin	13·97
Ash	7·31

Tha acidity of the granules increases slightly, reaching a maximum of 0·36 per cent., in terms of sulphuric acid, after a lapse of six months. A complete analysis of the starch gave the following results:—

Water (volatile at 100°)	13·17
Albuminous substances	9·06
Fatty matters	3·12
Starch	66·82
Dextrin	1·67
Maltose	3·18
Cellulose	1·18
Ash	1·12

The ash consists for the most part of potash, magnesia, phosphoric acid, and silica. The proportion of nucleic nitrogen is 0·256 per cent., and of proteic, 1·15; of the latter 0·785 per cent. is digested by gastric juice and 0·894 per cent. by gastric and pancreatic juices.

The author concludes that the durra is a cereal very rich in carbohydrates, and contains all the elements necessary for a material used for the manufacture of bread, and forms an article of food more suitable than maize.—V. H. V.

Birotation and Hydrazone Formation of Certain Sugars. H. Jacobi. Annalen, 1892, **272**, 170.

See under XXIII., *page* 629.

The Drying of Beetroot Strips. M. Müller and F. Ohlmer. Zeits. ang. Chem. 1893, 142—148.

After a lengthy introduction, dealing with the literature of this subject, the authors give in a tabulated form the results of their examination of pressed beetroot strips and of the water expressed from them, both filtered through a horse-hair sieve ("unfiltered waste water") and filtered several times in the laboratory. It will suffice to give here the average of their figures:—

——	Ashes.	Organic Substances.	Total Solids.	Nitrogen.	N of the Organic Substances.	N × 6·25.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
Strips	..	..	12·03	..	..	..
Unfiltered waste-water	0·255	0·589	0·844	0·0122	2·10	13·1
Filtered waste-water	0·013	0·298	0·311	0·00064	0·21	1·3
Substances held in suspension	0·243	0·290	0·533	0·0115	4·00	25·0

The strips supplied to the authors by a sugar works had been previously expressed in the works by hydraulic pressure, using Klusemann's presses. The authors further analysed the waste-water running from "conical presses," made by Selwig and Lange, with the following result:—

——	Ashes.	Organic Substances.	Total Solids.	Nitrogen.	N of the Organic Substances.	N × 6·25.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
Unfiltered waste-water	0·203	0·421	0·614	0·0054	1·29	8·05
Filtered waste-water	0·042	0·217	0·260	0·0005	0·22	1·40
Substances held in suspension	0·161	0·204	0·364	0·0050	2·53	15·80

There are less organic substances, consequently a smaller loss of valuable foodstuffs, in the second instance, but the conical presses of the present construction do not express a sufficient quantity of water so as to render the subsequent drying of the strips by hot air a sufficiently remunerative process. By using hydraulic pressure the pressed strips cannot be brought to contain 20 per cent. of the solid matter; this object might, however, be obtained if the strips were reduced to small pieces, as laboratory experiments instituted by the authors go to prove.—J. L.

Determination of Sucrose, Dextrose, and Levulose. F. G. Wiechmann. School of Mines Quarterly, **13**, 197.

See under XXIII., *page* 629.

XVII.—BREWING, WINES, SPIRITS, Etc.

The availability of the Fluoresceïn Reaction for the Detection of Saccharine in Beer. F. Gantter. Zeits. Anal. Chem. **32**, 309.

See under XXIII., *page* 628—629.

Glucose: its Application to the Improvement of Wines. J. Brössler. Dingl. Polyt. J. 1893, **287**, 231—235.

The fortification of wines which have been made from cold-climate grapes (containing a deficiency of sugar) with sugar, which, by its subsequent fermentation, will increase the alcohol-content of the wine and thus render it sounder, has long been practised. In this paper the question as to whether commercial glucose (from starch or potatoes) should be allowed to be used for the purpose is discussed. As at present made commercial glucose invariably contains dextrin and allied substances; in the following analyses these are termed unfermentable compounds:—

——	German and Austrian Glucose.	American Glucose.
	Per Cent.	Per Cent
Dextrose	64·3	73·4
Unfermentable compounds	18·0	9·1
Water	17·0	17·6
Ash	0·7	0·7

The dextro-rotatory character of these products, intermediate between starch and glucose, has led to the depreciation of wines which show such rotation to any considerable extent, mainly on the grounds that—(1) the soundness of the wine is impaired; (2) the action of the dextrins, and such alkaline and acid impurities as accompany commercial glucose, on the system is of an undesirable nature; (3) the fermentation of glucose, particularly from potatoes, is accompanied by the production of fusel oil.

The author proceeds to discuss the evidence which has recently been adduced both for and against the fermentability of these intermediate dextrin-like compounds (see this Journal, 1892, 765—766). So conflicting are the opinions on the subject that the question must at present remain open, and in view of this uncertainty as to the effect of the by-products in the commercial glucose, as ordinarily made, on the soundness and dietetic qualities of the wine, the author urges that the addition of all glucose shall be forbidden, save that of such as contains as nearly as possible 100 per cent. of sugar. This course has already been adopted in many quarters, with the beneficial effect that commercial glucose is rapidly becoming a pure article.—A. G. B.

PATENTS.

A New or Improved Method of Purifying and Hardening Water for Use in the Manufacture of Malt Extract, and for Brewing and Analogous Purposes. R. G. Ross, J. B. Hilliard, and W. Paterson, all of Glasgow. Eng. Pat. 9165, May 14, 1892.

A suitable quantity of lime and calcium chloride, or even a mixture of caustic alkalis, is added to the water it is desired to harden. Part of the lime is neutralised with sulphuric acid and the remainder converted into bicarbonate by passing carbonic acid gas into the water.—A. L. S.

A New or Improved Filtering Bag for Breweries, Distilleries, and the like Purposes. J. G. Müller, Garmisch, Bavaria. Eng. Pat. 9855, May 24, 1892.

This seamless, conical filtering-bag is knitted in one piece by a special machine, and is composed of asbestos and cotton. It is easily cleaned by boiling, and does not shrink or alter in shape when in use.—A. L. S.

A New or Improved Tonic Beverage. H. Rinck, Lyons, France. Eng. Pat. 13,846, July 29, 1892.

The desired dose of ammoniacal citrate of iron is dissolved in beer, which is then submitted to a slow and prolonged pasteurisation.—A. L. S.

Improvements in and connected with Yeast. H. Reid, Glasgow. Eng. Pat. 21,661, November 28, 1892.

To produce a portable yeast cake the pressed yeast is mixed with flour or other cereal produce, made into cakes, and dried in a current of air.—A. L. S.

Improvements in and connected with Brewers' and similar Thermographs. C. A. Day, London. From A. Walther, St. Louis, Missouri, U.S.A. Eng. Pat. 6963, April 4, 1893.

The apparatus consists of a bulb containing ether connected with a pressure gauge. The movements of the finger of the gauge are recorded by a pencil on a moving scale. When the bulb of the instrument is inserted in a mash tub the ether is vaporised by the heat of the mash, and the pressure of the ether vapour, which is proportional to the temperature, is recorded.—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

The existence of Gluten in Wheat. Balland. Comptes rend. **116**, 1893, 202—204.

According to Johannsen it is impossible to extract any gluten from wheat by working at a temperature of 0°, but from that point up to 40° the amount recoverable increases, decreasing again as the thermometer rises still further. The author has, however, been able to extract 27 per cent. of moist gluten from wheat kept at −8° for several days by levigating with water at +2°, while at 15° the yield is 27·6 per cent., and at 60° it rises to 30 per cent. On treating flour which has been disinfected by exposure to an atmosphere containing sulphurous acid formed by burning 60 grms. of sulphur per cubic metre in the ordinary way, no gluten is to be obtained, but on using salt water it may easily be isolated; or the same result may be arrived at by adding to sulphurous flour a known weight of washed gluten.

It is evident, therefore, that gluten exists as such in wheat. —F. H. L.

The Carbohydrates of the Coffee Berry. E. E. Ewell. Amer. Chem. **14**, 473—476.

Walter Maxwell has demonstrated the presence of a substance yielding galactose in that portion of coffee insoluble in water, and he succeeded in preparing a considerable amount of pure and well-crystallised galactose by hydrolysis with sulphuric acid of the residue insoluble in water. Reiss (Ber. 1889, **22**, 609) has reported the presence of a carbohydrate that yields mannose by hydrolysis, but the carbohydrates of coffee soluble in water have received less attention. The author's experiments show that cane sugar is the principal carbohydrate soluble in water. Pure and well crystallised preparations of cane sugar were obtained by two different methods: the first. that due to Schulze, Steiger, and Maxwell (Landwirt. Versuchs-stationen, 189, **39**, 269), and the second a modification of the foregoing, in which the extract is evaporated to a syrup after treatment with lead acetate, and is then directly treated with alcohol without the use of strontium hydroxide. For the quantitative determination of the cane sugar, 10 grms. of coffee in 1 mm. powder were extracted in a continuous percolation apparatus with absolute ether, and the residue remaining was extracted with 75 per cent. alcohol. Duplicate determinations gave 6·24 and 6·34 per cent. of sucrose. These numbers include the small amount of reducing sugar that was present. The portion of coffee insoluble in water yields an abundance of furfuraldehyde when distilled with hydrochloric acid sp. gr. 1·06, which indicates the presence of a pentose-yielding carbohydrate. By distillation of 5 grms. of untreated coffee, 4·2—4·6 per cent. of furfuraldehyde were obtained. which is equivalent to 8—10 per cent of a pentose (xylose or arabinose) in the original material. A gummy substance is obtained when a 5 per cent. sodium hydroxide extract is precipitated with alcohol according to the method used for the separation of xylan from wood. Lintner and Düll Zeits. f. angew. Chem., 1891, 538; Chem. Ztg. Repert., 1891, **15**, 266 (this Journal 1891, 1019), have reported a similar gum from barley, and Lippmann Ber. d. Chem. Ges. 1890, **23**, 3564; Zeits. f. angew. Chem., 1891, 538; Chem. Ztg. Repert., 1891, **15**, 44 (this Journal, 1891, 375), has separated gum from sugar beets that yields galactose and arabinose.—G. H. R.

Butter of Cocoa Nut. De Negri and Fabris. Ann. del Chim. Centr. delle Gabelli, 1891—2, 263—269.

See under XII., *page* 607.

Oil of Poppy Seed. De Negri and Fabris. Ann. del. Lab. Chim. Centr. delle Gabelli, 1891—2, 214.

See under XII., *page* 607.

Composition of Certain Spices. Th. Arnst and F. Hart. Zeits. ang. Chem. 1893, 136—137.

See under XXIII., *page* 631.

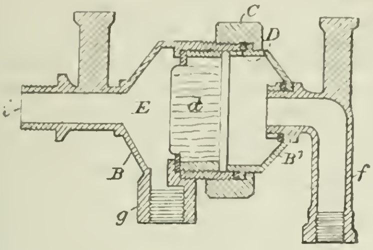
Estimation of Water in Butter. Wibel. Zeits. f. ang. Chem. 1893, 220.

See under XXIII., *page* 630.

PATENTS.

An Improved Filtering Apparatus. A. Southwell, Southampton. Eng. Pat. 12,272, July 2, 1892.

The invention is for a portable filtering apparatus for attachment to the service or daily supply pipes. It consists of a metal case made in two parts B, B¹, connected together by a union nut C and flexible washer D. A block of the filtering medium *d*, preferably of teak-wood is fixed inside the casing, and the water entering from the service pipe by the inlet *i*, percolates through this block *d*, and afterwards flows away through the outlet pipe *f* by means of a tap placed thereon. If filtered water is not required the outlet *f* is closed and the tap on pipe *g* is opened for supplying ordinary unfiltered water. The construction of the apparatus enables it to be easily taken apart for repairs and cleaning, while any deposit in the chamber E may be washed out at once by allowing the water to rush through the outlet pipe *g*.



IMPROVED FILTERING APPARATUS.

—E. G. C.

Improvements in Filters. S. A. Johnson, Poplar, Middlesex. Eng. Pat. 13,376, July 21, 1892.

THE invention relates to that class of filters which are attached to a water pipe and from which filtered or unfiltered water can be drawn off as desired. The body of the filter is barrel-shaped with a perforated pipe passing through it, which latter is plugged up at the centre. The lower part of the body is provided with the usual filtering block. When the water is allowed to enter by the central tube it passes through the perforations into the upper part of the barrel from which it can be drawn off if unfiltered water be required. This water also percolates through the filtering medium and again enters the perforated tube below the plug, and can then be drawn off by a tap or other connection.—E. G. C.

Apparatus for Cooling Liquids. W. H. Webb, Bootle, and J. Siddeley, Liverpool. Eng. Pat. 13,789, July 29, 1892.

THE invention has reference to apparatus for cooling such liquids as milk and cream which require the surfaces over which they flow to be capable of being cleansed with ease and thoroughness. Two corrugated plates are connected together to form a shallow closed box upon the top of which is placed a perforated containing trough for distributing the liquid over the corrugated surface; below is a collecting trough to catch the cooled liquid. The interior of the apparatus is filled with a cooling liquid, such as brine, while a coiled pipe through which ammonia or other fluid is forced, also passes from end to end of the corrugated box. The combined action of the brine and the fluid in the coiled pipe causes a considerable amount of heat to be abstracted from the liquid flowing over the corrugated surfaces.—E. G. C.

An Improved Preparation for Coagulating Milk. "The Nutriment Company" and C. P. Eyre, Chicago, U.S.A. Eng. Pat. 2675, February 7, 1893.

THE object of this invention is the preparation of rennet in a solid form and as free as possible from pepsin and other impurities (mucus, animal matter, &c.). For this purpose the cardiac portion of the mucous lining of the stomach of the hog, calf, &c. is washed, chopped, dried, and reduced to powder. The powder is digested for four days with dilute hydrochloric acid (5 per cent.), the mixture being frequently agitated. The solution is then filtered, strong magnesium sulphate solution added until nearly the whole of the pepsin is precipitated, and subsequently the excess of magnesium removed by the addition of ammonia. After filtration the nearly pure solution of rennin is concentrated *in vacuó* at a temperature not exceeding 105° F. to a thick syrup, mixed with sufficient powdered sugar or starch to yield a stiff paste, and finally dried—for instance, in a current of hot air. Prior to drying the preparation may be granulated by forcing it through a sieve; or it may be converted into any desired form. The dry preparation is stated to remain good indefinitely with ordinary care.—H. T. P.

Improved Means and Apparatus for Rapidly Cooling and Congealing Liquids or Semi-Liquids. J. O. Spong, London. Eng. Pat. 4984, March 7, 1893.

THE invention relates to apparatus for preparing edible or other ices in small quantities. The cream or other liquid required to be frozen is poured into a tube provided with a perforated piston, worked by a piston-rod passing through a stuffing-box at one end. The outer end of the tube is afterwards closed by a stopper, and the apparatus immersed in a freezing mixture, the piston being at the same time worked up and down to expose fresh surfaces to the cooling action of the sides of the tube until the liquid becomes pasty. The piston is then drawn up to the top to allow the liquid to solidify. At the close of the operation the tube is immersed in water to relieve the ice from the inner side of the tube. The stopper is then removed and the ice is pushed out by means of the piston. Instead of a tube of regular form any irregular shape may be used, such as a mould.—E. G. C.

Process of Purifying Water for Household Use and Consumption. F. W. Golby, London. From G. Oppermann, Roebel, Germany. Eng. Pat. 5596, March 15, 1893.

THE water is conveyed through a narrow channel in which it is repeatedly electrolysed by means of electrodes placed in compartments of the channel and "connected by a current circuit." The water thus absorbs "considerable quantities of ozonised oxygen and peroxide of hydrogen," with which it is thoroughly mixed by flowing over small weirs. "With a view to destroy the last traces of vital organisms and to rapidly expel the excess of ozone," the water is heated in a gutter by the electric current, after which it is cooled and filtered.—A. G. B.

Improved Process for Destroying Infectious Germs in Milk and Apparatus therefor. G. H. Neuhauss, J. F. H. Gronwald, and E. H. C. Oehlmann, Berlin, Germany. Eng. Pat. 6838, April 1, 1893.

ACCORDING to this process, milk is sterilised by heating it to 100° C. or more with steam under pressure, *i.e.*, the conditions are such that the milk cannot actually boil. It is claimed that by this means nearly all the properties of fresh milk are retained. For instance, the cream may still be separated by natural creaming or by a centrifugal separator for the purpose of butter making. This is not possible in the case of milk boiled in the ordinary way. The heating of the milk is effected in open vessels which are placed in a closed boiler fitted with a safety valve, and containing in its lower portion water for steam production. On the large scale, however, it is preferable to generate the steam in a separate boiler. The milk pans are made either very shallow or in the form of a series of deep, narrow vessels placed close together and connected end to end, the object being to present a large surface to the steam. It is almost unnecessary to say that in order to avoid ebullition, the milk after sterilisation must be allowed to partially cool under pressure before opening the vessels.—H. T. P.

An Improved Method of Purifying Water or Contaminated Water, and Apparatus therefor. H. Krieg, Reichenbach, Germany. Eng. Pat. 7870, April 18, 1893.

The purification is effected by aëration in an apparatus which consists of a rotating vertical cylinder, to the bottom of which the water flows by a central funnel which will serve for the addition of any desired chemical. The top of the funnel is covered by a fan for circulating fresh air through the apparatus. A pipe passing down the stem of the funnel serves for the introduction of carbon dioxide or other gas. By rapidly rotating the cylinder the water is caused to creep up its sides and flow through holes disposed in a ring round the top of the sides; from there it flows in a cascade over a number of baffle-plates alternately attached to the rotating cylinder and its outer casing. From the outer casing the water flows into the reservoir or into another aërator as may be required.—A. G. B.

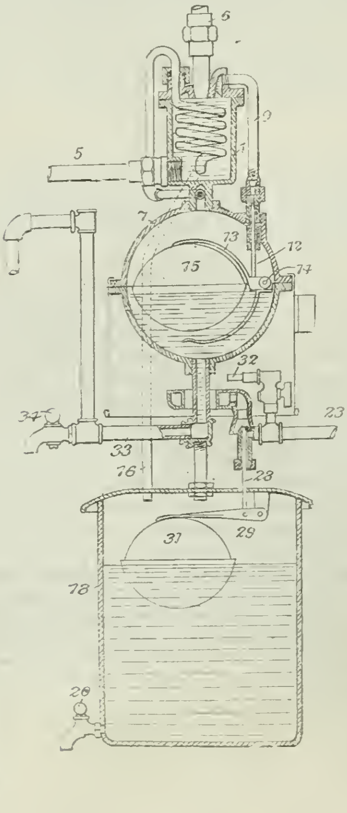
Improvements in or relating to the Sterilisation of Milk. A. J. Boult, London. From F. J. Haarlem and C. Henny, Sloten, Holland. Eng. Pat. 8505, April 27, 1893.

The milk to be sterilised is submitted to the action of a strong alternating current of electricity. It is stated that by this means all micro-organisms present, whether derived from the air, vessels, &c., or from diseased cows, are destroyed; and the risk of transmission of infectious maladies through the medium of milk obviated. The electric current may be applied to the milk in the ordinary containing vessels; or the process may be worked continuously, by passing the milk at a suitable rate through a long narrow trough fitted with a series of metallic plates connected with the poles of the source of electricity.

—H. T. P.

Improvements in Automatic Distilling Apparatus. E. Ruud, Pittsburgh, U.S.A. Eng. Pat. 8817, May 2, 1893.

The improvements are embodied in an automatic apparatus for the supply of pure distilled water for drinking, and of hot water for domestic purposes. The accompanying drawing is a central vertical section of the apparatus.



Water enters the condenser 1 by means of the supply pipe 5 where it is used for condensing the steam in the worm, it afterwards passes by means of the pipe 9 past the valve 12 into the boiler 7, or it may pass by the discharge pipe 6 into a hot water receptacle, such as a range boiler. The valve 12 is attached to a forked lever 13 with a limited motion and pivoted at 14; a float 15 bearing against the lever 13 regulates the admission past the valve 12. The boiler is heated by means of a ring gas burner 23, the supply of gas being controlled by a spindle valve 28 worked by means of a lever 29 and a float 31 in the distilled water tank 18. Thus, when enough distilled water has collected in the tank 18 the gas supply is cut off with the exception of the supply for the pilot burner 32, which is always kept alight. The steam from the boiler 7 is led away to the condenser by the pipe 16, and after passing through the worm it falls into the tank 18 by means of the pipe 16, where it can be drawn off as required by the tap 20. Hot water for domestic purposes can be drawn direct from the boiler 7 by means of the pipe 33 and tap 34. To admit of the escape of any excess of water entering the boiler when the apparatus is not in use and so prevent entry of such water into the distilled water tank 18, an overflow pipe 33 is led out of the bottom of the boiler and connected to suitable discharge.—E. G. C.

(*B.*)—SANITARY CHEMISTRY.

New Method of Determining Moisture in Walls. Arch. f. Hyg. 1892, **14**, 243.

According to Glässgen the moisture of a wall is accurately represented by the moisture contained in its mortar-covering, and Emmerich recommends the following as a thoroughly practical method:—120—200 grms. of mortar are dried in a vacuum apparatus at 100°. In order to determine at the same time the percentage of moisture and the total amount of water contained in the layer of mortar of the whole room, samples are punched out by means of cylindrical moulds of say 1, 0·5, 0·25 sq. cm. section, reduced to powder and dried on nickel pans, six of which are contained in the copper vacuum apparatus made on the principle of Soxhlet's quick drying closet. It is double-cased, the space between being filled with water kept boiling by a Bunsen burner. A Soxhlet's cooler prevents evaporation and ensures constant conditions. As soon as the condensation of water ceases, air free from carbonic acid and water is admitted, and the substance is weighed. As the area of the samples is known it is easy, if the total area of the wall has been measured, to calculate the total moisture.—Edo. T.

The Liberation of Nitrogen during Putrefaction. H. B. Gibson. Amer. Chem. J. **15**, 12.

Experiments upon the putrefaction of blood serum and beef extract were carried out, with special precautions for eliminating sources of error traceable throughout many of the previous investigations of the fate of nitrogen in such decompositions. The organisms employed for inoculation were those (1) of putrid flesh; (2) of putrid flesh together with soil infusion. It was found that the former have no marked power of determining the liberation of nitrogen, but under the influence of the latter, quantities of from 9 to 15 per cent. of the total nitrogen appeared in the elementary form.

It has also been established that the liberation of nitrogen is independent of the process of nitrification; the author's results confirming those of Leone (Centrbee Agr. Chem. 1890, 283), Bréal (Compt. Rend. **114**, 681), and Immendorff (Landw. Jahrb. 1892, 281).

In view of the facts stated the author does not hesitate to assert that liberation of nitrogen without the previous formation of nitrates or nitrites may take place during the process of putrefaction as a result of the action of micro-organisms.—C. F. C.

PATENTS.

Improvements in the Treatment of Sewage Sludge. J. B. Alliott, Nottingham. Eng. Pat. 9780, May 23, 1892.

Sewage sludge is compressed in a filter-press into cakes, which are broken up into small pieces in a grinding mill or disintegrator, mixed with other town's refuse, and burnt in a destructor.—J. G. W.

A New Compound suitable for the Purification of Sewage and other Polluted Liquors. A. S. Chinnock, London; W. Fairley, Kew; C. E. McLaren, London; and P. Meeks, Rainham, Essex. Eng. Pat. 12,392, July 4, 1892.

Calcined china clay, ferrous sulphate, soot (carbon), and sulphuric acid are mixed in a vessel provided with an agitator and heated to from 200° to 210° F., when violent ebullition takes place. On cooling, the compound, called "*carbferalum*," solidifies to a hard mass, in which form, or after prior dissolution, it is added to the sewage. Other aluminous minerals may be used instead of china clay; other salts of iron or manganese instead of ferrous sulphate, and other forms of carbon instead of soot. It is claimed that all the precipitating and deodorising effects of the several ingredients are obtained by the addition of this compound.—J. G. W.

The Manufacture of Ferric Chloride. J. H. Kidd, Manchester. Eng. Pat. 12,985, July 15, 1892.

See under VII., *page* 603.

A Furnace and other Apparatus for Deodorising and Consuming Excrement. A. Kozloff, Moscow, Russia, Eng. Pat. 13,713, July 27, 1892.

The excrement falls directly from the basin of the closets through a common soil pipe into a funnel-shaped wooden chamber lined with lead and provided with a cast-iron plug, which can be raised from the outside. Every 24 hours the plug is lifted, and the excrement falls on to an iron plate covering a furnace in a second chamber; on this it is dried prior to being tipped, by the reversal of the plate, into the furnace. The products of combustion pass through regenerating flues into pipes cooled by water, and from these into reservoirs containing water, where they are absorbed, any which may be unabsorbed passing into a second furnace constructed below the first one. The water which has been used for absorption is run away through charcoal filters. The circulation of the air is effected by the draught of the flue of the lower furnace, which passes up above the house; the air enters the system through the closet basins, and passes by means of a lateral pipe from the collecting chamber, through the regenerating flues, into the drying chamber; by this time it has collected other gases, which are next consumed by passing into the upper furnace; the course of the products of combustion of this furnace has been already traced.—A. G. B.

Improvements in Manufacturing Manure from Sewage. J. Carter, London. Eng. Pat. 18,648, October 18, 1892.

See under XV., *page* 612.

Improvements in the Treatment of Sewage or other Foul Water by Means of the Liquor obtained from Iron Pyrites Beds. J. H. Kidd, Manchester. Eng. Pat. 13,904, July 30, 1892.

The liquor from iron pyrites waste-heaps is exposed to the air until the ferrous sulphate it contains is partially oxidised to the ferric salt. It is then added to the sewage in quantity depending on the nature of the sewage, and sufficient milk of lime added to precipitate the iron. In this way hydrated ferrous and ferric oxides are formed in contact with the sewage itself, which is claimed to be an advantage.—J. G. W.

Improvements in and Apparatus for Softening Water. L. H. Bristowe, Nantwich. From E. H. Riddell and L. Watson, Chicago. Eng. Pat. 23,041, December 14, 1892.

This apparatus consists of an agitator, pump, precipitating tank, settling tank, and filtering tanks. The reagent used for precipitation, for instance lime, is introduced into the agitator, a small tank containing a series of vertically disposed screens, which are moved backwards and forwards in a horizontal direction by connection with the rod of the pump. An automatic supply of water to this tank is ensured by a small pipe from the delivery tube of the pump. This supply is controlled by a float-valve. The milk of lime passes from the agitator into the suction-pipe of the pump, in which it mixes with the water to be softened. The mixture then passes under pressure through a nozzle into the precipitating tank, which contains a horizontal wheel, around the periphery of which is a series of cups, having all their mouths facing sideways, and in one and the same direction. The impinging of the jet of water against these effects the revolution of the wheel, which brings about a still further mixture of the reagent and the water. The agitation thus brought about also tends to agglomerate the precipitate. The liquid passes from the top of this tank nearly to the bottom of the settling tank, from the top of which it is drawn off by a flexible tube connected with a float into the filtering tank or tanks.—J. G. W.

Improvements in or connected with Filtering Material for the collection of Dust, Soot, and the Like. L. B. Fiechter, Basle, Switzerland. Under International Convention, Swiss Patent, June 16, 1892.) Eng. Pat. 309, January 6, 1893.

The invention is for an improved filtering material for collecting dust, soot, and the like suspended in air or other fluid. It is intended for use in dust collecting apparatus, soot, or smoke catchers and other machinery in which air, steam, and other fluid filters are used.

The filtering material consists of a great number of parallel threads cross-woven at intervals a considerable distance apart, to keep the parallel warp threads in their places. The woven bands are made wide enough at their ends for attaching the material to framing. The fluid to be filtered is passed through a number of layers of this filtering medium, the dust particles remain hanging on to the threads, from which they can easily be detached by bringing the ends of the cloth alternately nearer together, and then stretched apart, the cloth will be thus violently shaken, and the dust particles caught among the threads will be immediately shaken out.—E. G. C.

(C.)—DISINFECTANTS.

PATENTS.

A Method of and Means for Preserving Plants from Destructive Parasites. J. A. F. Bang and M. C. A. Ruffin, Paris, France. Eng. Pat. 12,103, June 29, 1892.

The claims are for the use of α- or β-naphthol or their mixture, either dry or in solution, and of sodium or potassium "naphtholate," for the purpose indicated in the title. These latter compounds are sprayed in the form of a 1 per cent. solution; the naphthols themselves may be scattered in the form of powder.—A. G. B.

An Improved Process and Preparation for Preserving the Bodies of Animals in their Natural Form and Colour. G. E. Wiese, Hamburg, Germany. Eng. Pat. 4386, February 28, 1893.

The following preservative fluid is employed:—600 grms. of sodium hyposulphite dissolved in 5,000 grms. of water, and 75 grms. of ammonium chloride dissolved in 250 grms. of water. The two solutions are mixed together and added to 4—6 litres of spirits of wine. The bodies of the animals to be preserved are simply immersed in the above preparation; and it is claimed that they will retain their original form and colour for almost an unlimited period.—H. T. P.

XIX.—PAPER, PASTEBOARD, Etc.

Xylose from "Straw Liquor." W. E. Stone and W. H. Test. Amer. Chem. J. **15**, 195.

The authors have used in the preparation of xylose a straw liquor (lime boiling process) of the following composition—

	Per Cent.
Total solids	3·95
CaO	2·25
Specific gravity	1·215

In the manufacture of paper from straw, the latter is boiled for some hours with lime, or, according to an improved process, the straw and lime are placed in large rotating digestors and subjected to the action of steam under high pressure for some hours. After the digestion is complete the alkaline liquor is discharged.

From 32 litres of liquor they obtained 300 grms. of this the anhydride, xylan, but this still retained 8·6 per cent. of ash. The xylose was found to yield 46 per cent. of furfural (HCl hydrolysis). A quantity was hydrolysed with 2 per cent. H_2SO_4 and of crystallised xylose, 10 per cent. of its weight was obtained, representing about 1 per cent. of the original liquor.

Observations of the multi-rotation of the xylose confirmed the numbers of Tollens and Parcus (this Journal, 1890, 748).
—C. F. C.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Gelseminine. L. Spiegel. Ber. 1895, **26**, 1054—1060.

The author has made various analyses of the alkaloid manufactured in Trommsdorff's factory, and of certain of its salts, from which he deduces the formula, $C_{22}H_{26}N_2O_3$, as being somewhat better in accordance with the results than $C_{22}H_{28}N_2O_4$ The free alkaloid precipitated from a pure salt melts at near 120° ; it is sparingly soluble in water, readily soluble in alcohol, ether, and chloroform. It dissolves in sulphuric acid without colour; addition of solid potassium bichromate gives a clear rose-red coloration, gradually becoming violet and reddish-brown, and later changing to intense green. Nitric acid dissolves it to a solution at first colourless, but soon becoming reddish, and finally dark green, especially if warmed. The nitrate, hydrochloride, and hydrobromide crystallise readily; the sulphate, platinochloride, and aurochloride are amorphous. Zeisel's test (heating with hydriodic acid) gives no indication of the formation of methyl iodide, showing the absence of methoxyl. Methyl iodide combines with gelseminine, forming a crystalline methiodide, which melts at near 285° with partial decomposition. Potassium permanganate readily oxidises gelseminine, forming, *inter alia*, a small quantity of a colourless acid decomposition product, not yet fully investigated.—C. R. A. W.

Geissospermine. M. Freund and C. Fauvet. Ber. 1893, **26**, 1084—1085.

The authors have made analyses of the crystallised alkaloid manufactured in Trommsdorff's factory from Pereira bark, and sold as *Geissospermine*, and also of certain of its salts and other compounds, more especially the hydrochloride, hydrobromide, hydriodide, sulphate, and methiodide. The alkaloid melts at 189°, and has a physiological action akin to that of strychnine and brucine. The analyses lead to the formula, $C_{23}H_{28}N_{22}O_4$,whereas Hesse deduced the formula $C_{19}H_{24}N_2O_2$, H_2O for the crystalline alkaloid extracted by himself from the bark of *Geissospermum Vellosii*. An anhydro derivative, $C_{46}H_{54}N_4O_7$ melting between 60° and 70°, has also been examined. Fusing potash gives rise to a crystalline base melting at 151°, now under investigation.
—C. R. A. W.

The Amides of Ecgonine. A. Einhorn and F. K. de Norwall. Ber. 1893, **26**, 962—973.

The authors have attempted to elucidate the particular intra-molecular grouping to which is due the anæsthetic action of cocaine, and those of its derivatives possessing the same property. In the course of their experiments they have obtained various new derivatives, mostly of but little physiological potency; the following alkaloidal bodies are described, and various of their salts, &c. :—

L. Ecgonin amide and R. ecgonin amide	$C_9H_{16}N_2O_2$
L. Ecgonin nitrile	$C_9H_{14}N_2O$
Benzoyl-L. ecgonin and Benzoyl R. ecgonin nitrile	$C_9H_{13}(C_7H_5O)N_2O$
Acetyl-R. ecgonin nitrile	$C_9H_{13}(C_2H_3O)N_2O$

—C. R. A. W.

Officinal Creosotes and Guaiacol. A. Béhal and E. Choay. Comptes rend. **116**, 1893, 197—200. (See also this Journal, 1891, 354, and 1892, 511).

Wood-tar creosotes are of extremely variable composition, and though much used in therapeutics, the pharmacopœias of different countries give no criteria for valuing them beyond physical characteristics and colour reactions. The authors have accordingly worked out the following process. A current of hydrobromic acid is passed through the warmed creasote in presence of water to decompose the methylated ethers of the phenols. The mixture is then distilled with steam, when the monophenols pass over, leaving the others in the residue, from which liquids they are extracted with ether, while the pyrocatechol is separated from the homopyrocatechol by means of benzene.

To study its properties guaiacol was prepared synthetically from pyrocatechol by adding 270 grms. dissolved in methyl alcohol to a solution of 58 grms. of sodium dissolved in 600 grms. of the same solvent. The mixture was heated in a closed vessel to 120°—130° C. with excess of methyl iodide, then cooled and the alcohol distilled off; the residue was treated with steam, the guaiacol decanted, dissolved in soda and the solution extracted with ether to remove the veratrol, acidified, again treated with steam, and finally distilled through a fractionating tube. So prepared guaiacol forms a white solid, melting at 28·5° C., and boiling at 205·1°. It forms well-defined crystals, consisting of twelve-sided prisms, belonging to the rhombohedral system, the constant value of 30° being obtained for the angles. Examined optically the crystals are evidently uniaxial. Its specific gravity at 0° is 1·1534, and at 15° 1·143; it is soluble in most organic solvents, including anhydrous glycerin, but not in the officinal glycerin except on heating, being thrown out again in an oily form on cooling. It has a sweet taste, and when placed on the tongue, melts and then produces a feeling of intense astringency, but it is without action on mucous membrane.—F. H. L.

The Composition of Alkaline Phenates. De Forcrand. Comptes rend. **116**, 1893, 192—194.

By the term "alkaline phenates" are usually understood addition compounds of the general formula $C_6H_6O.MHO$, quite distinct from potassium or sodium phenols (phenoxides) C_6H_5MO, although these latter substances are capable of being hydrated so as to form similarly constituted bodies, which analysis shows cannot be regarded as isomeric with the "phenates." The author has prepared by Roméi's method of alcoholic solution the compounds—

$$C_6H_6O.KHO.H_2O \text{ or } C_6H_5KO.2H_2O\ ;$$
$$C_6H_6O.NaHO.2H_2O\ ; \text{ and } C_6H_6O.NaHO.4H_2O$$

which are all crystalline, and give on analysis figures agreeing well with theory, and has dehydrated them *in vacuâ* over sulphuric acid or phosphoric anhydride for several weeks, and he has found that, although even then not completely free from water, the dried substances approximate much more closely to the formula C_6H_5MO than to that containing one molecule of water, $C_6H_6O.MHO$. The heats of dissolution of these compounds point to the same result, and it is evident therefore, that Romeï's view as to the distinctness of the two classes of substances is incorrect, and that the "alkaline phenates" are simply the hydrated forms of the phenoxides.—F. H. L.

Compounds of Phenoxides with Phenol. De Forcrand. Comptes rend. **116**, 1893, 586—588.

By calorimetric methods the author has proved the existence of the following compounds: $C_6H_5KO, 3C_6H_6O$; $C_6H_5NaO, 3C_6H_6O$; and $C_6H_5NaO, 6C_6H_6O$. It is curious to notice that the proportion 1 : 3 is very common in addition compounds, a large number of salts and alcoholates combining with three molecules of water, acid, or alcohol. Also that sodium salts often form two successive compounds, while the corresponding potassium salt yields but one, while the latter retains the added molecules with greater tenacity. The sodium derivatives, too, are able to combine with a larger number of molecules.—F. H. L.

The Estimation of Creosote. A. Schlicht. Pharm. Zeit. **33**, 63.

See under XXIII., *page* 631.

Some Reactions of Essential Oils, Strychnine, &c. J. Stern. Zeits. ang. Chem. 1893, 136.

See under XXIII., *page* 628.

The Valuation of Salipyrine (Antipyrine Salicylate). J. Altschul. Pharm. Centralhalle, **33**, 61.

See under XXIII., *page* 631.

A Method of Testing Ether. M. C. Traub. Schweizer wochens. Pharm. 1892, 3.

See under XXIII., *page* 629.

Analysis of Tobacco and its Products. V. Vedrödi. Zeits. Anal. Chem. **32**, 277—296.

See under XXIII., *page* 631.

Decomposition of Iodoform. Kinzel. Pharm. Zeit. **38**, 387.

The decomposition of iodoform under the influence of sunlight takes place much more readily when it is dissolved in chloroform than when dissolved in other solvents. This is attributed by the author to an acceleration of the change produced in chloroform by contact with oxygen under the same condition, the effect produced by the greater susceptibility of iodoform to the action of oxygen being the reverse of that produced by alcohol in retarding the decomposition of chloroform. He assumes therefore that the mere presence of iodoform facilitates the action of oxygen upon the chloroform in which it is dissolved, and that the chloroform acts the part of a carrier of oxygen to the iodoform, the reactions taking place being as follow—

$$CHCl_3 + O = COCl_2 + HCl$$

and

$$2CHI_3 + 3COCl_2 = 2CHCl_3 + 6I + 3CO$$

Phenocoll as an Antiseptic. C. Beck. New York Med. J., April 22.

The author has compared the antiseptic value of acetanilide, phenacetin, and phenocoll, by employing them on wounds, &c., in the forms of powder, solution, ointment, and gauze. Acetanilide did not seem to cause irritation, and is ranked with boric acid. Phenacetin is more powerful and was found to produce no ill effects. It ranks between boric acid and iodol in value. Phenocoll, however, far surpasses both, its hydrochloride being stated to be probably as valuable an antiseptic as iodoform and stronger than most others. It is preferable to iodoform because of its lack of odour, ready solubility, and non-irritant effect. Further, it is not contra-indicated in kidney disease and, being non-poisonous, can be applied to very extended surfaces.

Coloration of Morphine Hydrochloride Solution. P. Welmans. Pharm. Zeit. **38**, 375.

The author has drawn attention to the coloration produced when a strong solution of morphine hydrochloride is prepared with the aid of heat. He attributes the coloration to the formation of some oxydimorphine resulting from the action of atmospheric oxygen condensed in the porous mass of the salt and suddenly disengaged during solution. He therefore recommends that solutions of morphine hydrochloride should be prepared without heat, and that they should not be made too strong.

Alcohol from Cellulose. Pharm. J., July 1, 1893, 5.

The convertibility of cellulose into sugar admits of its being made a source of alcohol, and attempts have been made to produce alcohol from wood in this way. The compact texture of wood has, however, proved an obstacle by which the cost of production was rendered too great for the practical adoption of the method. Quite recently it is reported that a more successful result has been obtained by operating upon cellulose of a naturally more open texture as it occurs in peat moss. For this purpose the turf is heated to 115°—120° C. with dilute sulphuric acid for four or five hours to convert the cellulose into sugar, and when the full effect has been produced the expressed liquor is fermented with yeast and afterwards submitted to distillation. It is stated that in this way turf is likely to compete favourably with potatoes as a source of alcohol, 1,000 kilos. of dry turf yielding from 62 to 63 litres of absolute alcohol, while 500 kilos. of potatoes containing 20 per cent. of starch yield at the utmost only 60 to 61 litres of absolute alcohol.

The Preparation of Hasheesh. Chem. and Drug. **43**, 38.

Majoom is prepared from the leaves, tops, and tender parts of the plant called *Cannabis Indica* or *Sativa*. Four ounces of such parts of the plant are taken, free from unripe fruit, flowers, or impurities. They are thoroughly washed, and 3 oz. of pure butter added to the leaves, with about 4 oz. of water. All these ingredients are put together in an earthern pot over a slow fire. The water is allowed to evaporate, leaving in the pot the buttered leaves, which are now strained through a piece of muslin. The strained greenish extract is removed with great care, the other impurities on the muslin being thrown away. The extract is then washed with pure water twice. In another pot about 16 oz. of sugar, with 32 oz. of water, and a little milk are boiled. By repeated boiling and mixing of milk a syrup is prepared. "In this syrup, the greenish oily extract is put, and boiled on a slow fire. Some now add *dhatura* seeds, others nux vomica seeds in finest powder. But the usual practice in Bengal is to add a few drops of otto of roses, or a few grains of musk, powdered cardamom seeds, and sometimes a minute quantity of opium. After boiling half an hour, the whole mass is poured into a flat basin. It solidifies, and is cut into cakes. Sometimes the best *hasheesh* is sold at sixteen rupees a seer, but usually the price is four rupees. *Hasheesh* is the Arabic *hashish,* which means "green, intoxicating liquor."

The Manufacture of Soy in China. Chem. and Drug. **43**, 38.

The manufacture of soy and beancurd is one of the most flourishing industries in the prefecture of Wênchow, China. The method is not supposed to be a secret, but the native manufacturers do not encourage inspection by foreigners. The beans used in the industry are principally white beans from Chinkiang. Besides these little else is required than a large amount of salt and flour, and an unlimited supply of fresh water. There are five large manufacturers in Wênchow, who work under licences issued by the provincial government, and (as salt is a Government monopoly) are subject to periodical inspection of their premises by excisemen. The largest manufacturer at Wênchow takes out a licence for eight salt "passes," each pass representing 368 bags of 85⅓ lb., or 2,243 cwt. of salt every year. For each "pass" obtained, the manufacturer is permitted to set up 36 vats, to each of which, again, are annexed two feeding vats. The vats are arranged at the bottom of a reservoir; the salt is stored in a similar reservoir at the back of the premises, where it is allowed to stand and drain for one year, Chinese salt being mostly unclarified sea-salt. Each vat is provided with an impervious cover. The beans, having been carefully washed, are placed in a cauldron holding 133⅓ lb. They are boiled for six hours, and then simmered and cooled through another 18 hours. The broth is drawn off for use later on in the process, while the mash is mixed with flour (apparently wheat flour) to the extent of 213 lb. of flour for each cauldron of mash. The resultant mixture is placed in large shallow baskets of bamboo, fitting each upon a wooden frame. These frames are piled one on the top of the other to a great height, and are left in the sun for five to eight days. When the mash emits a yellow exudation and turns yellow it is ready for further manipulation. It is now placed in the vats, and over it is poured a mixture of two parts of salt to five parts of water. To this clarified brine is added the bean-broth, and with this mixture the mash (now dry) is beaten up, and left to ferment. As it dries in the sun the process is repeated, and so on throughout the hot season (say, July to September), care being taken to cover the vats during rain. After three months or so a yellow oil appears, each vat producing about 667 lb. of the oil. To this oil are added 2,400 lb. of brine (but no bean-broth) thickened by 10 per cent. of salt, and the result is the soy of commerce. Of this there are six grades, the prices of which per catty (1⅓ lb.) are respectively 96 cash, 80 cash, 56 cash, 40 cash, 24 cash, and 20 cash—1,040 cash to the dollar (2*s.* 10*d.*). The soy of one year can be used in that year, but it is considered always better to give it a second summer's fermentation.

Ipecacuanha Root and Stems. Chem. and Drug. **43**, 84.

On the subject of ipecacuanha stems there is pharmacological uncertainty; the question of the emetine estimation appears to be much in want of authoritative elucidation. The following are some figures of the emetine value of ipecacuanha as given by various recent authors:—

——	——	Per Cent.
Ransom.......	Average of 10 samples (from 1·3 to 2·3)	1·66
Hooper.......	Root (E.I.)	1·79
"	Stem	1·13
"	Leaves	1·45
Cripps........	"Good average sample"	2·1—2·2
Merck........	.. .. ..	1·5—2
Lyons.........	.. .. ..	1·65—3
Arndt.........	Volatile alk. 0·3 plus emetine	0·6—1·1
Naylor........	.. .. ..	1·09
Braithwaite & Umney.	Minimum standard	1·25
Keller........	" "	2·57
Kottmayer....	Rio root	2·37
"	Singapore root	2·22
"	Cartagena root	1·81
Attfield.......	Official ipecacuanha	1·75—2

There is hardly any room for doubt that Mr. Cripps's figures of 2·1 to 2·2 per cent. as the average emetine percentage of Brazilian ipecacuanha root are too high. It is understood that certain German chemical manufacturers, working by Cripps and Whitby's process, published in 1889, obtain, on an average, barely 1 per cent. of emetine from commercial ipecacuanha, while others, using the lime process, obtain habitually from 1·8 to 2·2 per cent. The want of any simple method for obtaining crystallised emetine, and the consequent necessity of estimating it by weighing a precipitate containing emetine plus something of which we know little, no doubt accounts for much of the confusion which prevails.

PATENTS.

Improvements relating to Bottles or Receptacles suitable for Containing Ethyl Chloride and for Supplying the same for Producing Anæsthesia. J. B. Bengué, Paris. Eng. Pat. 10,293, May 30, 1892.

The proposed glass bottles terminate in a neck having only a capillary opening; the neck is further fitted with a metallic ring the upper part of which is screw-threaded and terminates on a level with the end of the glass neck. A small metallic capsule containing a washer of caoutchouc or other suitable material screws on to the metallic neck-piece, and the washer then hermetically seals the receptacle. The inventor claims that by inverting the bottle filled with the chloride a thin jet of ethyl-chloride suitable for producing local anæsthesia is obtainable, and that by means of the cap the bottle is quickly and easily sealed, and the unused chloride preserved.—L. T. T.

Process for the Separation and Recovery of Benzole, Alcohol, Ether, and other easily-volatile Substances from Air or other Gas. S. Pitt, Sutton. From C. Heinzerling, Frankfort-on-Maine, Germany. Eng. Pat. 12,390, July 4, 1892.

See under III., *page* 591.

Improved Means and Apparatus for rapidly Cooling and Congealing liquids on Semi-liquids. J. O. Spong, London. Eng. Pat. 4984, March 7, 1893.

See under XVIII., *page* 615.

Improvements in Pyroxyline Solvents and Compounds. L. Paget, Newark, U.S.A. Eng. Pat. 7277, Apr. 8, 1893.

This invention relates to new series of solvents for pyroxyline. The patentee *claims* to have discovered that by distilling mixtures of primary alcohols (not necessarily themselves solvents of pyroxyline) with sulphuric acid and a suitable organic acid, (such as acetic or salicylic acid), mixed compound ethers are produced which are exceedingly good solvents and diluents of pyroxyline, and moreover are different from simple mixtures of the corresponding compound ethers. Thus, for instance, when 25 parts by weight of ethyl alcohol, 25 to 20 parts of amyl alcohol, 25 parts of sulphuric acid, and 12½ parts of acetic acid are heated together and distilled a product is obtained which is an exceedingly good solvent for pyroxyline and is moreover distinct in its properties from a mixture of ethyl and amyl acetates.

Similarly he claims, by the etherification of mixtures of two, three, or more primary alcohols by means of sulphuric acid, to produce substances of good solvent power and differing from mixtures of the corresponding simple ethers. If these products are again distilled with glacial acetic acid, or with a mixture of sulphuric acid with a suitable organic acid, another new series of solvents, and diluents of solutions, of pyroxyline is obtained.

By careful selection of the alcohols and acids employed the properties and volatility of the products may be modified and varied as desired.—L. T. T.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Improvements in Pyroxyline Solvents and Compounds. L. Paget, Newark, U.S.A. Eng. Pat. 7277, April 8, 1893.

See under XX., page 620.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Annual Report (Seventeenth) of Her Majesty's Inspectors of Explosives for 1892.

From this report it is seen that no modification of the existing law has been made during the year, and only two deaths from accident during manufacture have occurred.

The total number of factories now licensed is 129, an increase of four on the previous year. The inspectors report that the condition of all the factories was satisfactory. A few new explosives have been placed on the list of authorised explosives, but they exhibit no strikingly new departure as they are modifications or slight variations of previously existing explosives. Referring to the regulations on the subject of electric lighting of factories, published in the last annual report, the inspectors have made some modifications and slight relaxations of the precautions then laid down as the result of observation and discussion of the arrangements adopted in several factories.

The package and conveyance of explosives in this country has, on the whole, been very satisfactory, but as an instance of criminal folly in this respect it is narrated in the case of some explosives sent from a continental country to the Transvaal that "the practice was to send what was practically dynamite in bulk as "guhr impregnie," and a very thin and therefore highly dangerous blasting gelatin as "cellulose." These substances were imported as "raw materials." The amount of foreign nitroglycerin compounds suitable for blasting purposes imported during the year was 856,668 lb., an increase on 1891, but a falling off from the average of previous years. Some foreign makers experience difficulty in producing gelatinous preparations up to the high standard insisted on in this country. Dr. Dupré in his report, which is given in full, refers to the diminution of the number of samples of dynamite No. 1 examined, and the increase of the number of gelatinous preparations, and he also states that judged by the number of samples blasting gelatin is giving place to gelatin dynamite. It having been alleged that accidents had occurred through combs and buttons made of celluloid or xylonite taking fire while the wearer stood in front of a fire, Dr. Dupré made some experiments on this subject and concludes that "celluloid buttons constitute no danger unless the wearer stand so close to the fire that the dress would be in danger even without the presence of the buttons." The number of accidents by fire or explosion of which the department has had cognisance during the year was 149, causing 28 deaths and injuring 126 persons. Of these numbers gunpowder is responsible for 14 killed and 35 injured, and nitroglycerin compounds for 9 killed and 33 injured. In regard to the two deaths which resulted from explosion during manufacture, it is pointed out that this was among 10,000 persons employed in the manufacture of explosives. Three fatal accidents have now occurred of poisoning by fumes of dinitro benzene or by the incautious handling of it during its manufacture into an explosive. Dr. Dupré and Captain Hamilton P. Smith conducted an inquiry into this matter and extracts from their report are given embodying the main recommendations they suggest to prevent its poisonous effects.

As in former years a brief account is given of the more interesting foreign explosions which have come under the notice of the department. In one which occurred at a factory near San Francisco about 200,000 lb. of nitro-glycerin explosive are considered to have exploded. There were five separate explosions, the first originating in the nitrating house and spreading finally to two magazines. Much damage was done to glass in San Francisco, distant 15 miles across the bay.

The only serious outrage perpetrated with explosives at home occurred on Christmas Eve in Dublin. Abroad, however, the past year was remarkable for the number and grave character of the outrages accomplished or attempted.

Notice is also taken of the more important accidents with petroleum. Reference is made to some interesting experiments which were witnessed at Woolwich "to ascertain the effect of burning large quantities of cordite under such conditions of quasi-confinement as would exist if a fire took place in a light roofed masonry building such as is used for the cordite drying houses at Waltham Abbey." 2,500 lb. of cordite were placed on trays in a building 19′ 6″ × 12′ 6″, and after having been heated to 100°—120° F. for several days the cordite was ignited by an electrical fuse. "There was no explosion in the ordinary sense of the word but a very rapid outburst of an intensely bright yellow flame which lasted for about seven seconds." The débris was not carried far being practically within a circle of some 12 yards radius. Altogether the results were regarded as satisfactory and tending to establish that "there exists with regard to cordite a very much larger margin of safety under all ordinary (or even under some extraordinary) conditions than exist in the case of most other explosives."—W. M.

Red Phosphorus. J. W. Retgers. Zeits. Anorg. Chem. 3, 339.

Phosphorus in this condition is not amorphous but crystalline. This has been ascertained by the use of the polarisation microscope. On account of the very high refractive power of the particles the optical examination must be made in a medium that is also of high refractive power, and eventually methylene iodide was selected for the purpose. The crystalline system has not been determined, but it is probably the hexagonal. The fact that ordinary yellow phosphorus is converted into the red modification under the influence of sunlight is in accord with the crystalline character of red phosphorus, since there is by such means, no known instance of a conversion from the crystalline into the amorphous state.

XXIII.—ANALYTICAL CHEMISTRY.

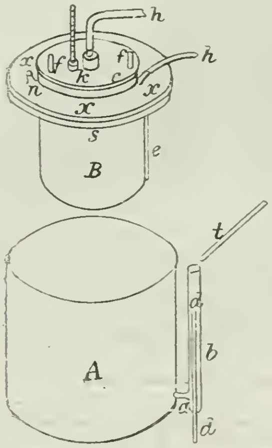
APPARATUS, ETC.

Some New Forms of Apparatus. E. B. Voorhees and L. A. Voorhees. Jour. Anal. and App. Chem. 7, 121—128.

The apparatus described were devised by the authors and are used in the laboratory of the New Jersey State Agricultural Experiment Station.

A water oven for drying in hydrogen.—The method for determinations of moisture in cattle foods, as adopted by the American Association of Official Agricultural Chemists, requires the drying of the substance for five hours, at 100° C. in a current of dry hydrogen. Fig. 1 is a drawing of the apparatus used by the authors. The cylindrical tank A, of copper, forms the outer wall of the bath and holds the boiling water; it is 9 inches high. The inner vessel B, also of copper and cylindrical, is 6 inches in diameter, and $7\frac{1}{2}$ inches high. It fits inside A and the top of the annular space between the two vessels is closed by the flange x. The bottom of B when placed inside A is just $4\frac{1}{2}$ inches from the bottom of A. B is held down in position by slot fastenings, one of which is shown at *s*. B is closed by a lid *c*, which screws down upon an india-rubber gasket. The brass handles in the lid at *f f* are to facilitate the operation of screwing the lid on and off; at *k* a thermometer may be inserted: at *h h* are the openings for the passage of the hydrogen, one through the lid, and the other through the side near the bottom by means of the tube *e*. At *x* is an opening in the flange *n* to allow of the steam escaping from the boiling water in the annular space between A and B.

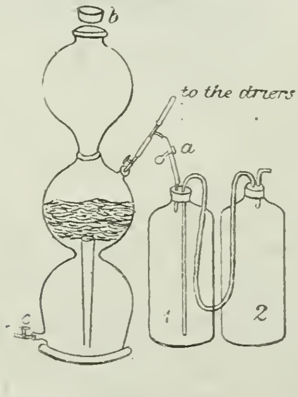
Fig. 1.



Inasmuch as the fat must subsequently be extracted from the dried samples, the substances are dried in fat extraction tubes. These are of $\frac{7}{8}$-inch glass-tubing, $5\frac{1}{2}$ in. long, capped at the end with fine copper gauze upon which a plug of asbestos is laid in the same manner as in the Gooch crucible. The tubes are held upright in a rack which fits inside B. Water from a reservoir constantly drops into *b* from the tube *t*, and any excess over the amount evaporating escapes by the overflow *d d*. At the expiration of the time of drying, the bath and its contents are rapidly cooled whilst the current of hydrogen is maintained, by allowing cold water to flow into the annular space through the steam escape *n*. After cooling, the samples may be removed and placed under a bell-jar, until the hydrogen has diffused, and may then be weighed.

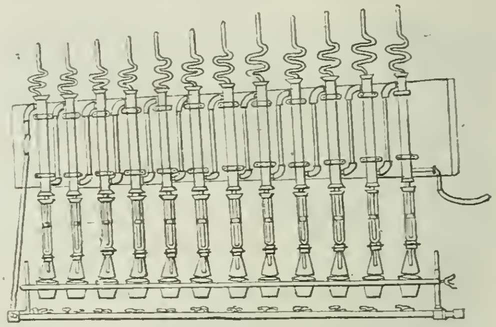
A constant supply of hydrogen is secured by the arrangement shown in Fig. 2. This consists of a Kipp generator connected with two bottles each of a capacity of two litres. At the start, bottle No. 1 is filled with water to displace all the air. As soon as the generator is delivering hydrogen free from air, the pinch cock at *a* is opened; the hydrogen then forces the water in bottle No. 1 over into No. 2. When No. 1 is nearly full of hydrogen the pinch cock *a* is closed, and the supply of hydrogen is taken to the drying apparatus in the usual manner direct from the generator. As soon as the acid in the latter begins to lose its efficiency, bottle No. 2 is placed in a higher elevation than No. 1, thus putting the hydrogen in No. 1 under pressure. The stopper *b* is then inserted, pinch cock *a* is opened and cock *c* is opened. The gas in No. 1 now supplies the current through the drying bath, and at the same time helps to force out the spent acid from the Kipp, whilst the stopper *b* prevents any movement of the contents of the upper bulb. The tubes are made of small calibre so that the bottle can be filled without diminishing the current through the water-oven. Before passing into the water-oven the hydrogen is dried by bubbling through four separate portions of sulphuric acid.

Fig. 2.



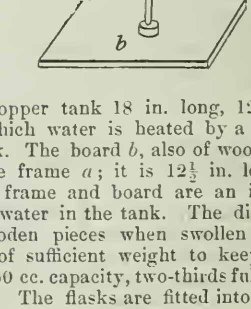
Apparatus for fat extraction.—Fig. 3 is a drawing of this apparatus. Its main feature is an arrangement by which the cups of water in which the flasks are immersed together with the burners under them for heating the water can, after individual adjustment, be all raised or lowered together. The condensers are of iron piping $1\frac{1}{4}$ in. in diameter, closed at the ends with rubber stoppers perforated to admit the passage of the glass tubes. They are all connected together by iron piping of $\frac{3}{4}$-in. diameter, and a single stream of water supplies all the condensers.

Fig. 3.



A bath for the digestion of phosphates in ammonium citrate.—The wooden frame *a*, Fig. 4, fits loosely inside a rectangular copper tank 18 in. long, 12 in. wide, and 5 in. deep, in which water is heated by a Bunsen burner beneath the tank. The board *b*, also of wood, fills the open space inside the frame *a*; it is $12\frac{1}{2}$ in. long and $6\frac{1}{2}$ in. wide, and both frame and board are an inch thick, and float upon the water in the tank. The dimensions given are for the wooden pieces when swollen by the water. They are then of sufficient weight to keep immersed 12 flasks each of 150 cc. capacity, two-thirds full of ammonium citrate solution. The flasks are fitted into the slots in the frame *a*. The temperature is observed by means of a thermometer inserted through a hole in *b*. The covering of the entire surface of the water with a non-conducting material, maintains the required temperature for half an hour, almost without assistance.

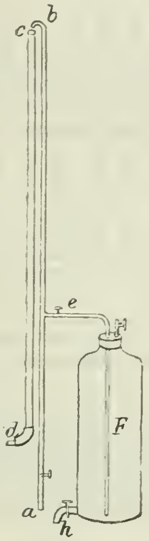
Fig. 4.



Pipettes of Special Volume for the Simplification of Calculations.—Such pipettes are used in this laboratory in the estimation of phosphoric acid potash and chlorine. Definite weights of the substances are taken, and their solutions are made up to definite volumes. The pipettes are then constructed to deliver a volume of the solutions containing an amount of the original substance equal to the conversion factor divided by an integer, which latter, by cancellation, becomes the multiplier. Thus, if the solution of 2 grms. of material be diluted to 200 cc. and 63·965 cc. (practically 64 cc.) be measured off for the determination of the total phosphoric acid, the actual weight of magnesium pyrophosphate obtained only needs the decimal point moved two places to the right to read per cent. (63·965 being the conversion factor of magnesium pyrophosphate into phosphoric acid).

A Means of Transferring Wash Solutions.—The tube *a*, *b*, Fig. 5, is kept full and gently overflowing with water by connection at *a* with the town water supply, the excess being conducted to a sink through the pipe *c*, *d*. When the cock *e* is opened the tube *a*, *b*, tends to empty itself into the large bottle F, which at the start is full of air. The air in F is consequently under pressure to a degree determined by the height of the column of water in *a*, *b*, and the pressure under which it is flowing out at *b*. This compressed air is conducted by ¼-inch lead piping to various convenient parts of the laboratory where any wash-bottle with the customary short and long tubes may be attached by its short tube, and the wash water delivered through a nozzle. In the laboratory of the authors the bottle used is one large enough to suffice for half a day's continuous use, after which the water is allowed to drain into the sink by opening the cock *h*.—H. S. P.

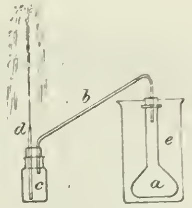
Fig. 5.



Porous Earthenware Filters and their Use in Chemical and Bacteriological Laboratories. W. Pukall. Ber. 1893, **26**, 1159—1172.

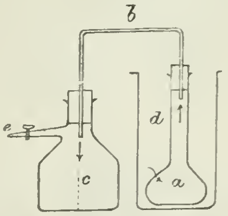
Porous earthenware has long been in use as a straining or filtering material for certain purposes, the porosity being sometimes increased by mixing with the clay carbonaceous or organic pulverulent material, subsequently burnt off during the firing of the goods. As a rule this operation is not carried very far, so that a comparatively soft product results, hard burnt material being much less frequently employed. The author finds, however, that thoroughly hard-burnt unglazed filters answer better, especially when made of a particular porcelain-like composition of kaolins of various kinds. A flask-shaped vessel of this special ware is the most convenient for use; it allows gases to diffuse through readily, although they will not pass *en masse* through the walls; aqueous fluids, on the other hand, readily pass through the pores, especially when some difference of pressure exists between the inside and outside. Mercury does not pass, even under 2·5 atmospheres pressure. Fig. 1 illustrates these properties; the flask *a* is provided with a cork fitting air tight, through which passes the exit tube *b*, leading into the closed bottle *c* containing water. Starting with the flask perfectly dry, on immersing it in a beaker of water *e*, this fluid passes through the walls so rapidly that the air in *c* becomes considerably compressed; a small fountain is consequently developed, the water in *c* being forced out through the delivery jet *d*.

Fig. 1.



The special composition finally arrived at after various experiments made in order to obtain the best result is so hard, after being thoroughly burnt, as not to be scratched by steel, and is strong enough to resist wear and tear much better than soft earthenware goods such as terra cotta and the like materials. It is not attacked by acids or alkalies, whether in concentrated or dilute solution, whether hot or cold; whilst sufficiently porous to allow of pretty rapid passage of watery fluid, it will retain very finely divided or gelatinous precipitates, such as the hydroxides of iron, aluminium, and magnesium; barium sulphate precipitated cold; zinc, manganese, and tin sulphides, &c. Milk furnishes a perfectly clear effluent when placed inside a "balloon filter" of the kind, the oil particles being retained, whilst a watery fluid exudes. Similarly, starch-paste yields a crystal-clear filtrate. In such cases filtration is greatly accelerated by connecting the interior of the porous flask with a water air pump or other means of exhaustion, and immersing the flask in the liquid to be filtered. The arrangement shown in Fig. 2 is convenient, the filter-flask *a* being placed inside the beaker *d*, and connected with the filtrate reservoir *c* by the tube *b*. This reservoir is exhausted by connecting the outlet of *c* with a filter-pump, &c.; the stopcock *e* is then closed, and the whole left to itself for some time, *e.g.*, overnight. Precipitated substances may be thus collected and washed with facility, the crust of washed substance that forms round the flask being usually detachable with ease. When employed for rendering turbid fluids clear (*e.g.*, drinking water), the diminution in permeability brought about by the accumulation of solid particles is mostly removeable by scrubbing the outer surface with sand, &c. The rapidity with which clear water traverses the walls is indicated by the following figures; three sets of five filters each were examined, each set

Fig. 2.

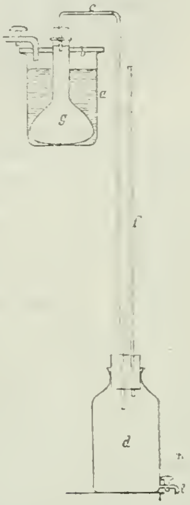


having the capacity of 50, 135, and 1,000 ccs. respectively :—

—	Rate in ccs. per Hour.		
	Maximum.	Minimum.	Average.
1st set	5,100	4,680	4,875
2nd „	9,042	8,118	8,623
3rd „	34,200	28,020	29,628

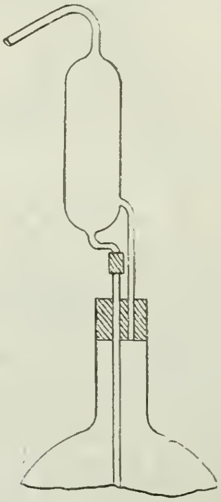
Fig. 3 represents an automatic filtration arrangement whereby filtration under slightly diminished pressure is effected, the filtered liquid being drawn off from the reservoir *d* from time to time by the cock *e*.—C. R. A. W.

Fig. 3.



A Reliable Glass Interceptor for Distilling Purposes. M. Müller. Zeits. angew. Chem. 1893, 229—230.

The author recommends this equivalent to a catch-box represented in the accompanying sketch as absolutely reliable in cases where particles of a boiling liquid might be spirted over and be carried along with vapours into the distillate. This apparatus has been found especially useful for the nitrogen determinations according to Kjehldahl's process.—J. L.



Rise of Salt Solutions in Bibulous Paper. E. Fischer and E. Schmidmer. Annalen, 1892, 272, 156—169.

Schönbein has shown (Pogg. Annalen, **114**, 275) that when bibulous paper is moistened with an aqueous solution a separation of the water and dissolved substance takes place, the water rising more quickly than the dissolved substance and to a relative height which varies with the nature of the substance. These observations have been made use of for analytical purposes; for example, the detection of various colouring matters (*see* Bailey, J. Chem. Soc. 1878, i. 304; Lloyd, Chem. News, **37**, 211; Goppelsröder, this Journal, 1889, 569—570).

Schönbein ascribes the phenomenon to capilarity, whilst Ostwald (Lehrbuch) compares the action of bibulous paper to that of porous carbon, and it is impossible to deny that many colouring matters have an affinity for cellulose. This is not the case, however, with simple inorganic compounds, and the author's experiments support the hypothesis that the separation is here chiefly conditioned by the difference of velocity of diffusion of the substances. Diffusion phenomena of all liquids which moisten bibulous paper can be observed in this manner equally well as with the aid of membranes.

The apparatus employed was a glass tube 70 cm. long and 2 cm. wide, in which were placed, horizontally, six cylindrical rolls of bibulous paper, previously treated with hydrochloric and hydrofluoric acids. The length of each roll was 10 cm., and the rolls were so placed as to be in close contact with the walls of the tube. The tube was now dipped into the solution at a depth of a few centimetres, and there kept in a vertical position, at the ordinary temperature, until the fifth roll was thoroughly moistened, which was generally the case at the end of three or four days. The tube was then broken at the points of junction of the rolls, and the rolls extracted with the solvent employed and the amounts of dissolved substance determined in the extracts. Generally the experiments show that the more diffusible a substance is the more rapidly does its solution rise. The double salts of mercuric chloride with sodium and lithium chlorides are dissociated by water but not by alcohol. Mercuric ammonium chloride is not dissociated by either solvent. The salts $Na(NH_4)H\ PO_4 + 4H_2O$; KCNAgCN; and Rochelle salt do not dissociate in aqueous solution. The compound of dextrose and sodium chloride $2C_6H_{12}O_6 + NaCl$ is, however, partially dissociated. Naphthalene picrate seems not to undergo dissociation in alcoholic solution.

—A. R. L.

INORGANIC CHEMISTRY.—QUALITATIVE.

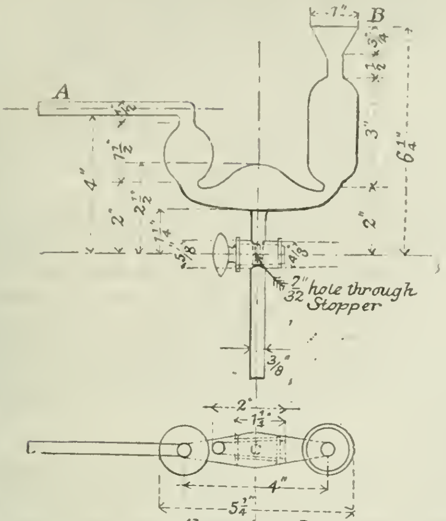
The Detection of Empyreumatic Matter in Ammonium Chloride. O. Schobert. Pharm. Zeit. 1892, 397. From Pharm. Centralhalle, 33, 403.

When 1 cc. of a solution of potassium permanganate is added to 50 cc. of a 5 per cent. solution of ammonium chloride, the red colour ought to remain permanent for at least 10 minutes, if the ammonium chloride is free from empyreumatic matters.—J. S.

INORGANIC CHEMISTRY.— QUANTITATIVE.

Absorption Bulb for Sulphur Determinations. J. K. Mackenzie. Jour. Anal. and App. Chem. 7, 134.

The annexed figure of the apparatus explains itself. The absorption bulb is intended to be used for the determination of sulphur in iron and steel, by evolution of the sulphur as sulphuretted hydrogen, which is allowed to bubble through a liquid placed in the bulb that will retain this gas. After the whole of the sulphuretted hydrogen has been evolved, by opening the stop-cock, the liquid is run out of the bulb into a beaker or flask, placed underneath the delivery tube attached to the bottom of the bulb, and the bulb is then rinsed out with water. After recharging the bulb with absorbing liquid another determination of sulphur can be at once started without any time having been lost in removing the apparatus from its stand and replacing it.



Absorption tube

—H. S. P.

New Method of Determining Moisture in Walls. Arch. f. Hyg. 1892, **14**, 1243.

See under XVIII., *page* 616.

Estimation of Sulphur in Iron by the Sulphuretted Hydrogen Method. W. Schindler. Zeits. ang. Chem. 1893, 11.

According to C. Meineke (this Journal, 1888, 643) when sulphur-containing iron is treated with hydrochloric acid, the whole of the sulphur present is not converted into sulphuretted hydrogen, as is usually supposed, but a more or less considerable fraction remains in an insoluble form in the generating flask, and may be obtained by suitably treating the insoluble residue. On the other hand, Hattensauer found that the correction necessary when only the evolved sulphuretted hydrogen was determined, in order to allow for sulphur in the insoluble residue, was practically unappreciable. The author finds that if the hydrochloric acid used be sufficiently strong (sp. gr. 1·19) all the sulphur present is eliminated as sulphuretted hydrogen, even with a white iron containing 0·09 per cent. of copper; whereas if acid of only about half that strength (sp. gr. 1·10) be employed (as was done by Meineke) a sulphur-containing residue is left undissolved. The sulphur was determined in the evolved gases by passing through a washing bottle containing bromine dissolved in strong hydrochloric acid, and then through another containing hydrobromic acid; the solution was evaporated to dryness with a little caustic soda and the sulphate present precipitated by means of barium chloride. Or, the sulphuretted hydrogen evolved was oxidised by means of an ammoniacal solution of hydrogen peroxide. The following figures were obtained in various trials with two samples of iron, A and B:—

Hydrochloric Acid of sp. gr. 1·19.

Bromine Method.	Hydrogen Peroxide.	Sulphur in Residue.
Per Cent.	Per Cent.	
A. Sulphur found... 0·070	0·071	Traces only.
Duplicate .... 0·071	0·067	Nil
B. Sulphur found... 0·221	..	Nil
Duplicate .... 0·216	..	Nil

Hydrochloric Acid of sp. gr. 1·10.

A. Sulphur found... 0·018	0·018	Residues contained much sulphur.
Duplicate .... 0·018	0·018	
B. Sulphur found... 0·149	..	Do.
Duplicate .... 0·157	..	

—C. R. A. W.

Analysis of Chromite. E. Waller and H. T. Vulté. School of Mines Quarterly, **13**, 225.

The methods previously described for the valuation of chromite (more or less pure FeO, Cr_2O_3) are of two kinds: those where liquid reagents are used as solvents (boiling nitric acid and $KClO_3$; bromine water at 130°—170°; sulphuric acid at 200° in sealed tubes); and those where fusion is used (acid potassium fluoride; alkaline bisulphates; caustic alkali and lime; alkaline carbonate and borax, with or without nitrate; and analogous fluxes being employed). The authors obtain satisfactory results by proceeding as follows, test analyses being made with numerous mixtures of rich chromite (57 per cent. chromic oxide) mixed with varying quantities of iron and manganese ores.

From 0·5 to 1 grm. is fused in a platinum dish with 5—6 times its weight of Dittmar's flux (mixture of 3 parts mixed potassium and sodium carbonates, and 2 parts borax glass, the carbonates being approximately in molecular proportions, 106—138). The melt is dissolved in water and the insoluble part tested with hydrochloric acid, in which it should dissolve completely; if black grains of undecomposed ore are left, they are fused over again with fresh flux. The filtered watery solution is evaporated to dryness with ammonium nitrate, added until no more ammonia is evolved; the residue is moistened with a few drops of nitric acid and heated till dry, and then dissolved in water containing a little nitric acid; this treatment causes manganese to separate as MnO_2, whilst alumina is precipitated as hydrate, which by the prolonged heating becomes practically insoluble in nitric acid; the last treatment with nitric acid and heating renders all silica insoluble, so that finally only alkaline chromate and nitrate are dissolved by the acidulated water. The chromate is then reduced by adding sulphurous acid (or ammonium sulphite solution) and hydrochloric acid, and boiling till all excess of SO_2 is expelled; finally ammonia is added and the whole boiled, to precipitate chromium hydroxide; this is facilitated by the addition of a little ammonium sulphide. The precipitate carries down alkalies, so that it cannot be directly weighed, but must be dissolved in hydrochloric acid after washing, and reprecipitated by boiling with ammonia, at least once. If the final precipitate contain alkali, not only is error introduced from this cause, but further, during ignition chromate is apt to be formed by oxidation, causing additional error in excess.—C. R. A. W.

The Volumetric Estimation of Zinc. B. C. Hinman. School of Mines Quarterly, **14**, 1892, 40—47.

The author has investigated the method of Von Schultz and Low, which has a vogue in the United States for the commercial estimation of zinc in its ores, and has introduced certain modifications which are claimed to be advantageous. The Von Schultz and Low method depends on the volumetric estimation of zinc by means of potassium ferrocyanide, and its details, as far as they are essential to the author's process are as follows:—A solution of potassium ferrocyanide is prepared by dissolving 44 grms. of the salt in one litre of water; it is standardised on a solution of 200 mgrms. of pure zinc oxide in 10 cc. of pure hydrochloric acid to which 7 grms. of pure ammonium chloride are added, together with about 100 cc. of boiling water. The clear liquid is titrated with the ferrocyanide solution, the end reaction being that given by a strong solution of uranium acetate spotted on a porcelain plate. When the end reaction appears, a minute or two are allowed to elapse, to ascertain whether any one of the previous tests also develops a brown tinge, in which case the reading must be amended accordingly. A further correction of about 0·14 cc. is necessary for the amount of potassium ferrocyanide required to produce a distinct brown colour. The original method of bringing the ore into solution prescribed by Von Schultz and Low answers well with ores free or nearly free from iron, but in the presence of iron additional precautions are requisite. These are embodied in the ensuing scheme. The ore is very finely ground and treated with *aqua regia* until no further action is perceptible. If the action appears to be incomplete, the solution is evaporated to dryness, taken up with hydrochloric acid, and the silica and unattacked ore fused in platinum with a mixture of sodium carbonate and nitrate. The melt is dissolved in hydrochloric acid and added to the main solution. The dehydration of the silica should be perfect, as its filtration is thereby expedited. The solution, containing the whole of the zinc as chloride, is treated with nitric acid and heated until the hydrochloric acid is expelled, evaporated nearly to dryness and treated with 25 cc. of strong nitric acid, saturated with potassium chlorate, and taken to complete dryness. A mixture of 7 grms. of ammonium chloride, 15 cc. of strong ammonia, and 25 cc. of hot water is then added, the solution filtered, and washed with a solution of ammonium chloride containing 10 grms. of the salt per litre and made alkaline with ammonia. The residue on the filter is removed from the paper and re-treated with the solution of potassium chlorate in nitric acid above mentioned and carried through the series of operations previously described, the resulting filtrate being added to the main quantity already obtained, neutralised with hydrochloric acid, using methyl orange as an indicator, and 25 cc. of strong hydrochloric acid added; the neutralisation being performed in order to ensure the presence of an identical amount of hydrochloric acid in the liquid to be titrated in all cases. The titration is then carried out with the standard solution of potassium ferrocyanide at a temperature near the boiling point. In the presence of copper the original method of Von Schultz and Low, consisting in precipitating the copper by means of metallic lead, is adopted in the modified process. The author remarks that he prefers metallic zinc to zinc oxide for standardising the ferrocyanide, as it is more easily obtained pure.—B. B.

Calculation and Statement of Analyses of Brine and Salt. J. and S. Wiernik. Zeits. f. ang. Chem. 1893, 43.

THE essential constituents to be determined in the analysis of brine and salt are chlorine, sulphate, magnesia, and lime; no special difficulty attaches to the accurate determination of these bodies, but the interpretation of the figures obtained is a different matter. No particular doubt seems to exist that the lime is always present as calcium sulphate, $CaSO_4$; but as the total sulphate present is ordinarily more or less in excess of that equivalent to the lime present, the question arises in what form does the extra amount of sulphate exist? Whether wholly as sodium sulphate, or more or less as magnesium sulphate in addition? When magnesium chloride and sodium sulphate are dissolved in water and the mixed solution evaporated to dryness, as shown by Fresenius and corroborated by subsequent experimenters, sodium chloride and magnesium sulphate are formed; hence the mode of calculation would seem to be warranted whereby all sulphate in excess of that equivalent to lime is calculated as magnesium sulphate, any surplus of magnesia being reckoned as magnesium chloride, and the balance of the chlorine calculated as sodium chloride. Results thus obtained may be conveniently referred as deduced by the "$MgSO_4$ rule."

On the other hand, Bockmann and others have found that in watery solution (*i.e.* in brines) magnesium sulphate and sodium chloride undergo double decomposition in the direction opposite to that indicated by the "$MgSO_4$ rule," *i.e.* magnesium chloride and sodium sulphate are produced; whence it would seem legitimate to suppose that the magnesium exists *in the form of chloride only;* so that the entire excess of sulphate over that equivalent to lime should be calculated as sodium sulphate, the whole of the magnesium as chloride, and the balance of the chlorine as sodium chloride. Results thus reckoned may be conveniently spoken of as deduced by the "$MgCl_2$ rule."

The authors have been led by their own experience to the conclusion that neither the "$MgSO_4$ rule" nor the "$MgCl_2$ rule" is correct, but that better results are obtained by means of a third system or "halving rule," based on the assumption that the magnesium present exists *half as chloride, half as sulphate;* if the total sulphate present is in excess of that equivalent to the total lime and half the magnesia jointly, the surplus is reckoned as sodium sulphate; if on the other hand it is in deficiency, then the surplus sulphate over that present as calcium sulphate is calculated as magnesium sulphate, the rest of the magnesia as magnesium chloride, and the balance of the chlorine as sodium chloride, *i.e.*, the "$MgSO_4$ rule" is followed. By evaporating down 100 cc. of brine and exhausting the residue with absolute alcohol (sp. gr. 0·796) so that the last runnings give no precipitate with silver nitrate, all magnesium chloride present is dissolved out; after distillation of the alcohol (for use over again) the residue is titrated for chlorine (or the magnesium present is determined). In the case of salt a weighed quantity is dried and similarly treated. The magnesium thus found as chloride being subtracted from the total amount, the balance is calculated as sulphate; any surplus sulphate over and above the $CaSO_4$ and $MgSO_4$ thus deduced is reckoned as sodium sulphate; and the total chlorine, less that found in the alcohol extract, as sodium chloride.

The following three analyses are specimens of a number quoted illustrating the results obtained with the "$MgSO_4$ rule," the "$MgCl_2$ rule," "the Halving rule," and the alcohol extraction method respectively:—

—	Gravimetric Results (Grammes per Litre).		
	Brine. Montmorot.	Mother-liquor from Saltpan. Dieuze.	Salt. Dieuze.
			Per Cent.
Chlorine, Cl.	183·31	208·20	56·49
$BaSO_4$	24·550	29·935	5·796
$Mg_2P_2O_7$	9·630	18·035	1·6727
CaO.	1·175	1·103	0·6012
$MgCl_2$ in alcoholic extract	3·65	10·72	0·87

—	Results calculated by Means of			
	$MgSO_4$ Rule.	$MgCl_2$ Rule.	Halving Rule.	Alcohol Extraction Process.
Montmorot brine:				
NaCl	301·81	291·94	297·02	293·00
$MgCl_2$	0·23	8·24	4·12	3·65
$CaSO_4$	2·85	2·85	2·85	2·85
$MgSO_4$	10·12	..	5·29	5·36
Na_2SO_4	..	11·98	5·82	5·63
Mother liquor from salt pan (Dieuze):				
NaCl	333·82	324·10	333·66	330·00
$MgCl_2$	7·55	15·43	7·71	10·72
$CaSO_4$	2·68	2·68	2·68	2·68
$MgSO_4$	9·95	..	9·75	5·96
$NaSO_4$	..	11·78	0·27	4·76
Salt, Dieuze:				
NaCl	92·98	91·33	92·22	92·09
$MgCl_2$	0·09	1·43	0·71	0·87
$CaSO_4$	1·46	1·46	1·46	1·46
$MgSO_4$	1·69	..	0·90	0·71
Na_2SO_4	...	2·00	0·94	1·15

On comparing together specimens of salt deposited at different stages of the boiling down operation, a regular increment is noticed in the proportion of sulphates of each kind (calcium, magnesium, and sodium), the alcohol extraction method above described being employed; on the other hand, the amount of magnesium chloride is sensibly constant.

——	Salt from		
	First Boiling Operation.	Second Boiling Operation.	Last Boiling Operation.
NaCl	85·00	91·00	92·00
$MgCl_2$	0·85	0·81	0·87
$CaSO_4$	0·31	0·74	1·46
$MgSO_2$	0·07	0·20	0·71
Na_2SO_4	0·14	0·62	1·15

—C. R. A. W.

Notes on Emmerton's Method for the Determination of Phosphorus in Steel, &c. H. C. Babbitt. Trans. Ann. Inst. Min. Eng., Montreal Meeting, 1893. From Jour. Anal. and Appl. Chem. 7, 165—168.

The Effect of Arsenic.—A known quantity of arsenic was added to a steel solution, and the precipitate of ammonium phospho-molybdate thrown down at varying temperatures, with the following results:—

Temperature, ° C..	85	70	60	50	40	35	30	25
Proportion of As added which was precipitated, per cent.	75·2	63·9	12·0	7·8	7·8	4·3	2·5	0·2

These results show the possibility of contamination of the phospho-molybdate by arsenic if the temperature exceeds 25° C. While differing degrees of dilution, &c. seem to affect the percentage of arsenic precipitated at 25°, the author never found it to exceed the limits of error of a phosphorus determination.

Temperature.—To determine whether all the phosphorus was precipitated at 25°, whether the ratio of phosphorus to molybdic acid remained constant regardless of temperature of precipitation, and whether the presence of ferric nitrate had any effect on the composition of the phospho-molybdate, 0·100 per cent. of phosphorus was added to a steel solution and precipitated at 25° C. and 85° C., due allowance being made for the phosphorus existing in the steel. The results obtained were—

At 25°	0·101 per cent. of phosphorus.	
At 85°	0·103	„ „

The difference is within the limits of experimental error, and shows that all the phosphorus is precipitated at 25° after five minutes' shaking, and that the composition of the phospho-molybdate is constant.

The Ratio of Phosphorus to Molybdic Acid in the Ammonium Phospho-molybdate.—The author analysed the precipitate formed at 25° C. and dried at 85°—90° C. for three days. On further drying at 150° C. it lost 0·990 per cent. of water, after which it remained constant, even when dried for 14 hours at 180° C. The analysis showed the composition of the precipitate dried at 85°—90° to be—

$(NH_4)_6O_3$	4·091
P_2O_5	3·724
MoO_3	90·315
H_2O	0·990

The percentage of phosphorus he found to be equal to 1·626 per cent. of the precipitate, and the ratio of phosphorus to molybdic acid 1·80 per cent.

Reduction of Molybdic Acid.—In reducing molybdic acid preparatory to oxidising with potassium permanganate, the author used a modification of Jones's reductor, consisting of a tube about ⅜ in. internal diameter, filled with powdered zinc to about 6 ins. The reduction seems to be carried further than in Emmerton's original process of adding zinc to a sulphuric acid solution. By the author's method, assuming the precipitate to contain 1·63 per cent. of phosphorus and the ratio of phosphorus to molybdic acid to be 1·794, he finds that molybdic acid = iron × 87·847. A reduction to Mo_2O_3 requires that molybdic acid = iron × 85·714. Using Emmerton's method, he found molybdic acid = iron × 90·814, as against 90·76, corresponding to the formula given by Emmerton and Werncke, $Mo_{12}O_{19}$, as the product of the reduction by zinc and sulphuric acid. The author's modification therefore reduces to an intermediate point between Mo_2O_3 and $Mo_{12}O_{19}$

Speed of Reduction.—Reduction in from 12 minutes to 2 minutes gave results that agreed with each other, but reduction in 30 seconds gave results varying by nearly 10 per cent. The reduced solution, after standing exposed to the air for half an hour, showed no oxidation.—H. S. P.

The Estimation of Mercury in Dilute Solutions. Leo Vignon. Comptes rend. 116, 1893, 584—586.

Mercury may be estimated as sulphide gravimetrically in solutions containing not less than 1 part of mercuric chloride per 1,000, but as in much weaker solution the sulphide remains dissolved, and possesses a brown colour, a colourimetric process may be employed between the limits of 1 part of chloride in 10,000, and 1 part in 240,000 of water, which gives very distinct results.—F. H. L.

The Separation of Barium, Strontium, and Calcium. R. Fresenius, Wiesbaden. Zeits. Anal. Chem. 32, 312—317.

For the separation of barium, strontium, and calcium the author recommends either of the following methods:—(1) The calcium is separated from the barium and strontium by treating the nitrates dried at 180° C. with ether-alcohol. From the solution of the latter two the barium is then precipitated as chromate. Or (2) the barium is first of all precipitated as chromate, and the strontium and calcium then converted successively into carbonates and nitrates and treated with ether-alcohol.

Some conception of the accuracy of the methods may be gained from the following table, which contains the results of quantitative analyses made according to the two methods.

	Method 1.		Method 2.	
——	Taken.	Found.	Taken.	Found.
	Grms.	Grms.	Grms.	Grms.
$BaCO_3$	0·4016	0·4002	0·4053	0·4034
$SrCO_3$	0·4072	0·4085	0·4060	0·4067
$CaCO_3$	0·4110	0·4090	0·4000	0·3993

The barium and calcium precipitates, examined spectroscopically, were found to be pure, whilst the strontium precipitate contained in both cases a trace of calcium.

—J. S.

Electrolytic Separations. E. F. Smith and J. C. Saltar. Jour. Anal. and App. Chem. 7, 128.

See under XI., page 605.

The Electrolytic Separation of Palladium and Platinum from Indium. E. F. Smith. Amer. Chem. Jour. 14, 435. (See this Journal, 1890, 898 and 1892, 61.)

See under XI., page 606.

ORGANIC CHEMISTRY—QUALITATIVE.

Some Reactions of Essential Oils, Strychnine, &c., used in Forensic Analysis. J. Stern. Zeits. ang. Chem. 1893, 136—138.

1. *Oil of Pimento and Oil of Cloves.*—In the course of a forensic examination of the viscera of a corpse a distinct smell of oil of cloves was noticed, whilst caryophyllin, a characteristic component of cloves, could not be detected. Further experiments pointed to the presence of pimento (Jamaica pepper). The author suspected therefore the presence of oil of pimento, and this led him, in the absence of any references in the literature, to a comparative examination of the oils of cloves and pimento. In the following table the reagents used and the reactions obtained are tabulated:—

Reagent.	Oil of Pimento.	Oil of Cloves.
Ethereal solution of bromine.	Colourless at first, afterwards light green.	Colourless at first, afterwards light green to brownish.
Alcoholic hydrochloric acid.	Brownish	Brownish.
Pure sulphuric acid......	Red with violet shade.	Red.
Fröhde's reagent.........	Dark blood-red, afterwards cherry-red.	
Mixture of 6 vol. of conc. SO_4H_2 and 1 vol. of a solution of iron perchloride (1:20).	Reddish-brown to blood-red and afterwards cherry-red.	
Fuming nitric acid.......	Reddish-brown.	
Picric acid..............	Dissolves the oil.	

Five drops of either oil shaken violently with 10 cc. lime water give a flocculent precipitate, partly adhering to the walls of the vessel. Two drops of either oil dissolved in 4 cc. alcohol, yield, on adding one drop of iron perchloride, a green, afterwards blue colouration, which passes to a red and yellow colour. Oil of pimento is, therefore, identical with oil of cloves.

2. *The Reaction of Strychnine Nitrate with Hydrochloric Acid.*—The author points out that the reaction given by the German Pharmacopœia for strychnine nitrate, viz., red coloration on heating with hydrochloric acid, is also shown by cane sugar. Care has therefore to be exercised if grave errors are to be avoided.—J. L.

Chemical Investigation of Handwriting suspected of being Forged. A. Robertson and J. J. Hofmann. Pharm. Centr. 1892, **33**, 225.

To demonstrate forgeries the following reagents are proposed, which are drawn over the characters by means of quill-pens:—

(1.) 3 per cent. solution of oxalic acid in water.
(2.) 10 per cent. solution of citric acid in water.
(3.) 2 per cent. solution of chloride of lime in water.
(4.) Solution of 1 part stannous chloride in 1 part hydrochloric acid and 10 parts water.
(5.) 15 per cent. sulphuric acid solution.
(6.) 10 per cent. hydrochloric acid solution.
(7.) 20 per cent. nitric acid solution.
(8.) Saturated solution of sulphur dioxide in water.
(9.) 4 per cent. solution of gold chloride in water.
(10.) Solution of 1 part potassium ferrocyanide in 1 part hydrochloric acid and 10 parts water.
(11.) Solution of 1 part sodium thiosulphate in 1 part ammonia and 10 parts water.
(12.) 4 per cent. solution of sodium hydroxide.

The action of these solutions on a number of inks is set forth in the following table:—

Reagents.	Iron Gallotannic Ink.	Logwood.		Nigrosin.	Vanadium Ink.	Resorcin Ink.
		With Potassium Chromate.	With Copper Sulphate.			
Oxalic acid	Disappears	Violet	Orange-yellow	Unchanged	Fades, and runs a little.	Bright red
Citric acid	Fades	Violet	Orange-yellow	Runs, with dark blue colour.	Fades and runs	Disappears
Hydrochloric acid	Disappears, but leaves behind a yellow coloration.	Purplish-red	Blood-red	Slightly altered	Fades slightly and runs a little.	Bright pink
Sulphuric acid	Disappears	Red	Purplish-red	Unchanged	Fades a little	Bright red
Nitric acid	Disappears	Red	Purplish-red	Runs a little	Fades a little	Bright pink
Stannous chloride	Disappears	Red	Magenta-red	Unchanged	Fades a little	Disappears
Sulphurous acid	Fades	Greyish-violet	Red	Unchanged	Fades a little and runs.	Fades
Gold chloride	Fades slightly	Reddish-brown	Brown	Unchanged	Unchanged	Runs, with brown colour.
Sodium thiosulphate and ammonia.	Dark red	Unchanged	Dark blue	Dark violet, runs	Runs very much	Brown
Potassium ferrocyanide and hydrochloric acid.	Blue	Red	Brick-red	Unchanged	Unchanged	Pink
Sodium hydroxide	Dark red	Brown	Dark red, runs	Dark violet, runs	Dirty brown, runs	Unchanged
Chloride of lime	Disappears	Disappears	Disappears, but leaves a yellow colouration.	Brown	Unchanged	Brown

When characters have been removed mechanically, proof may be obtained by means of a photograph taken by transmitted light, or by exposing the paper to iodine vapour. The latter process is especially useful in cases where, for the removal of the writing, the paper has been moistened; these places become blue, the others brown. When the removal has been effected by chemical means, in most cases by oxalic acid, chloride of lime, and sulphur dioxide, the suspected places are treated with a solution of sulphur dioxide in water, then with 3 per cent. solution of hydrogen peroxide, and finally with dilute ammonia. After the evaporation of the excess of ammonia, good results may be obtained with tannin, which darkens the characters.—Ed. T.

The Availability of the Fluoresceïn Reaction for the Detection of Saccharine in Beer. F. Gantter. Zeits. Anal. Chem. **32**, 309—312.

The author finds that the production of a fluoresceïn by heating saccharine with concentrated sulphuric acid and resorcinol, according to the method recommended by Bornstein (this Journal, 1888, 458, and 1889, 216), is of no value for indicating the presence of saccharine in beer, because the resinous matters in the extract, and even common resin itself, give a fluorescein when heated with sulphuric acid and resorcinol.

The author concludes that the most reliable method for detecting saccharine in beer, is by tasting the residue after separating the resinous matter and dextrin from the petroleum spirit extract.—J. S.

A Method for Testing Ether. M. C. Traub. Schweiz. Wochens. Pharm. 1892, 3. From Pharm. Zeits. Russland. **31**, 504.

The author finds that good ether undergoes no change when boiled with caustic potash for 12 hours instead of for half an hour, as is required by the Pharmacopœia. It should also give a colourless solution when carefully dissolved in concentrated sulphuric acid in the cold. When allowed to evaporate on blotting-paper it should leave no smell; occasionally a sample of impure ether leaves a fruity odour. —J. S.

Estimation of Small Amounts of Furfurol. Soluble Pentoses in Plants. G. de Chalmot. Amer. Chem. J. **15**, 21.

See under Anal. and Scient. Notes, *page* 632.

Birotation and Hydrazone Formation of certain Sugars. H. Jacobi. Annalen, 1892, **272**, 170—182.

The author finds that in the case of certain sugars which exhibit the phenomenon of birotation, the formation of a phenylhydrazone takes place more quickly when the freshly-prepared solution is used than when a solution is employed that has been kept until its rotation is constant. He therefore thinks that birotation is due to the combination of the solvent with the optically active substance.—A. R. L.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Determination of Sucrose, Dextrose, Lævulose in Mixture. F. G. Wiechmann. School of Mines Quarterly, **13**, 197.

In order to determine the relative quantities of these three forms of sugar when present together, but without admixture with any other optically active substances, a solution of arbitrary density is first prepared; the specific gravity of this is accurately determined by balance, and the degree Brix corresponding therewith found: 1,000 divided by this degree represents the weight in grms. of solution containing 10 grms. of dry substance. This amount is weighed out and diluted to 100 cc. with distilled water in an accurately graduated flask. Three portions of the fluid are then taken: (1) for valuation in the polariscope at 20° C.; (2) for gravimetric valuation of copper reducing power before inversion; (3) for similar valuation after inversion. The polariscope reading is reduced to the basis of a reading in a 100 mm. tube transformed into circular degrees, the factor 0·346 being employed when a sugar polariscope is used with 26·048 grms. as the normal weight. The gravimetric valuations (2) and (3) are made by collecting the cuprous oxide precipitated by means of Fehling's solution on a weighed asbestos filter, and weighing after washing successively with boiling water, alcohol, and ether, and drying. From the weights of cuprous oxide the equivalent quantities of sucrose are deduced by table; the "total reducing sugars" present are obtained by adding on $\frac{1}{20}$ to the sucrose value thus indicated by (2), whilst the sucrose present is the difference between the sucrose values indicated by (2) and (3) respectively. Calling this latter value a, and writing b for the "total reducing sugar" present, and p for the polarisation observed, expressed in circular degrees, the amounts of dextrose and levulose present (x and y respectively) are given by the equations—

$$x = \frac{p + yl - as}{d}$$

$$y = \frac{bd - p + as}{1 + d}$$

where s, d, and l represent respectively the hundredth parts of the numerical values of the specific rotatory powers of sucrose, dextrose, and levulose; the latter values are taken as + 66·5, + 53·5, and − 81·9 respectively, these figures being deduced from careful observations on the purest granulated sugar obtainable, after repeated washing with absolute alcohol; on commercial anhydrous dextrose treated with best blood carbon, and repeatedly crystallised from absolute alcohol; and on the product of the action of hydrochloric acid on inulin, twice recrystallised from absolute alcohol. The weights of metallic copper reduced per grm. of the purified dextrose and levulose thus obtained were found to average 1·8636 and 1·7256 grms. respectively. Direct experiments with solutions containing known varying quantities of the three sugars gave satisfactory results as regards concordance between the quantities known to be present and those found by means of these valuations and formulæ.—C. R. A. W.

A New Method for Detecting Cotton-seed Oil in Pig's Lard and Olive Oil, and on the Approximate Estimation of Cotton-seed Oil in Lard. F. Gantter. Zeits. Anal. Chem. **32**, 303—308.

When testing numerous samples of pig's lard by Becchi's method, the author failed to obtain any blackening of the silver nitrate, although he felt sure from its price and behaviour that it contained cotton-seed or some other oil. He therefore tested three different samples of cotton-seed oil in the same way, and again failed to observe any reduction of the silver nitrate. It appears therefore that there is in the market a cotton-seed oil which, in consequence of heating or some other treatment, no longer blackens silver nitrate. The author is of opinion that the reduction of the silver nitrate is not occasioned by the glucoside of cotton-seed oil, as was at first supposed by Becchi, but by certain impurities which can be removed by proper treatment. In place of Becchi's test, which can no longer be trusted, he proposes the following:—1 cc. of the dry, melted fat or oil is dissolved in 10 cc. of petroleum spirit in a test tube and one drop of concentrated sulphuric acid added, the contents of the tube being well shaken. From the nature of the coloration, conclusions may be drawn as to the purity of the substance examined. Pure pig's lard treated in the above way shows a coloration between straw-yellow and a faint reddish-yellow; the solution at first remains clear, but heavy drops of a reddish-yellow colour are gradually deposited, and the upper layer of liquid in the tube becomes almost colourless. Olive oil behaves similarly, but the solution at first shows only a faint dark coloration. Cotton-seed oil, on the other hand, immediately becomes dark brown or black, and remains so for a very long time. A mixture of pig's lard and cotton-seed oil assumes a more or less dark brown colour according to the proportion of the latter present. The addition of even 1 per cent. of cotton-seed oil can be detected in this way.

As regards the quantitative determination of the fats, the author found that 100 mgrms. of pig's lard absorb 24 mgrms., while the same quantity of cotton-seed oil absorbs nearly 44 mgrms. of iodine. By determining the amount of iodine absorbed by a given mixture of the two fats, it is possible to calculate approximately the relative amount of each present in the sample. A pure specimen of pig's lard ought to fulfil the following conditions:—

(1.) When tested by the sulphuric acid test it should show a straw-yellow, at most a reddish-yellow coloration.

(2.) The amount of iodine absorbed by 100 mgrms. should not exceed 27 mgrms.

From the table it will be seen that the indications of the sulphuric acid test are confirmed by the amount of iodine absorption, except in the case of sample 15, which probably contains some other oil than cotton-seed oil.

No.	Remarks.	Sulphuric Acid Test.	Iodine Absorption.	Approximate Percentage of Cotton-seed Oil.
1	American pig's lard obtained wholesale.	Dark brown	36·9	50—60
2		Straw yellow	27·2	..
3		Dark brown	29·8	20—30
4		„	31·7	30—40
5		Straw yellow	26·7	..
6		Dark brown	27·9	10—20
7		„	28·7	20
8	Bought from retail dealers.	„	30·0	60—70
9		„	40·8	70
10		„	39·2	60—70
11		„	40·6	70
12		„	38·4	60—70
13		„	37·2	60—70
14		„	35·1	50—60
15		Colourless	32·0	..
16	Bought from butchers.	Faint reddish-yellow.	23·8	..
17		„	24·3	..
18		Colourless	25·1	..
19		Straw yellow	24·9	..
20		„	22·6	..
21		„	26·4	..
22		„	22·7	..
23		„	27·0	..
24		„	26·8	..
25		„	26·3	..
26		„	26·4	..
27		„	25·6	..

—J. S.

Estimation of Water in Butter. Wibel. Zeits. ang. Chem. 1893, 220.

A MODERATELY accurate method of quickly determining the amount of water in butter is much wanted for commercial purposes, as in many cases it is impossible to wait for the time requisite for an exact weight analysis. Birnbaum uses for this purpose the following method: the butter is dissolved in ether and shaken with a known volume of water, the increment in bulk of which gives a measure of the amount of water present in the butter. The author modifies this process by shaking up 10 grms. of butter with 30 cc. of ether saturated with water in a tube corked at one end and provided with a stop-cock at the other, through which the liquid is run off into a second narrow graduated tube containing 5 cc. of saturated brine coloured red with litmus and a trace of acetic acid. This coloration enables the upper surface of the watery layer to be more readily read off, the particles of caseous matter, &c. insoluble in ether that usually obscure the level being now distinguishable through their want of colour. The results are usually slightly below those obtained by weight analysis, but are sufficiently exact to enable the process to be useful for market control and police regulation purposes.—C. R. A. W.

Soap: its Manufacture and Analysis. H. T. Vulté, School of Mines Quarterly, **13**, 243.

SOAPS (as manufactured in America) may be classified as follows:—

Toilet Soaps.—Pure soaps containing no resin, free or carbonated alkali, or silicate.

Household Soaps.—Containing resin and free and carbonated alkali and silicate not exceeding 0·5 per cent.

Manufacturers' Soaps.—Strongly alkaline soaps, with or without resin or silicate, as the special case may require.

Medicated Soaps.—Pure soap containing phenol, naphthol, or other medicinal agent.

Salt Water Soaps.—Mixed soda and potash soaps of cocoa-nut oil, which are soluble in both fresh and salt water.

Resin Soaps are rated according to the proportion the resin bears to the fatty acids present. A soap of equal parts resin and fat is called 100 per cent. resin; one of one-quarter resin and three-quarters fat, 50 per cent. resin; and one of three-quarters resin and one-quarter fat, 150 per cent., and so on.

The author recommends the following scheme of analysis: the bar examined is cut into ½-in. cubes, several of which are placed in a dry test-tube, which is kept corked. When portions are to be weighed up, as many cubes as may be requisite are shaken out and the loss of weight of the tube determined. Two or three cubes (5–10 grms.) are thus shaken out into a dish of platinum or porcelain, or preferably lead (a large bottle-cap answers well), containing 25—30 grms. of clean dry sand and a small glass rod, all weighed together. 50—75 cc. of absolute alcohol are added and the whole heated on the water-bath, stirring at intervals until the soap is dissolved; the whole is then evaporated to dryness, the contents of the dish being thoroughly mixed as drying proceeds, and finally dried in an air-bath at 100° C. until a constant weight is attained. The loss of weight represents water, together with alcohol and part of the essential oils, &c. used as perfume (when present).

The leaden dish is then bent up and placed in the inner tube of an extraction apparatus, preferably the Knœffler, and treated with petroleum ether for 1 to 2 hours so as to dissolve out unsaponified fat. The residue is similarly treated with alcohol of 95 per cent. for 1½ hours, whereby soap and glycerol are dissolved out. The insoluble residue is treated with water and fractions of the solutions tested for sodium chloride, carbonate, sulphate, and silicate respectively. Anything insoluble in water is examined for pigments, metallic soaps, wood-pulp, clay, silica, &c.

The alcoholic solution is titrated for free caustic alkali with phenolphthaleïn as indicator; water is then added and the alcohol boiled off in a current of steam. Excess of normal hydrochloric acid is added, together with sodium chloride or sulphate to salt out the soluble fatty acids of cocoa-nut oil, and the whole boiled. After chilling to solidify the fatty acids, two holes are punched in the cake and the acid watery fluid run off through a filter. The residual cake is boiled up with water and salt as before, and the final watery liquid poured off added to the previous amount; the unneutralised acid present being determined, the amount of alkali combined as soap is known. The fatty acids, &c. left as cake and the portions adherent to the filter-paper are dissolved by ether and ultimately weighed, resin being subsequently determined either by Gladding's method or by Twitchell's process; that is to say, either by separation as silver resinate, soluble in ether, or conversion of fatty acids into compound ethers by treatment with absolute alcohol and hydrogen chloride, the resin acids being unaffected by this treatment. In determining the amount of hydrochloric acid not neutralised phenolphthaleïn is used as indicator; when neutrality is attained some methyl-orange is added, and the titration proceeded with afresh; the extra amount of acid thus indicated represents the soluble fatty acids present in the brine. In this way direct determinations are obtained of water; fatty and resin acids (to be calculated as anhydrides); alkali (Na_2O) combined therewith as soap; free alkali present as $NaOH$; that present as Na_2CO_3; alkaline silicate; $NaCl$; Na_2SO_4; and mineral and other insoluble matters. In addition glycerol may be estimated by Muter's copper test (determination of amount of copper hydroxide kept in solution when treated with copper sulphate in excess and caustic soda), and cane sugar by inversion and Fehling's test, using the aqueous solution from which fatty acids have been separated. Gelatin may be determined in the portion insoluble in alcohol by estimating nitrogen by soda-lime or by Kjeldahl's process.—C. R. A. W.

The Estimation of Creosote. A. Schlicht. Pharm. Zeit. 38, 63.

From its alkaline solution the author extracts creosote by shaking up with ether saturated with water at a given temperature, and then calculates its amount from the quantity and specific gravity of the ethereal extract. For every grm. of creosote, of sp. gr. 1,077, dissolved in 100 cc. of ether saturated with water, the specific gravity of the ethereal creosote solution increases quite uniformly by 0·00477 at 17·5° C.—J. S.

The Valuation of Salipyrine (Antipyrine Salicylate). J. Altschul. Pharm. Centralhalle, 33, 61.

The method depends on the fact that phenolphthaleïn is not coloured by antipyrine. 3·26 grms. ($\frac{1}{100}$th mol.) of the substance are dissolved in dilute alcohol and titrated with normal alkali, phenolphthaleïn being used as indicator. The amount of alkali required, expressed in tenths of cubic centimetres, represents the percentage amount of antipyrine salicylate present in the sample.—J. S.

Analysis of Tobacco and its Products. V. Vedrödi. Zeits. Anal. Chem. 32, 277—296.

The author has critically examined and compared the methods of Kosutány and Kissling for estimating the amount of nicotine in tobacco. Kosutány first determines the ammonia by treating a weighed quantity (20 grms.) of the dry powdered tobacco with an excess of milk of lime. The mixture is placed under a bell-jar along with a basin containing 20 cc. of normal sulphuric acid and allowed to stand for 3—4 days. By that time all the ammonia is absorbed by the sulphuric acid, and its amount may be determined by titrating the excess of free acid with a standard solution of barium hydrate. The residue is then thoroughly washed with cold water, filtered, and the alkaline filtrate extracted three times by shaking up with a quarter of its volume of petroleum spirit. In each case the petroleum spirit should be allowed to remain in contact with the solution 24 hours and occasionally shaken. To determine the amount of nicotine, the petroleum spirit extract is made slightly acid with decinormal sulphuric acid and thoroughly shaken. The liquid which separates out at the bottom is separated from the petroleum spirit and the process repeated until the petroleum spirit extract is no longer alkaline. The excess of free acid is then determined by titration with standard barium hydrate solution, and the amount of nicotine calculated from the quantity of sulphuric acid necessary for neutralisation.

Kissling determines the nicotine in the following manner: 20 grms. of the powdered tobacco, dried at 50—60° C. are moistened with 10 cc. of a dilute alcoholic solution of sodium hydrate (6 grms. sodium hydrate, 40 cc. water, and 60 cc. 95 per cent. alcohol), introduced into an extraction apparatus, and extracted with ether. The ethereal extract is then evaporated to small bulk, treated with 50 cc. sodium hydrate solution (4 equiv. sodium hydrate in 1 litre water), and distilled in a current of steam. The distillate is collected in portions of 100 cc. and titrated. If $\frac{1}{3}$ normal sulphuric acid is employed for titration, each cc. corresponds to 0·054 grm. nicotine.

On comparison of the two methods the author found that neither gives accurate results. Kosutány's method invariably shows too low and Kissling's too high a percentage of nicotine. Better results may be obtained by Kissling's method if the tobacco, moistened with dilute alcoholic solution of caustic soda, be allowed to stand for 3—4 days, in order to get rid of the free ammonia, before extracting with *dry* ether. The defect of this method is chiefly due to the fact that some of the nitrogenous organic substances are rendered soluble in ether by the treatment with soda solution, and, on subsequent distillation with sodium hydrate in a current of steam, are converted into ammonia, which passes over and is reckoned as nicotine. Kosutány's method, on the other hand, suffers from the opposite defect, namely, a portion of the nicotine remains behind in the aqueous extract of tobacco when this is shaken up with petroleum spirit. If this defect could be remedied, the method would prove to be a very valuable one on account of its simplicity, convenience, and accuracy.
—J. S.

Composition of certain Spices. T. Arnst and F. Hart. Zeits. ang. Chem. 1893, 136—137.

The following table contains the analyses of some spices, the essential oils whereof were determined by the following method: 10 grms. of the substance, dried at 100° C., were exhausted in a Soxhlet extractor with dry ether; the ethereal solution was evaporated at a temperature not exceeding 40° C. and the residue weighed. Afterwards the residue was heated with water on the water-bath until the odour was no longer noticeable. The water was now evaporated and the remaining fat weighed. The difference between the two results corresponds to the amount of essential oil.

The following remarks may be added to the tabulated values: *Illicium anisatum* and *Illicium religiosum* are easily differentiated by their percentages of essential oil; the same holds good of genuine and Bombay maces. The detection of flowers of Calandula as an admixture with saffron is facilitated by estimating the amount of fat and essential oil. The capers were only obtainable in a preserved state; the capers "nonpareilles" and "capotes" had been preserved in salt water, the other two brands in vinegar.

No.	Name	Calculated on Original Substance.	Calculated on the Dried Substance.								Remarks.
		Water.	Protein.	Fat.	Essential Oil.	Sugar.	Starch.	Other Extractive Substances N-free.	Wood Fibre.	Ashes.	
1	Spanish liquorice	8·82	14·17	4·07	..	10·50	34·36	12·71	19·37	4·82	
2	Russian liquorice	8·68	10·13	3·35	..	17·94	22·70	19·43	20 59	5·86	
3	Illicium anisatum	13·16	5·93	6·73	5·52	43·20			35·57	3·05	
4	Illicium religiosum	11·94	7·21	2·67	0·75	54·53			31·69	3·15	
5	Genuine mace	18·21	9·53	26·78	4·12	53·08			4·52	1·97	
6	Bombay mace	7·04	5·64	61·05	0·27	22·79			8·79	1·46	
7	Ginger from Bengal	10·92	9·36	3·96	1·39	Trace	51·30	16·34	9·98	7·67	

No.	Name.	Calculated on Original Substance.	Calculated on the Dried Substance.								Remarks.
		Water.	Protein.	Fat.	Essential Oil.	Sugar.	Starch.	Other Extractive Substances N-free.	Wood Fibre.	Ashes.	
8	Ginger from Cochinchina	10·17	8·47	3·88	0·76	1·34	60·78	15·86	4·69	4·22	
9	Zedoary	18·62	13·32	3·92	0·45	1·66	60·70	8·98	5·79	5·18	
10	"	16·56	15·09	2·24	1·26	1·22	60·40	7·88	6·48	5·43	
11	Curcuma (turmeric) (Bengal)	15·82	9·45	8·33	3·61	1·81	37·14	22·22	8·49	8·95	
12	" (Madras)	13·76	7·65	5·70	1·14	4·29	86·07	9·47	6·85	8·83	The seeds consist of— Per Cent.
13	Cardamoms from Ceylon .. Fruits ..	12·25	14·77	2·33	0·97	0·51	48·46	8·17	16·37	8·42	Kernel...64·58
14	Cardamoms from Ceylon .. Husks ..	9·15	11·14	3·38	0·08	0·92	20·54	18·57	31·56	13·79	Husks ...35·42
15	" " Malabar. Fruits ..	11·25	16·64	1·95	2·06	0·72	35·75	12·13	18·81	11·94	Kernel...56·94
16	" " Malabar. Husks ..	9·52	8·44	2·84	0·14	1·28	22·98	18·04	33·15	13·13	Husks ...43·06
17	Galangal	14·42	5·31	5·08	0·22	1·11	38·94	21·21	22·52	5·61	
18	Coriander	11·31	12·44	21·61	0·26	2·16	11·87	16·14	29·57	5·95	
19	Anise-seed (Russian)	12·75	20·73	11·40	0·87	6·30	6·19	28·70	13·87	11·94	
20	" (Levantine)	12·81	20·82	11·98	1·16	3·92	5·58	32·94	16·73	6·87	
21	Caraway-seed (Dutch)	15·87	24·07	10·47	4·49	4·87	5·38	21·97	21·07	7·68	
22	Fennel-seed	17·19	19·66	10·70	3·49	5·69	17·30	16·18	16·59	10·39	
23	Saffron (Spanish)	15·90	14·95	5·58	0·96	14·24	53·90		5·56	4·81	
24	" (Gâtinais)	14·45	15·88	10·02	0·43	14·61	48·96		5·12	4·98	
25	Flowers of Calandula	29·15	18·12	21·14	0·11	Trace	31·85		15·91	12·87	
26	Safflower	10·16	18·64	4·64	0·76	7·24	38·59		14·14	15·99	
27	"Nonpareilles" Capers	87·20	21·10	4·41	..	37·86			9·75	26·88	
28	"Superfines" Capers	87·54	28·95	3·84	..	44·99			11·47	10·75	
29	"Capricines" Capers	86·49	29·11	3·92	..	47·93			10·78	8·26	
30	"Capotes" Capers	88·52	22·71	4·56	..	39·89			10·74	22·10	
31	Caltha palustris (buds)	5·01	31·13	4·77	..	3·31	17·4		17·4	7·64	
32	Spartium scoparium (buds)	8·00	..	4·28	..	6·42	14·0		14·0	6·45	

—J. L.

ANALYTICAL AND SCIENTIFIC NOTES.

Soluble Pentoses in Plants. G. de Chalmot. Amer. Chem. J. **15**, 21.

The sugars that up to the present time have been obtained from the pentosans are arabinose and xylose. The author's investigations are based on the hypothesis that pentoses are formed as primary products of plant assimilation. From a large number of experiments upon leaves it appears "that in all the higher green plants there are soluble substances in the leaves which form furfural (HCl hydrolysis) and are neither albuminous substances nor hexoses, but must be regarded as pentoses." The following determinations of quantities of hexoses and pentoses may be cited:—

——	Hexose.	Pentose.
	Per Cent.	Per Cent.
Bignonia	..	0·37
Trifolium	0·89	0·20
Solanum	0·35	0·45
Daucus	1·80	0·45
Trachelospermum	1·80	0·03
Verbascum	1·40	0·008

Pentoses were also found in the colourless bark of the young limbs. It was further shown that these soluble pentoses were easily diffusible, and are therefore of lower molecular weight.

Determinations at the morning and evening periods showed a greater proportion in the latter, and it is probable, therefore, that the pentoses are elaborated into more complex forms in the period of darkness.

For the estimation of small amounts of furfurol a method was devised depending on the colour reaction between furfurol and aniline in acetic acid solution.—C. F. C.

The Relative Strengths or "Avidities" of some Compounds of Weak Acid Character. John Shields. Proc. Chem. Soc. 1893 [125], 144.

The author has calculated the relative strengths of a number of compounds of weak acid character from the rate at which salt solutions saponify ethylic acetate (Phil. Mag. [5], **35**, 365).

The comparison has been made in decinormal solution, the "dissociation ratio" being taken as the measure of relative strength or "avidity," and in order to obtain a better idea of their relative strengths the compounds examined have been compared with some of the stronger acids taken from Ostwald's tables. The results are contained in the following table, from which it will be seen that in decinormal solution, hydrogen chloride, for example, is about 100,000 times stronger than phenol.

Hydrogen chloride	100
Trichloracetic acid	68
Dichloracetic "	33
Monochloracetic acid	4·3
Acetic "	0·35
Biboric "	0·0057
Hydrogen cyanide	0·0026
Phenol	0·00094
Carbonic acid	0·00091

The Decomposition of Hydriodic Acid Gas at High Temperatures. M. Bodenstein and V. Meyer. Ber. **26**, 1146—1159.

In hydrogen iodide the authors have discovered a substance which admits of an exact study of chemical equilibrium or balanced action in the gaseous state. When hydrogen iodide is heated, it is partially decomposed into hydrogen and iodine, and when hydrogen and iodine in equivalent quantity are heated together, they combine to a certain extent, with formation of hydrogen iodide. The pure hydrogen iodide, which was employed in these experiments, was prepared by passing pure hydrogen and the vapours of iodine over heated platinised asbestos. The gas was absorbed in cold water, from which it could be obtained as required by warming. The pure dry gas is slowly but almost completely decomposed by exposure to sunlight, so that experiments with it had to be performed in the dark. Hydrogen iodide does not begin to decompose at 150° C., as stated in text-books, but the higher the temperature the more *rapid* the decomposition. At any given temperature the relative amounts of hydrogen iodide and free elements remains the same, whether the reaction is one of combination or decomposition. Since hydrogen iodide is an endothermic compound there must be a temperature at which the heat of formation is 0. This temperature the authors find to lie between 310°—350° C.; calculated according to Van't Hoff's formula it should be about 324° C.

The rate at which hydrogen iodide is decomposed at various temperatures was also measured, and it was found that the law of mass action was obeyed.—J. S.

The Temperatures of Explosion of Gaseous Mixtures. V. Meyer. Ber. **26**, 428—429.

Freyer and V. Meyer (this Journal, 1893, 437) observed that the temperature of explosion of a mixture of hydrogen and chlorine was very irregular. The author describes additional experiments which confirm this. If bulbs containing the mixture, prepared in exactly the same way, be rapidly introduced into boiling dimethyl aniline (193° C.) in the dark, explosion usually takes place. Out of about 40 bulbs dipped into boiling aniline (182° C.) only two exploded. Mere traces of foreign gases, as well as the nature of the walls of the bulbs, are of considerable influence in determining the temperature at which explosion occurs. —J. S.

Graphite and Graphitite. W. Luzi. Ber. **26**, 890.

By previous research (Zeits. f. Naturw. **64**, 244; and Ber. **24**, 1085; **25**, 216, 1378) the author has been led to distinguish two forms of graphite, one of which he calls graphite and the other graphitite. They are characterised by the difference of their behaviour when heated with a mixture of potassium chlorate and the strongest nitric acid. In confirmation of this view, three samples of graphite from widely distant places of origin (Ceylon, Norway, Canada) yielded an oxidation product, translucent, composed of thin tabelliform crystals with cleavage lines, and yielding when ignited a residue, pyrographite oxide, of enormous size, made up of very fine swollen, curly threads. On the other hand, three samples of graphitite from the Fichtelgebirge, Siberia, and Greenland, submitted to the same process, yielded an oxidation product possessing no crystalline form, no fissures, and of quite irregular formation. This graphitite oxide, when decomposed by heat, yields a powdery residue, pyrographitite oxide, neither swollen up nor showing any indication of fine threads.—Edo. T.

New Books.

Tabellarische Uebersicht über die Künstlichen Organischen Farbstoffe und Ihre Anwendung in Färberei und Zeugdruck. Von Dr. Adolf Lehne. *Zweite Lieferung.* Berlin: Verlag von Julius Springer, 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. Six Parts, 6*s.* each.

This is the Second Part of the work already noticed in this Journal, 1893, 384, where Part I. is referred to. As there stated, the tabular review when complete will form an almost indispensable companion work to Schultz and Julius's "*Tabellarische Uebersicht der Künstlichen Organischen Farbstoffe.*"

In this Part II. the number 63 is commenced with on p. 17, corresponding to No. 86 in Schultz and Julius's Tables, and refers to Croceïn Scarlet 3 BX, and the part ends with No. 119, or 148 in Schultz's Tables, and refers to Stilbene Red. As in Part I., the column devoted to illustration by means of dyed specimens, is again in Part II. a brilliant success.

Chemisch-technisches Repertorium. Uebersichtlich Geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobson, 1892, Zweites Halbjahr. Erste Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung. Herman Heyfelder, Schönebergerstrasse 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

This issue forms the first of the second half year of 1892, and contains pages 3 to 112, in which the following matters are treated of:—Building Materials, Cements, &c. Colours, Dyes, and Calico printing. Fats, Oils, Illuminating and Heating Materials. Fermented Liquors. Tanning, Leather, and Glue. Textiles. Glass and Earthenware. Wood and Horn. India-rubber. Cements, Varnishes, and Paints. Metals.

Ueber die Entwickelung der Theerfarben-Industrie. Von Dr. Heinrich Caro, Hofrath in Mannheim. Berlin: R. Friedländer and Sohn, 1893. Price 3*s.* 6*d.*

This is a reprint in book-form of the remarkable address given by Dr. Caro before the Berlin Chemical Society, June 22nd, 1891, on the "*Development of the Coal-tar Colour Industry.*" The book contains 151 pages, entirely filled with subject-matter, and without either preface or index.

Rules for the Estimation of Alcohol in Imported Spirits. With Tables giving the specific gravity of alcohol from 984 to 936, computed to the third place of decimals. By C. J. H. Warden, M.D., Chemical Examiner to the Government of Bengal. *Issued by order of the Board of Revenue, Bengal.* Calcutta: Bengal Secretariat Press, 1892. Price Rs.10.

This is a strongly bound 8vo. volume, containing introduction of 7 pages, $3\frac{1}{2}$ pages of rules for testing spirits, and 413 pages filled with tables giving in one column the specific gravities of spirits at 15·5° C., and in the adjoining column the corresponding percentages U.P. or O.P., as the case may demand.

Errata.—This Journal, 1893, 181, col. 1, 19 lines from bottom, for "1877" *read* "1887"; 16 lines from bottom delete the word "of."

Page 67, col. 2, line 2 below table, after the word "of" add the words "sodium hydrate and 10 cc. of" before the words "hydrogen dioxide."

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

UNITED STATES.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Potato starch, certain so-called farina is dutiable at 2 cents per pound under paragraph 323 N.T.

Ammoniacal gas liquor, the product of the destructive distillation of coal in the manufacture of illuminating gas, and purified and concentrated by redistillation, so that it contains a much larger percentage of ammonia and sulphide of ammonia than was contained in said liquor when first distilled, is dutiable at 20 per cent. *ad val.* under section 4 N.T.

Lupuline, a resinous secretion in the form of a powder from the scales and fruit of the hop flowers, which are the hops of commerce, is a crude drug of the class enumerated in paragraph 560 N.T., and is exempt from duty.

Cow or ox hides of the description known as Russia leather, and chiefly used as a material for razor strops, are dutiable at 10 per cent. under paragraph 455 N.T.

Oil-dressed elk hides having a chamois finish are dutiable at 10 per cent.—*Board of Trade Journal.*

CUSTOMS TARIFF OF VICTORIA.

The following is a statement of the rates of import duty now in force under the Customs tariff of Victoria. They are leviable under the Customs Act of 1890 as amended by the "Customs Act, 1892," dated the 19th January 1893.

Articles.	Rates of Duty.	£	s.	d.
Acids, viz.:—				
Acetic, containing not more than 30 per cent. acidity.	Pint or lb.	0	0	3
Do., for every extra 10 per cent. or part of 10 per cent. above 30 per cent.	„	0	0	1
Muriatic, nitric, sulphuric	Per cwt.	0	5	0
Blacking, including burnishing ink, dressing, harness polishing, and paste.	25 % *ad val.*			
Blue	Per lb.	0	0	2
Brownware, tiles, retorts, fire lumps, and fire clay goods, including firebricks.	20 % *ad val.*			
Butterine and oleomargarine	Per lb.	0	1	0
Candles	„	0	0	2
Cement, including plaster of Paris, and other products having sulphate of lime as a basis.	Per cwt.	0	1	0
Charcoal and coal (ground)	20 % *ad val.*			
Chinaware and porcelain (except photographic, scientific, and telegraphic materials—free).	15 % *ad val.*			
Cloths, oil and other floor	20 % *ad val.*			
Earthenware, including packing (except photographic, scientific, and telegraphic materials—free), measuring outside the package as imported.	Per cubic foot	0	0	8
Drugs, viz.:—				
Ammonia, carbonate of	Per pint or lb.	0	0	2
„ liquid	„	0	0	2
Chlorodyne	25 % *ad val.*			
Cocculus indicus	Per lb.	0	1	0
Glycerine, pure	„	0	0	3
„ crude	„	0	0	1
Drugs—*cont.*				
Morphia	Per oz.	0	1	6
Nitrate of silver	„	0	0	6
Nux vomica	Per lb.	0	0	2
Strychnine	Per oz.	0	1	0
Explosives (except fine meal powder, not sporting, in bulk and in packages of not less than 25 lbs. each—free), viz.:—				
Powder, sporting	Per lb.	0	0	3
„ blasting	„	0	0	1
Gelatine and gelatine dynamite	„	0	0	1
Other explosives	„	0	0	4
Fireworks	20 % *ad val.*			
Fuse	Per coil of 24 feet or less, and in proportion for any greater quantity	0	0	1½
Gelatine	Per lb.	0	0	6
Glucose:—				
Solid	Per cwt.	0	6	0
Liquid	„	0	3	0
Glue: Liquid and liquid gum, and cements.	20 % *ad val.*			
Glue	Per lb.	0	0	2
Grease (antifriction)	Per ton.	3	0	0
Ink, printing (coloured)	Per lb.	0	0	6
Inks, writing, liquid or powder	10 % *ad val.*			
Lead, sheet, and piping	Per cwt.	0	2	6
Leather [except (crust or rough tanned, viz.:—calf, goat, hogskin, sheep, or kangaroo, when not exceeding seven lbs. each skin; and English bend, sometimes called butt—free), and kid, calf-kid, mock-kid, and patent calf—free].	Per lb.	0	0	6
Leather, furniture, bootmaking, and bookbinding morocco (except black), Persian sheep roan, and skivers.	35 % *ad val.*			
Black morocco and goat levant	20 % *ad val.*			
Medicines, consisting of two or more ingredients mixed ready for use, not being in chemical combination, drugs and chemicals packed ready for retail sale or consumption, including medical compounds containing spirits not exceeding the strength of proof by Sykes' hydrometer, and all preparations recommended as beneficial for any portion of the human or animal body, or the cure or the treatment of any disease or affection whatever: and medicine chests or cases, with or without fittings.	25 % *ad val.*			
Milk, preserved	Per pint or lb.	0	0	2
Mustard	Per lb.	0	0	2
Oil and paste, furniture	20 % *ad val.*			
Oils, in bulk (except cocoanut, fish of all sorts, mineral refined of which the point of ignition is below 80° F., kerosene, palm, lubricating, of which the chief component part is mineral, and resin—free).	Per gallon	0	0	6
Oils packed in bottles, jars, or other vessels, not exceeding one gallon in size, as under:—				
Quarts and over a pint	Per dozen	0	4	0
Pints and over a half-pint	„	0	2	0
Half-pints and smaller sizes	„	0	1	0
Over a quart and not exceeding a gallon.	„	0	12	0

CUSTOMS TARIFF OF VICTORIA—*continued.*

Articles.	Rates of Duty.			
Oilmen's stores (except essential oils and essences not containing alcohol—free), packed in bottles or jars not exceeding one reputed quart in size, or in canisters or vessels not exceeding one quart in size.	20 °/₀ *ad val.*			
Oilmen's stores not otherwise enumerated (except isinglass, uncut—free).	10 °/₀ *ad val.*			
Opium, including all goods, wares, and merchandise mixed or saturated with opium, or with any preparation or solution thereof, or steeped therein respectively.	Per lb.	1	0	0
Paints and colours (except artists' colours):—				
Ground in oil, including patent dryers and putty.	Per ton	2	0	0
Mixed ready for use, from or of any substance.	"	4	0	0
Paper (except writing and printing in original wrappers and uncut edges as it leaves the mill; paperhangings and millboard—free):—				
Cut	Per lb.	0	0	2
Paper, other	Per cwt.	0	6	0
" bags	"	0	15	0
" cardboard, pasteboard	"	0	4	0
Powders, baking, seidlitz, washing	20 °/₀ *ad val.*			
Soap, perfumed and toilet	Per lb.	0	0	4
Do., other	"	0	0	2
Soda crystals	Per ton	2	0	0
Spirits, cordials, liqueurs, or strong waters, sweetened or mixed with any article so that the degree of strength cannot be ascertained by Sykes' hydrometer (including all alcohol diluted or undiluted with water or other menstruum, and containing in solution any essence, essential oil, ether, or other flavouring or other substance, whether of natural or artificial origin.	Per gallon	0	15	0
Spirits, methylated	Per liquid gall.	0	1	0
Do., perfumed	Per gallon	1	4	0
Springs, sofa, chair, and other furniture	10 °/₀ *ad val.*			
Starch	Per lb.	0	0	2
Stearine	"	0	0	2
Sugar, the produce of the sugar cane	Per cwt.	0	3	0
Do., the produce of sugar cane bonded and refined in Victoria in a bonded warehouse, under regulations framed by the Governor in Council.	"	0	2	0
Do., the produce of beet-root, and all other sugar.	"	0	6	0
Do., candy	Per pint or lb.	0	0	2
Do., molasses (except unrefined—free)	Per cwt.	0	3	0
Varnish, including lithographic	Per gallon	0	2	0
Vinegar, not being acetic acid or crude vinegar, aromatic or raspberry.	"	0	6	0

The following are exempt from duty:—

Charcoal, animal (ground); chinaware and porcelain, being scientific materials; colours, artists'; explosives, being fine meal powder, not sporting, in packages of not less than 25 lb. each; glassware, scientific; matches, wood, safety; molasses; oil in bulk, being cocoanut, fish, mineral refined, of which the point of ignition is below 80° F., kerosene, palm, lubricating, of which the chief part is mineral, and resin; oilmen's stores, being essential oils and essences, not containing alcohol and isinglass uncut; and salt, being rock salt.—*Ibid.*

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

MANGANESE ORE TRADE IN THE CAUCASUS.

The manganese ore trade in the Caucasus to the United Kingdom and the United States of America is steadily increasing. In his report to the Foreign Office on the trade and commerce of Batoum for the year 1892, Mr. P. Stevens, Her Majesty's Consul at that port, writes:—

It is stated that as soon as the branch railway from the Transcaucasian main line to Chiatur is completed, which is expected to take place shortly now, this trade will, according to all present appearances, assume very large proportions. The Government has lately been much concerned in the welfare of the mining industry of the Caucasus, and measures have been adopted for the immediate improvement of the existing horse tracts in the mining sections of of the sub-district of Sharopan. The construction of macadamised roads has also been undertaken in those sections, which, when brought into use, will render the mines easier of access, and enable mine-owners to deliver the ore at a reduced rate at the railway station of Kviril, situated about 50 miles distant from the mines, on the Transcaucasian main line, which is in direct communication with the ports of Batoum and Poti, whence the ore finds its way abroad.

In order to illustrate the saving that will take place, the present prices paid for manganese at the sea-board may be quoted, as well as the prices at which it is expected dealers will be able to deliver the ore at the same spot on completion of the improvements above referred to:—

——	Present Prices per Pood.	Expected Future Prices per Pood.
	Copecks.	Copecks.
Cost of ore at the mines	8	8
Transport to Kviril	25	5
Commissions	2	2
Freight from Kviril	4	4
Total	39	19

The average f.o.b. price paid for this ore at the sea-board is, therefore, about 40 c. per pood, which is equivalent to 10*d.* for every 36 English lb., and the saving that is likely to occur is 20 c., or 5*d.*, per pood. It is said that 1¼*d.* of this sum will go towards advancing the price of the ore at the mines, and another 1¼*d.* towards increasing the commissions, so that a net saving of 2½*d.* per pood will take place in the f.o.b. price of the ore. The quantity of manganese ore shipped in the Caucasus for the United States of America in 1892 was 26,420 tons, valued at 62,066*l.*, and the total quantity that left the country during the same period reached the figures of 33,790 tons, and 76,861*l.* in value.—(*No. 1191, Foreign Office Annual Series.*)

PRICES ADOPTED IN NORWAY FOR WOOD PULP (CELLULOSE).

In a report to the Foreign Office dated the 22nd June, Mr. T. Michell, Her Majesty's Consul-General at Christiania, states that at a meeting of the Norwegian and Swedish sections of the Cellulose Pulp Association held on the previous day in that city the following standard prices were unanimously adopted:—

For prime, dry, unmixed sulphite, Kr. 200 to Kr. 210.

For second quality, dry, unmixed sulphite, Kr. 185 to Kr. 195.

For prime, dry, unmixed sulphite pulp, Kr. 180 to Kr. 190.

For second quality, dry, unmixed sulphite pulp, Kr. 170 to Kr. 180.

All per 1,000 kilos. (1 ton) f.o.b. in the Christiania fiord or the Swedish harbours on the West Coast.

It was also again agreed that in computing the weight of air-dry pulp 12 per cent. shall be added to the gross weight, or that 100 kilos. air-dry cellulose shall contain 88 kilos. absolutely dry pulp and 12 kilos. water.

British importers of wood pulp are aware that these prices are not obligatory on the manufacturers, who strive, however, to obtain them.—*Board of Trade Journal.*

Prosecution for Butter Adulteration in Normandy.

Mr. F. Bernal, Her Majesty's Consul-General at Havre, in a recent report to the Foreign Office, encloses an account taken from a Havre newspaper of the prosecution of a butter merchant at Lisieux, on the 26th June, for adulterating butter. The defendant, who carries on a large trade with England, added margarine to his butter. He had already been condemned for a similar offence to four months' imprisonment. The punishment for the present offence was eight months' imprisonment, a fine of 3,000 francs, and the insertion of the judgment in 45 newspapers of the five departments of Normandy.—*Ibid.*

The Production of Tartaric Materials in Italy.

The following information respecting the production of tartaric materials in Italy is extracted from a report to the Foreign Office by Mr. E. H. B. Hartwell, Her Majesty's Consul at Naples, dated the 21st June:—

The large increase in the production of tartaric materials in Italy must be attributed to the abundant wine harvests during the last quinquennium. In their exportation the southern provinces of Italy have the largest share. From reliable authority I am enabled to state that the total exports from Italy to foreign countries from October 1891 to September 1892 (the period in which those articles are produced and exported) amounted to 9,814 tons, representing a value of 425,240*l.* sterling. Of this total amount 1,512 tons, value 98,280*l.* sterling, was composed of the "half refined tartars"; 3,124 tons, value 181,100*l.* sterling, of "Vinaccia Argols"; 2,430 tons, value 104,640*l.* sterling, of "Crude Argols"; and 2,748 tons, value 41,220*l.* sterling, of "Winelces."

No less than 4,022 tons, value 174,300*l.* sterling, were shipped from Naples alone, and chiefly to the United States of America, that country taking 2,069 tons. In the United States these articles are mostly used in the production of baking powder in substitution of the more expensive yeast. Great Britain took 709 tons from here, France 253, and Italy 106 tons; the balance was shipped to the other European countries.

The excellent harvest of last year, with good prospects of the present one, had the effect of bringing down prices to a point which has not been touched during the last 30 years.—*Ibid.*

GENERAL TRADE NOTES.

Russian Petroleum.

The *Journal des Mines* for the 22nd June, quoting from a contemporary, states:—

The Russian petroleum market is at the present time in a very favourable condition, upon news arriving from Baku that the proprietors of the naphtha springs have succeeded in furnishing a quality of petroleum offering every security and inoffensive to a degree hitherto unknown. The specific weight of the new product is 50, its explosive temperature 100.

The process employed has this in particular, that in place of from 25 to 30 per cent. of normal petroleum which has been extracted from the naphtha hitherto, 70 to 80 per cent. can be obtained. In order to differentiate the new product from the old, a reddish tinge is given to it, which does not at all affect its purity and brightness. It is already in great demand both at Odessa and Baku.

Aluminium in France.

According to *L'Echo des Mines* the *Société Bernard Frères* has made arrangements to enlarge its works for the production of aluminium at St. Michel and Froges. The *Echo* claims a great advantage for France in aluminium manufacture, on account of the deposits of bauxite in the departments of Var and Alps-Maritimes, which, it says, is much purer and of more even quality than the bauxite of Alabama and Georgia.

The Petroleum Wells of Sumatra.

The *Journal des Mines*, in its issue of the 22nd June, states that the petroleum springs of Sumatra, which have only been recently discovered, are showing rapid development.

It is affirmed that English capitalists have obtained concessions. A Dutch syndicate has already commenced to work. It counts upon producing 2,000 tons daily by the end of the year. The Russians and Americans are also desirous of obtaining a footing in these regions. The total concessions granted hitherto are 320 square miles in extent.

The producers are endeavouring to secure the market of Singapore, the monthly consumption of which is from 34,000 to 38,000 tons, and to displace the Russian and American petroleums.

The American Tin Plate Industry.

The American tin plate industry will suffer a serious handicap after July 1st through the provisions of section 209 of the McKinley tariff law, which was presumably passed to protect the tin mining industry of Dakota and California, and according to which there shall be imposed after July 1st, 1893, on cassiterite, or black oxide of tin, and upon bar, block, and pig tin a duty of 4 cents per pound; but if the product of the mines of the United States shall have exceeded 5,000 tons of cassiterite and bar, block, and pig tin in any one year prior to July 1st, 1895, then all imported cassiterite bar, block, and pig tin shall after that date be admitted free of duty. Up to the present time the pig tin output of the United States has been, according to Mr. Wm. Benedict, in the *Mineral Industry*, about 150 tons, divided as follows: California, 134 tons; Dakota, 10 tons; and Virginia, 8 tons. As none of the mines are now being worked, it may be taken for granted that neither 5,000 tons, nor, indeed, any considerable part of it, will be produced before July 1st, 1895, and the duty will consequently cease on that date by limitation. It is, however, highly probable that long before that Congress will repeal the section and others similar to it and allow the free entrance of raw materials. Meanwhile importers and users of pig tin have made provision against the duty by laying in a big stock of metal, the imports for April being 7,146,086 lb., worth 1,467,234 dols., against 4,893,618 lb., worth 940,508 dols., during the corresponding month of 1892. The imports for the 10 months ending May 1st, 1893, amounted to 41,833,381 lb., worth 8,465,714 dols., against 32,987,780 lb., worth 6,469,913 dols., during the corresponding period of 1892. It is expected that the imports of May and June will show a still larger increase.—*Engineering and Mining Journal.*

The Thomas Gilchrist Process.

The manufacture of steel by the Thomas process, which began with 20 tons in 1878, has steadily increased, and last year a production of 3,202,640 metric tons was reported. It is in Germany that this process has found its greatest development. Introduced in 1879, it was found peculiarly suited to some German irons, and the output has increased each year, reaching 2,013,481 tons last year. France and Austria are nearly equal, the former showing last year 287,528 and the latter 288,122 tons—both a considerable increase over 1891. In England the production has been more variable, reaching a maximum of 503,400 tons in 1890 and falling off last year to 406,839 tons—a reduction of over 19 per cent. How much of this was due to an abandonment of the process and how much to the general falling off in the steel trade are not indicated by the returns. In the United States the use of the Thomas process is first reported in 1890, when 77,779 tons were made; the production increased to 110,116 tons in 1890, but fell off again to

91,729 tons last year. It is probable, however, that a considerable gain will be shown in the current year, and a further extension in the use of the process is to be expected.
—*Ibid.*

Mineral Production of Germany in 1891 and 1892.

	1891.		1892.	
	Quantity.	Value.	Quantity.	Value.
	Tons.	Dollars.	Tons.	Dollars.
Minerals.				
Coal	73,715,653	147,379,551	71,327,752	131,724,900
Lignite	20,536,625	13,511,457	20,977,931	14,136 759
Graphite	3,824	73,510	4,036	63,240
Asphaltum	49,150	93,928	53,279	104,750
Petroleum	15,315	298,659	14,527	220,000
Rock salt	666,793	744,754	659,322	703,000
Kainit	472,256	1,701,640	548,445	1,955,750
Other potash salts	898,993	2,771,494	802,630	2,528,500
Epsomite	7,454	16,314	10,207	22,357
Boracite	177	12,660	179	13,772
Salt	..	..	493,606	3,455,250
Chloride of potassium	..	..	123,961	4,106,500
Sulphate of potash	..	..	26,267	1,072,000
Sulphate of magnesia	..	..	23,879	84,000
Sulphate of potash and magnesia.	..	..	11,593	223,250
Sulphate of alumina.	..	..	28,388	504,825
Alum	..	..	4,276	117,500
Iron ore	10,657,521	9,852,076	11,539,235	10,319,852
Zinc ore	793,544	6,238,384	800,167	5,305,324
Lead ore	159,215	4,163,988	163,372	3,671,881
Copper ore	587,626	5,216,192	567,630	5,128,221
Silver and gold ores	22,569	1,151,723	19,319	916,378
Cobalt, nickel, and bismuth ores.	1,074	159,328	3,185	199,537
Tin ore	75	22,839	63	18,554
Antimony ore	1	41	..	..
Arsenic ore	3,124	32,563	2,148	19,491
Manganese ore	40,335	202.445	32,891	127,014
Uranium and wolfram ores.	47	10,564	48	11,057
Pyrites	128,288	239,468	113,461	210,359
Other vitriol and alum ores.	2,496	1,517	2,973	2,019
Total	108,762,065	193,925,125	108,370,670	187,285,129
Metals.				
Pig-iron	4,631,218	58,107,003	4,913,174	56,987,252
Zinc	139,353	15,639,337	139,938	13,765,510
Lead (pig)	95,615	5,816,587	97,936	5,145,560
Litharge	3,124	197,317	3,468	201,765
Copper (pig)	24,302	7,011,268	24,778	6,188,432
Copper, matte and black.	596	46,139	625	24,630
	Kilos.		Kilos.	
Silver	414,852	14,749,420	487,784	14,256,396
Gold	3,077	2.141,998	2,877	2,001,379
Cadmium	..	..	3,000	2,850
	Tons.		Tons.	
Tin	287	131,131	684	309,974

Mineral Production of Germany—*cont.*

	1891.		1892.	
	Quantity.	Value.	Quantity.	Value.
Nickel, bismuth and uranium.	..	..	1,238	1,713,531
Antimony and manganese.	..	..	219	44,531
Arsenic	..	..	1,667	69 127
Sulphur	..	..	668	13,819
Sulphuric acid	467,633	4,018,746	436,389	3,410,120
Sulphate of iron	..	..	8,670	53,179
Sulphate of copper	3,502	288,938	4.001	279,410
Sulphate of zinc	..	..	4,390	65,369
Tin salts	..	..	89	27 603
Coloring earths	..	..	2,629	68,316
Unenumerated	21,805	2,088,133	..	..
Total tons	5,317,135	110,236,017	..	104 668,703
Total kilos.	447,929	..	..	..

—*Ibid.*

Patents in Switzerland.

Instead of patentees being allowed only two years for filing proofs that models or specimens of their inventions are in existence, they will in future be allowed a year longer, and this change also applies to those patents taken since July 31, 1891; so that now three years, reckoning from the date of the provisional application in Switzerland, will be allowed within which the patentee is to take his definitive patent by means of filing the proofs aforesaid.
—J. H.

The Alcohol Duty and Manufacturers.

M. Poirrier, the well-known chemical manufacturer and senator, has invited the Syndical Chamber of Paris chemical manufacturers to make an effort, if not to obtain the suppression of the tax on alcohols used for industrial purposes, at least to prevent its proposed increase. The Chamber has readily taken the matter up, and an address has been sent to the French Minister of Finance showing that, even under existing circumstances, competition with other countries is well-nigh impossible for pharmaceutical preparations, chemicals, &c., in which alcohol is used. The tax is at present 37f. 50c. per 100 litres, and it is proposed to raise it to 50f., or 50c. per litre. It is very improbable that the tax will be suppressed entirely, and the best French manufacturers can hope for is that the old rate will be maintained.—*Chemist and Druggist.*

Crisis in the Sulphur Industry.

Some mine-owners at Caltanissetta, in Sicily, are endeavouring to form a syndicate to regulate the excess in the sulphur output at the mines to prevent over-production and consequent fall in prices. As a rule, when prices are high, mine-owners resume operations and depress their own trade by glutting the markets; hence the necessity of organising a syndicate to regulate the supply. But the difficulty apprehended is the inherent distrust Sicilians have of each other, and on this account it is feared that the combination will be of short duration. When it is remembered that the number of sulphur mines worked in Sicily is about 400, producing an average annual yield of 328,000 tons, valued at 2,000,000*l.*, and giving employment to nearly 30,000 workmen, the anxiety caused by the present depression can be easily understood. A deputation of Sicilian mine-owners waited not long ago upon the Minister of Public Works to obtain a reduction in railway charges on the conveyance of materials essential for the working of the mines.—*Ibid.*

THE TUSCAN BORACIC ACID PRODUCTION.

Boracic acid in its native form exists in large quantities at several places in the provinces of Pisa and Grosseto in Tuscany (Italy), the works of Count de Larderel at Monte Cerboli, which produce annually about 40,000 cwt., being especially well known. There are, according to a statistical work of Professor Garollo, 12 boracic acid establishments in the two provinces, and he estimates their annual output at over 60,000 cwt. All the boracic acid works of Tuscany are in the hands of four different proprietors; they do not act as direct exporters, but sell to merchants in Leghorn. In spite of the claims of other antiseptics, the demand for the boracic acid of Tuscany continues a large one. There was a drop of 8,000 cwt. in the export of 1892 (1889, 38,222 cwt.; 1890, 40,462 cwt.; 1891, 38,283 cwt.; 1892, 29,793 cwt.), but this falling off is rather to be attributed to the general slackness of trade than to any causes particularly affecting this branch of it. The shipment to England is always large. Of the 38,283 cwt. exported from Leghorn in 1891, 27,807 cwt. were sent to the United Kingdom, almost the whole of the remainder being taken by the United States of America, Russia, Belgium, and France. Borax (not native, but having boracic acid as its source) is also produced in considerable quantities in Tuscany. The export of borax and borate of soda in 1890 was 14,889 cwt. (7,361 cwt. to England), in 1891, 12,341 cwt. (7,005 cwt. to England), and in 1892, 14,323 cwt.—*Ibid.*

PRODUCTION OF LEAD IN THE UNITED STATES.

——	1890.	1891.	1892.
	Tons.	Tons.	Tons.
From domestic ores:			
Desilverised	106,980	139,033	142,087
Soft	32,000	34,000	31,000
Antimonial	4,896	5,105	5,805
Total domestic	143,876	178,138	178,892
From foreign ores	18,124	21,162	26,734
Foreign bullion refined, in bond	..	2,700	12,874
Total product of works	162,000	202,000	218,500
Imported for consumption	9,975	1,915	..
Total supply	171,975	203,915	218,500
Exported in bond	..	2,700	12,874
Stocks, of refined	..	9,000	5,500
Consumption	171,975	192,215	200,126
In white lead	..	60,000	64,800
Pipe	..	35,000	37,000
Sheet	..	12,500	13,500
Shot	..	15,000	15,000
Other uses and stock	..	69,715	75,626

—*Engineering and Mining Journal.*

IMPORTS OF CEYLON DURING 1892.

	£
Articles of food	2,195,745
Artificial and bone manures	16,953
Asphalte, pitch, tar, and resin	1,105
Ale and beer	31,742
Brandy	9,854
Brass sheets and brassware	5,082
Beads	1,474
Boots and shoes	3,441
Bricks and tiles	16,948

IMPORTS OF CEYLON DURING 1892—*cont.*

	£
Blasting requisites	5,646
Brushes	612
Books and maps	6,230
Cigars and tobaccos, manufactured	43,496
Cement	16,000
Carriages and carts	3,351
Clocks and watches	3.181
Copper sheathing, &c.	5,088
Cotton manufactures	342,100
Cutlery and hardware	27,583
Coal and coke (312,757 tons)	
Candles	1,442
Earthenware	13,168
Fire-arms and ammunition	4,206
Furniture	5,220
Fancy articles	6,556
Glass and glassware	10,657
Gin	19,622
Government stores (machinery, iron, hardware, metals, paints, &c.).	117,364
Hosiery	2,017
Haberdashery	51,214
Hats, caps, and bonnets	4,876
Hardware and cutlery	27,583
Iron, angle, bolt, bar, and rod	10,479
Iron, galvanised	18,021
Iron, pig, plate, and sheet	1,868
Iron, nails	5,702
Iron, hoop	14,306
Iron tanks	1,732
Jewellery	4,143
Kerosine	43,344
Liqueurs	299
Lead, sheet, pipe, pig, &c.	448
Lead, tea	25,905
Lubricating and vegetable oil	8,928
Machinery	60,000
Musical, optical, and scientific instruments	2,390
Matches	5,236
Medicines	21,157
Mining requisites	5,645
Oil, kerosine	43,344
Oil, lubricating and vegetable	8,928
Playing cards	600
Painting materials	7,156
Paper and envelopes	11,004
Perfumery	4,466
Printing materials	1,046
Prints and pictures	1,177
Plate and platedware	2,941
Pitch, tar, resin, and asphalte	1,105
Railway materials	24,788
Rum	46
Silks	25,725
Solder	2,562
Soap	7,516
Scientific and musical instruments	2,390
Saddlery and harness	1,826
Steel	1,241
Stationery	7,000
Tin, spelter, and zinc in plates, bars, and slabs, &c.	1,914
Toys	2,000
Twine	1,300
Umbrellas	13,776
Woollen goods	20,244
Wearing apparel	5,088
Whisky	37,984
Wines	22,350
Total value of imports	4,417,968
Toal value of exports	3,891,997

W. H. DAVIES & Co.,
Colombo.

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

Articles.	Month ending 30th June	
	1892.	1893.
	£	£
Metals	2,002,260	1,719,100
Chemicals and dyestuffs	447,093	401,262
Oils	541,983	554,143
Raw materials for non-textile industries.	3,721,372	3,462,845
Total value of all imports	32,777,479	31,838,792

SUMMARY OF EXPORTS.

Articles.	Month ending 30th June	
	1892.	1893.
	£	£
Metals (other than machinery)	2,698,953	2,924,051
Chemicals and medicines	647,328	749,734
Miscellaneous articles	2,396,562	2,670,898
Total value of all exports	18,070,318	18,785,271

IMPORTS OF METALS FOR MONTH ENDING 30TH JUNE.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Copper:— Ore	Tons	4,790	7,546	40,457	56,262
Regulus	„	17,393	11,088	412,608	261,583
Unwrought	„	2,832	1,817	132,377	83,148
Iron:— Ore	„	246,214	375,615	182,102	254,238
Bolt, bar, &c.	„	7,519	7,814	73,714	71,066
Steel, unwrought	„	783	608	7,032	4,869
Lead, pig and sheet	„	16,312	18,013	178,335	167,771
Pyrites	„	54,770	53,535	96,376	91,967
Quicksilver	Lb.	1,702,050	698,820	152,557	62,841
Silver ore	Value £	..	..	301,601	269,616
Tin	Cwt.	33,421	35,824	162,310	156,905
Zinc	Tons	5,554	4,623	124,528	78,952
Other articles	Value £	..	..	138,263	160,191
Total value of metals		..	..	2,002,260	1,719,100

IMPORTS OF OILS FOR MONTH ENDING 30TH JUNE.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Cocoa-nut	Cwt.	17,711	3,323	19,947	4,436
Olive	Tuns	2,315	700	81,131	29,589
Palm	Cwt.	81,748	119,509	92,288	141,357
Petroleum	Gall.	8,993,357	11,161,489	161,682	172,352
Seed	Tons	986	1,738	25,928	41,139
Train, &c.	Tuns	3,098	2,446	54,497	49,761
Turpentine	Cwt.	35,823	33,671	39,734	37,968
Other articles	Value £	..	..	63,776	77,541
Total value of oils		..	..	541,983	551,143

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH JUNE.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Bark, Peruvian	Cwt.	7,024	5,840	15,371	9,547
Bristles	Lb.	204,409	456,492	29,254	71,634
Caoutchouc	Cwt.	17,275	21,655	161,846	230,878
Gum:— Arabic	„	4,318	4,448	12,598	10,901
Lac, &c.	„	7,275	12,090	27,339	58,215
Gutta-percha	„	3,121	3,279	44,439	22,978
Hides, raw:— Dry	„	28,422	29,459	84,291	87,268
Wet	„	42,345	41,012	87,161	85,736
Ivory	„	741	791	34,317	33,261
Manure:— Guano	Tons	3,722	2,265	32,930	8,999
Bones	„	3,820	2,879	16,883	12,763
Nitrate of soda.	„	4,593	4,557	35,587	40,952
Phosphate of lime	„	31,927	27,811	61,325	55,595
Paraffin	Cwt.	20,552	64,309	32,030	66,105
Linen rags	Tons	2,572	1,223	24,854	10,794
Esparto	„	16,286	15,388	79,301	68,950
Pulp of wood	„	15,749	7,692	79,873	100,849
Rosin	Cwt.	113,259	1,518	33,693	26,967
Tallow and stearin	„	150,365	3,117	189,214	260,177
Tar	Barrels	5,496	1,282	2,949	817
Wood:— Hewn	Loads	228,457	196,053	429,672	339,875
Sawn	„	635,532	453,380	1,327,778	972,812
Staves	„	13,954	7,854	43,487	34,987
Mahogany	Tons	2,072	4,004	17,067	32,027
Other articles	Value £	..	..	818,083	919,728
Total value		..	..	3,721,372	3,462,845

Besides the above, drugs to the value of 50,725*l.* were imported as against 57,100*l.* in June 1892.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali.............. Cwt.	7,356	8,967	4,973	8,691
Bark (tanners', &c.) „	34,048	39,309	13,920	13,997
Brimstone .... „	46,789	30,877	12,559	8,237
Chemicals...... Value £	..	..	128,926	102,481
Cochineal .... Cwt.	431	438	2,872	2,532
Cutch and gambier Tons	1,717	1,198	36,696	27,664
Dyes :—				
Aniline .... Value £	..	..	20,522	11,556
Alizarin ...... „	..	..	16,464	27,212
Other .... „	..	..	264	3,342
Indigo .... Cwt.	930	738	16,191	12,099
Nitrate of potash . „	20,986	20,992	18,651	18,281
Valonia .... Tons	2,468	2,404	35,533	31,039
Other articles... Value £	..	..	139,522	134,101
Total value of chemicals	..	..	447,093	401,262

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	732,300	710,000	19,378	16,646
Military stores.. Value £	..	..	72,987	83,867
Candles.......... Lb.	1,376,900	1,463,390	25,817	27,804
Caoutchouc ..... Value £	..	..	91,355	96,699
Cement.......... Tons	39,048	48,883	71,850	83,504
Products of coal Value £	..	..	89,175	91,266
Earthenware ... „	..	..	131,601	152,639
Stoneware ...... „	..	..	13,343	13,670
Glass :—				
Plate........... Sq. Ft.	172,525	178,260	10,020	7,754
Flint........... Cwt.	9,815	6,559	20,903	18,105
Bottles......... „	62,413	55,448	30,099	26,991
Other kinds.... „	15,173	16,687	13,120	14,067
Leather :—				
Unwrought .... „	10,721	12,971	101,723	124,945
Wrought ..... Value £	..	..	21,931	22,447
Seed oil.......... Tons	4,937	6,264	97,200	133,832
Floorcloth ..... Sq. Yds.	1,339,100	1,500,900	59,262	60,791
Painters' materials Val. £	..	..	143,437	139,945
Paper .... Cwt.	76,071	82,882	129,392	134,181
Rags............. Tons	4,361	5,160	30,147	34,748
Soap............. Cwt.	39,572	57,041	45,424	57 238
Total value	..	..	2,396,562	2,670,898

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	10,471	12,383	41,347	45,600
Copper :—				
Unwrought ..... „	81,233	61,123	200,158	147,334
Wrought........ „	24,697	35,938	75,564	101,340
Mixed metal .... „	13,971	23,163	35,255	54,287
Hardware ..... Value £	..	..	183,988	176,574
Implements....... „	..	..	104,192	105,589
Iron and steel..... Tons	215,318	296,264	1,813,407	2,053,106
Lead .... „	4,857	4,644	58,296	51,167
Plated wares... Value £	..	..	21,288	18,942
Telegraph wires „	..	..	24,177	28,274
Tin .... Cwt.	10,354	13,834	51,651	63,714
Zinc .... „	14,673	13,638	13,427	11,291
Other articles .. Value £	..	..	76,203	66,833
Total value	..	..	2,698,953	2,924,051

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 30TH JUNE.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	390,425	451,371	150,956	151,397
Bleaching materials „	98,418	154,434	39,367	65,574
Chemical manures. Tons	28,287	27,905	165,484	169,444
Medicines....... Value £	..	..	74,641	77,565
Other articles ... „	..	..	216,880	285,754
Total value	..	..	647,328	749,734

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

APPLICATIONS.

12,018. J. Clarkson and S. Mortimer. Improvements in apparatus for supplying air and steam to furnaces so as to effect a more complete combustion of fuel and prevent the formation of black smoke. June 19.

12,037. J. W. Mackenzie.—From J. Bengue, France. Improvements in the method of closing and in the construction of receptacles for the reception of chloride of ethyl or methyl, or other similar liquid. Complete Specification. June 19.

12,120. M. Wanner. Improved process of refrigeration and improved refrigerating apparatus. Complete Specification. June 20.

12,121. M. Wanner. Improvements in the process of refrigeration and refrigerating apparatus. Complete Specification. June 20.

12,301. W. Cliff and M. Mannaberg. Improvements in furnaces for smelting, melting, and calcining purposes. June 22.

12,528. A. Lavy. An improved distilling apparatus. June 26.

12,774. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in evaporating brine and other liquors, and apparatus therefor. June 29.

12,941. L. Maiche and C. Maiche. Improvements relating to the purification of water and to apparatus therefor. July 1.

12,972. A. Horn. New or improved cooling apparatus. July 3.

13,146. F. Spence. A new or improved hydrostatic apparatus for automatically mixing with water or other liquid disinfectants, softening or purifying substances, or saturated solutions of any soluble substances in definite proportions. July 5.

13,314. A. R. T. Woods. Improvements in evaporating pans. July 8.

13,567. V. Edwards. Copper distillation flask. July 12.

13,784. J. Horne. Improvements in means for mixing or blending liquids. July 15.

Complete Specifications Accepted.*

1892.

14,145. J. Proctor. Improvements in mechanical stokers. July 5.

14,851. F. Windhausen. Process and apparatus for separating out the constituent parts of gaseous and liquid compounds. July 12.

14,926. J. U. Askham. Apparatus for separating substances of different sizes or specific gravities. July 12.

14,985. T. Blatcher. Apparatus for producing currents of inflammable gases and air. June 28.

15,124. G. H. Richmond. Apparatus for heating and cooling liquids. July 19.

15,244. V. J. Kuess and C. H. J. D. Donnadieu. An improved construction of alembic. July 19.

15,270. G. Thomas.—From A. Stauber. An oil-testing apparatus for ascertaining the frictional co-efficient of oils and fats. June 28.

16,259. G. Mitchell. Improvements in presses for the expression of oils or other liquids from substances containing the same. July 19.

1893.

6959. M. Prentice. Means or apparatus for distilling or obtaining volatile constituents or products. July 5.

9838. C. C. A. Forstreuter. Apparatus for evaporating boiling, heating, and cooling liquids. June 28.

10,700. E. B. Caird and T. J. Rayner. Evaporating apparatus. July 5.

11,104. S. M. Lillie. Evaporating apparatus. July 12.

II.—FUEL, GAS, and LIGHT.

Applications.

11,995. G. Clough and F. Hall. The heating of steam generators, using as a fuel a mixture of coal-gas and air. June 19.

12,247. A. Norreys. Improved means or process for producing block fuel. June 21.

12,355. W. Young. Improvements in the production of illuminating gas from mineral oils, and in apparatus therefor, and for producing water-gas. June 23.

12,389. W. B. Hartridge. Improvements in and relating to the manufacture of fuel. June 23.

12,410. L. Mond. Improvements in obtaining combustible gases, ammonia, and tar from fuel, and in apparatus therefor. June 24.

12,450. H. H. Leigh.—From G. Cabrie-Gardieu, France. Improvements in carburettes. June 24.

12,903. J. Bowing. *See* Class III.

12,990. G. Winstanley. Improvements in gas apparatus. Complete Specification. July 3.

13,069. A. J. Boult.—From E. Cowen, United States. Improvements in the method of and apparatus for manufacturing fuel gas. Complete Specification. July 4.

13,126. W. Young. Improvements in the production of illuminating gas and by-products from liquid hydrocarbons, and in apparatus therefor. July 5.

13,139. E. L. Bernard. Improvements in fire-lighters. July 5.

13,163. H. M. Caldwell and J. E. Tatham. Improvements in and apparatus for distilling or cracking and gasifying hydrocarbon oils and the like. July 5.

13,176. W. H. Williamson. A new and improved apparatus or method for treating combustible or other materials and charging the same into coke-ovens or furnaces or kilns. July 6.

13,185. J. H. Hilton. Improvements in apparatus for carburetting gases. July 6.

13,482. H. H. Lake.—From A. C. Humphreys, United States. Improvements in apparatus for the manufacture of gas. Complete Specification. July 11.

Complete Specifications Accepted.

1892.

12,421. W. Young and A. Bell. Improvements in the decomposition of mineral oils for the production of illuminating gas. June 28.

16,694. B. Ratcliff. Improvements in or additions to carbon lamps or carbon burners for illuminating purposes. June 28.

17,067. H. Collet and M. Merichenski. Improvements in making gas and a compound therefor. July 12.

21,444. R. Adcock. An improved smoke consumer for destroying the carbon products of gas combustion and increasing the power of the gas light. July 12.

23,657. B. Friedl. Improvements in or relating to incandescent lamps. June 28.

1893.

10,227. C. R. Collins. Improvements in carburettors. June 28.

10,501. C. H. Prichard. Improved method of heating liquids by electricity. July 5.

11,226. A. Lange. Lighting compositions. July 12.

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* *See* Note (*) on previous page.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

12,440. L. Mond. *See* Class II.

12,903. J. Bowing. Improvements in coking processes and apparatus, and in the recovery of the products of distillation. July 1.

IV.—COLOURING MATTERS and DYES.

Applications.

12,133. A. Savage. A new or improved dye for dyeing feathers, artificial flowers, silk, and satin ribbons, laces, fringes, and other articles. June 20.

12,323. H. H. Lake.—From Messrs. Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. June 22.

12,324. H. H. Lake.—From Messrs. Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. June 22.

12,515. O. Imray.—From the Society of Chemical Industry in Basle, Switzerland. Production of blue-green colouring matters of the malachite-green series. June 26.

12,636. Read, Holliday, and Sons, and J. Turner. Improvements in the production of azo colouring matters. June 28.

12,704. J. Imray.—From L. D. Huguenin and Co., Switzerland. Production of new unsymmetrical diamido bases and manufacture of dyes therefrom. Complete Specification. June 28.

12,928. P. Monnet and M. C. Traub. Production of a diamidophenolester and its acid derivatives. Complete Specification. July 1.

12,975. W. L. Wise.—From F. von Heyden and Co., Germany. Improvements in the manufacture of paraphenetolcarbamide. July 3.

13,304. J. Wetter.—From J. D. Riedel and Co., Germany. A new derivative of ortho-tolyldimethylpyrazolone and process for obtaining the same. July 8.

13,394. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of new leuco compounds and the production of colouring matters therefrom. July 10.

13,395. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of colouring matters by reduction of tetranitroanthrachrysone and dinitroanthrachrysone-disulphonic acid. July 10.

13,402. H. H. Lake.—From K. Oehler, Germany. Improvements relating to the production of amidophenol and amidocresolsulpho acids, and to the manufacture of colouring matters therefrom. July 10.

13,419. A. Ashworth and J. Burger. Improvements relating to the production of colouring matters. July 11.

13,551. H. E. Newton. From The Farbenfabriken vormals F. Bayer and Co., Germany. The production of aromatic amido compounds by means of electrolysis. July 12.

Complete Specifications Accepted.

1892.

14,927. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new colouring matters. July 5.

14,993. G. Pitt.—From L. Cassella and Co. Production of new dyestuffs derived from amidonaphthol sulphonic acids. July 5.

15,325. J. Y. Johnson.—From the Badische Anilin und Soda Fabrik. The manufacture and production of new mordant-dyeing colouring matters and of new intermediate products relating thereto. July 5.

15,439. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. Improvements in the production of black azo colours upon fibres. July 19.

15,636. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new azo colouring matters suitable for dyeing and printing. July 12.

15,789. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Production of azo colouring matters. July 19.

17,546. H. H. Lake.—From K. Oehler. Manufacture of colouring matters. July 5.

1893.

8604. J. B. F. E. Roy. An improved process for the purification of tanning, dye, and other vegetable extracts. June 14.

9182. J. C. L. Durand, D. E. Huguenin, and A. J. J. D'Andiran. Manufacture of new colouring matters derived from dioxydiphenylmethan. July 19.

9183. J. C. L. Durand, D. E. Huguenin, and A. J. J. D'Andiran. Manufacture of new colouring matters derived from the condensation products of formic aldehyde with benzidine, tolidine, or dianisidine. July 19.

10,320. H. A. Frasch. Method of obtaining dyestuffs from petroleum. July 19.

10,321. H. A. Frasch. Sulpho acid and the process of producing the same. July 12.

10,322. H. A. Frasch. Art of manufacturing sulpho acid from petroleum. July 12.

10,323. H. A. Frasch. Art of producing dyestuffs from natural mineral oils by sulphonation. July 12.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

12,148. A. V. Newton. — From A. Nobel, France. Improvements in the manufacture of artificial silk. June 20.

14,433. R. J. Urquhart.—From E. R. Lagerie, France. Improvements in the method of and apparatus for extracting suint or yolk from wool. Complete Specification. June 24.

Complete Specifications Accepted.

1892.

14,029. J. Miller and J. Miller, jun. Apparatus for rendering textile fabrics waterproof by one treatment or process. July 19.

1893.

10,729. W. E. Heys.—From E. Goldchaux. A new or improved substance for oiling or similarly treating wool. July 5.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

APPLICATIONS.

12,076. J. Grime. Improvements in vats for dyeing indigo-blues and the like. June 20.

12,367. I. Frankenburg and C. O. Weber. Improvements in or connected with the producing or printing of designs upon waterproof fabrics. June 23.

13,579. J. Rhodes, jun., and A. B. Perkins. Improvements in apparatus for dyeing slubbing or slivers of fibrous material. July 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

14,421. S. Schmidlin. Improvements in certain machines for washing, soaping, bleaching, dyeing, and similarly treating textile fabrics. June 28.

14,507. J. M. Collins. Improvements in and connected with machinery for dyeing and scouring yarn. July 19.

15,000. J. O. Obermaier. Improvements in or relating to the mordanting, dyeing, washing, and otherwise treating of spun yarn and the like, and apparatus therefor. June 28.

15,726. D. Stewart and T. Lambert. Improvements in cleansing, bleaching, and dyeing textile materials and fabrics, and in apparatus therefor. July 5.

1893.

10,447. J. D. Bulffer and C. T. Bulffer. Improvements in printing decorative designs on fabrics. July 5.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

12,074. A. Vogt and A. R. Scott. Improvements in obtaining chlorine. June 20.

12,426. A. Campbell and W. Boyd. Improvements in obtaining or reforming manganese peroxide for use in obtaining chlorine and otherwise. Complete Specification. June 24.

12,572. J. Addie, J. Cunninghame, and W. Macfarlane. Improvements in the production of cyanides. June 27.

12,604. Pierre Rogatien Vicomte de Lambilly. An improved process of fixing atmospheric nitrogen, and of producing bicarbonate and formiate of ammonium, formic acid, and other formiates. Complete Specification. June 27.

12,927. A. Mitscherlich. Process for utilising the lyes of sulphite cellulose products obtained in such process, and apparatus employed for that purpose. July 1.

12,995. H. Lane and J. Pullman. An improved method of and apparatus for producing carbonic acid gas. July 3.

12,997. La Société Marcheville Daguin and Co. Improvements in calcining apparatus for the conversion of bicarbonate of soda into carbonate of soda and other uses. Filed July 3. Date applied for December 3, 1892, being date of application in France.

13,406. R. Haddan.—From Compagnie Electro-chimique de St. Beron, France. Improvements in or relating to the treatment of sodium chloride, and to the method of utilising the product in the manufacture of white lead, soda, chlorine, and their derivatives. July 10.

13,438. R. P. Geddes. Improvements in the production of acetic, citric, and analogous acids, alcoholic spirits, and vinegar. July 11.

13,627. C. D. Abel.—From W. Feld, Germany. Process for the manufacture of sulphide of carbon. July 13.

13,628. C. D. Abel.—From W. Feld, Germany. Improvements in the production of sulphur. July 13.

13,654. G. Lunge and F. Maxwell Lyte. Improvements in the production of nitric acid, caustic alkali, and ferric oxide. July 13.

13,655. F. Maxwell Lyte and G. Lunge. Improvements in the production of caustic alkali and chloride of lead for conversion into chlorine and refined lead. July 13.

13,656. G. Lunge and C. H. Maxwell Lyte. An improved process for producing basic lead salts and obtaining certain by-products. July 13.

13,708. Sir Lowthian Bell, Bart. Improvements in the treatment of bicarbonate of soda. July 14.

13,709. Sir Lowthian Bell, Bart. Improvements in evaporating saline solutions. July 14.

13,722. C. Kellner. Improvements in the manufacture of ammonia, sodium hydroxide, and chlorine, and in apparatus therefor. July 14.

13,754. W. Siepermann. Process for the production of alkali cyanides. Complete Specification. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

15,083. L. Grabau. Manufacture of aluminium fluoride. June 28.

16,046. H. Y. Castner. An improved process of and apparatus for the electrolytic decomposition of alkaline salts. July 19.

17,228. W. P. Thompson.—From T. Mayer. A new or improved manufacture of double salts containing fluorine and an always constant amount of antimony. July 19.

1893.

6815. P. Hart. Manufacture of iron salts. July 19.

9294. T. Craney. Improvements in salt purifiers. July 5.

10,053. A. J. Boult.—From A. Nieske. Manufacture of chlorates. July 12.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

12,590. H. W. Cox. Improvements in vitrifying photographic prints on glass, metal, porcelain, china, and like substances. June 27.

12,976. H. Lepersonne. An improvement in the manufacture of glass or the like. July 3.

13,236. E. Till and F. Snelling. "Glassed enamelnite." July 7.

13,380. W. Defries. Improvements in glass painting and in Mosaic. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

12,939. H. Doulton and J. Slater. Improvements in treating vitreous substances for making metallic connections. July 12.

15,162. W. L. Pilkington. Improvements in the production of corrugated or like roughened surface sheet glass. June 28.

15,934. J. Bilton. A new method of decorating pottery, porcelain, tiles, bricks, &c. July 12.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

12,227. T. L. Banks. Improvements in fireproof structures for ceilings, floors, and roofs. June 21.

12,468. The firm of Goegg and Früh. Improved decorative material on surface in imitation of marble. Complete Specification. Filed June 26. Date applied for November 28, 1892, being date of application in Switzerland. June 26.

12,584. P. Bilstein. Improvements in the manufacture of fireproof plates or slabs. Complete Specification. June 27.

12,880. R. Bammann. A composition for the production of marble-like plaster. Complete Specification. July 1.

13,026. J. B. Howard.—From T. W. Arold, Germany. Improvements in building blocks or bricks. Complete Specification. July 4.

13,079. A. Typlt. Process for making paving stones, patterned slabs, and the like. Complete Specification. July 4.

13,080. A. Typlt. Mixture and process for producing artificial marble and other stone imitations. Complete Specification. July 4.

13,300. T. D. Owen. Improvements in compositions for use as cement or artificial stone. Complete Specification. July 8.

13,357. G. M. Restall. A chemical and mineral compound or mixture to be used for general decorative work, and called holdfast. July 10.

13,386. H. Salmon and J. E. Whiting. New or improved substitute for pumice stone, and process of manufacturing the same. July 10.

13,598. J. Fisher. Improvements in and connected with concrete and similar pavements and floorings. July 13.

Complete Specifications Accepted.

1892.

13,825. W. N. Hartley and W. E. B. Blenkinsopp. Manufacture of metal applicable as a waterproof covering for roofs and other such like purposes, or as a substitute for glass. July 12.

1893.

9629. J. T. Chappell. Improvement in fireproof floor structures.

X.—METALLURGY, MINING, Etc.

Applications.

12,001. W. Mills. Improvements in the manufacture of aluminium. June 19.

12,034. G. Bischof. Improvements in the treatment of lead fumes. June 19.

12,192. T. Middleton. The manufacture of armour-plates. June 21.

12,487. J. D. Gilmour. Improvements in the extraction of gold or other metals from ores. June 26.

12,534. W. Mills. Improvements in the manufacture of aluminium and its alloys. June 27.

12,588. A. J. Boult.—From W. A. Koneman, C. G. Singer, and A. F. Hatch, United States. Improvements in or relating to the conversion or purification of iron and steel. Complete Specification. June 27.

12,624. A. F. Seccombe. Improvements in apparatus for testing presence of and recovering float gold and other metals. June 27.

12,647. W. Mills. Improvements in metallurgy. June 28.

12,665. G. E. Bowen and R. B. Wilkinson. An improvement or improvements in annealing copper and alloys of copper in the processes of rolling, drawing, and stamping. June 28.

12,789. J. C. Montgomerie. Improvements in and in connection with the treatment of cyanide solutions of gold and silver. June 29.

12,931. C. James and W. Griffiths. Improvements in the construction of metallurgical furnaces. Complete Specification. July 1.

12,946. D. P. G. Matthews. Improvements in and connected with metallic moulds, and in the method of using such moulds for casting brass or bronze alloys. July 3.

12,979. J. W. Hall. An improved process for treating complex and refractory ores and materials, and obtaining the metals and pigments therefrom. July 3.

13,117. A. Sternberg and A. Deutsch. Improvements in and connected with the production of chromium, manganese, molybdenum, titanium, tungsten, and similar metals from their alkaline and alkaline earth compounds. Complete Specification. July 5.

13,227. C. J. Bagley, L. Roberts, and the Moor Steel and Iron Co., Lim. Improvements in the means employed for re-heating slabs of steel or iron. July 7.

13,505. T. F. Barbour. Improved process for extracting gold, silver, and other metals from ores. July 12.

13,696. J. B. Torres. A new or improved furnace with fixed crucible for and connected with the metallurgical and siderurgycal treatment, reduction, and refining of ores and metals. July 14.

Complete Specifications Accepted.

1892.

6567. H. R. Lewis and C. Gelstharp. Improvements relating to the treatment of ores and other compounds containing metals and sulphur, and apparatus therefor. July 12.

12,641. J. C. Montgomerie. Improvements in the extraction of gold and silver from ores and compounds containing the same, and in apparatus applicable for use in the treatment of such materials by means of solvents. July 12.

12,776. R. E. B. Crompton. Improvements in regulating temperatures in manufacturing metals, and in means or apparatus employed therein. July 5.

13,137. L. J. D. Holtzer. Production of steel and manufacture of springs therefrom. July 12.

14,579. A. K. Huntington and R. T. Preston. Improvements in bronze alloys. June 28.

14,982. T. D. Rock. A new method of dealing with blast-furnace and other slag, and apparatus therefor. June 28.

15,491. E. H. L. Sturzel. Coating articles with zinc. July 5.

16,312. O. C. Strecker. Preparation and production of aluminium plates for printing purposes. July 19.

17,918. C. A. Netto, J. Pfleger, and L. Hausmann. Production of easily separable metallic deposits. July 12.

1893.

8346. C. M. Allen. Improvements in and relating to the smelting of ores and refining of metals, and to apparatus therefor. July 5.

10,215. J. A. Hunter. Manufacture or conversion of iron and steel compound or preparations to be used therein. July 5.

10,601. J. Beckmann. Apparatus for drying moulds for metal castings. July 5.

10,672. H. B. Goldthorp. Improvements in the method of and apparatus for hardening and tempering steel wire. July 5.

11,622. R. H. Sanders and C. T. Thompson. Process of magnetic separation and apparatus adapted to the conducting of such process. July 19.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Applications.

12,291. A. J. Boult.—From H. Woodward, Canada. Improvements in secondary batteries. June 22.

12,492. E. S. d'Odiardi and E. S. d'Odiardi. Improvements in liquid electrodes. June 26.

12,507. C. Vogt. Improvements in the construction of galvanic cells. June 26.

12,625. W. Walker. Improvements in and connected with the purification of sewage by electrolysis, producing electricity as a by-product. Complete Specification. June 27.

12,662. E. Andrioli. Improvements in electrolysis. Complete Specification. June 28.

12,787. J. L. Dobell, C. P. Shrewsbury, F. L. Marshall, and J. Cooper. Improvements in the manufacture of coke or carbon for electrical purposes. June 29.

12,857. J. C. Richardson. Improvements in and connected with tanks for the electrical decomposition of chloride of sodium or potassium in solution. June 30.

13,081. J. Pitkin. Improvements in the construction of plates for secondary batteries. July 4.

13,217. The Lithanode and General Electric Co., Lim., and J. T. Niblett. Improvements in secondary electric batteries. July 6.

13,218. The Lithanode and General Electric Co., Lim., and J. T. Niblett. Improvements in plates or elements for secondary electric batteries. July 6.

13,274. C. Rousseau. Improvements in the manufacture of plates for electric accumulators. July 7.

13,336. C. Hoepfner. Improvements in the electrolytical production of nickel and other metals. July 8.

13,339. H. H. Lake.—From A. C. Girard and E. A. G. Street, France. An improved manufacture of carbon for electrical purposes. July 8.

13,408. J. H. Mason and A. van Derwerken. Improvements in electric batteries. Complete Specification. July 11.

13,568. C. T. J. Vautin. An improved dry electrolytical process for the production of an alloy of lead and sodium or potassium. July 12.

13,723. C. Kellner. Apparatus for the electrolytic production of bleaching liquid. July 14.

Complete Specifications Accepted.

1892.

14,181. C. P. Shrewsbury and J. L. Dobell. Improvements in or connected with electric batteries. July 12.

15,319. D. Federman. Improvements in and relating to electric batteries. June 28.

15,649. J. Stoerk. Apparatus for continuous decomposition of alkaline chlorides by electrolytic fusion. July 5.

15,887. H. H. Frei. Apparatus for obtaining metals by electrolysis. July 5.

16,545. A. E. J. Ball. Improvements in and relating to dry and other galvanic batteries. June 21.

16,588. P. Garuti. Production of oxygen and hydrogen by electrolysis of water. July 19.

1893.

7387. W. P. Thompson.—From C. L. Coffin. Improvements in or relating to machines for electrically welding metals. July 12.

10,283. J. E. Hofmann. Improvements in and connected with the manufacture of electrode plates for secondary batteries. June 28.

10,501. C. H. Prichard. *See* Class II.

11,092. M. L. M. Hellesen. Electric batteries. July 12.

11,105. T. Craney. Electrolytic apparatus. July 12.

11,106. T. Craney. Improvements in electrolytic cells. July 12.

11,107. T. Craney. Electrolytic apparatus. July 12.

11,108. T. Craney. Improvements relating to the electrolysis of salts and to apparatus therefor. July 12.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Applications.

12,116. E. W. Stanton. Improvements in naphtha soap, and in the method of and apparatus for producing such a soap. Complete Specification. June 20.

12,847. E. Watel. A process of improving and preserving oils and fats. June 30.

12,884. C. R. Illingworth. A superfatted biniodide of mercury soap. July 1.

13,057. D. Nagy and J. Block. Improved manufacture of soap. July 4.

Complete Specifications Accepted.

1892.

15,270. G. Thomas.—From A. Stauber. *See* Class I.

17,230. J. C. Lahusen. Improvements in or relating to the production of a neutral wool-grease from suint or wool washings. July 12.

1893.

9291. H. H. Lake.—From W. N. Blakeman, jun. Treatment of oils for imparting drying properties thereto. July 5.

10,707. J. Wetter.—From J. D. Riedel and Co. Process for the manufacture of new soaps containing sulphur in chemical combination. July 5.

10,834. D. H. McClelland and S. W. Curriden. Oil purifiers. July 12.

11,034. G. W. Scollay. Improvements in the art of treating cotton-seed, linseed, and other vegetable oils. July 5.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

12,266. R. Hutchison. Improvements in treating or preparing gutta-percha and rubber for various purposes. June 22.

12,791. E. Edwards.—From J. W. Overton, United States. An improved paint. June 29.

12,863. J. Bibby and J. Bibby. An improvement in the manufacture of printing ink. June 30.

12,979. J. W. Hall. *See* Class X.

13,173. B. Cannon and W. J. Cannon. Improvements in wood stains. July 6.

13,450. W. P. Thompson.—From T. G. Hojer, United States. Improvements in the manufacture of preservative driers and drying compounds for varnishes, oils, and the like. Complete Specification. July 11.

13,558. H. R. Gregory. Improvements in the manufacture of lead pigments. July 12.

13,702. W. P. Thompson.—From Sohler and Burger, Germany. Improved composition or preparation for protecting metals from rust. Complete Specification. June 14.

Complete Specifications Accepted.

1893.

6906. L. M. Williams. Williams' enameline. July 5.

7784. L. Paget. Preparation of solvents for pyroxyline, shellac, and similar materials.

10,303. J. C. Müller. An improved process for manufacturing paint. July 19.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

12,792. J. Pullman. Improvements in apparatus for treating skins in the manufacture of leather. June 29.

12,849. C. Heinzerling. Improvements in tanning. June 30.

13,335. A. Masure. Improvements in tanning and apparatus therefor. July 8.

Complete Specifications Accepted.

1893.

5700. G. Popp and J. H. Becker. Improvements in the process and in means and apparatus for ungreasing hides, skins, leather, and other materials. June 28.

7283. F. Hess. A composition for glueing purposes. June 28.

8604. J. B. F. E. Roy. *See* Class IV.

XV.—AGRICULTURE and MANURES.

Complete Specification Accepted.

1893.

10,189. J. Schmitt. Improved manure. June 28.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Application.

13,608. G. Heydecke, J. Selwig, and B. Lange. Improved process of rapidly and completely extracting sugar from mass-cuite in sugar manufactories and refineries. July 13.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

12,015. A. Bryan. Improvements in treating the waste or bottoms remaining in beer casks after the bright liquor has been drawn off. June 19.

12,391. O. Oldham. An improved mixture for the manufacture of non-intoxicating beer and stout. June 23.

12,555. J. A. Tilden. Improvement in process of malting. Complete Specification. June 27.

12,559. T. Melville.—From D. R. S. Galbraith, New Zealand. Improvements in and relating to the treatment of beer, stout, and the like. June 27.

12,609. P. W. May and B. E. R. Newlands. Improvements in and apparatus for sterilising or preventing fermentation or acetification of beers, beverages, or the like. June 27.

12,837. L. Lederer. Improvements in the manufacture of yeast and the distillation of spirits. June 30.

13,438. R. P. Geddes. *See* Class VII.

Complete Specifications Accepted.

1892.

7643. A. H. Hobson. Production of non-alcoholic ales or beers. June 28.

9855. J. G. Müller. A new or improved filtering bag for breweries, distilleries, and the like purposes. May 31.

16,048. G. Francke and O. E. Nycander. Production of dry yeast. July 5.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

12,030. E. de Pass.—From P. G. Biron, France. A new process of preserving alimentary substances. Complete Specification. June 19.

12,617. H. W. Hart. Improved method of treating coffee berries for the extraction and production of their food and health (dietetic) giving constituents. Complete Specification. June 27.

12,873. G. A. Goubault. Improvements in the preservation of fruit and vegetables. June 30.

13,021. G. W. Richards and J. W. Hodgson. Improvements in the manufacture or production of articles of food for human consumption. Complete Specification. July 4.

13,260. H. Hugo de Witt Gray. Improved means for preserving ground coffee. July 7.

13,537. A. Fjelstrup. An improved method of producing sterilised condensed milk and other substances. Complete Specification. July 12.

13,600. L. C. Tipper. Improvements in the preparation and treatment of animal and vegetable substances and fruit, and compounding the same with other ingredients for use as human food. July 13.

13,704. H. H. Lake.—From Baron Helfried Kaiserstein, Austria. Improvements in and relating to the manufacture of food for horses. July 14.

B.—Sanitary Chemistry.

11,993. J. Burton. Improvements in the means for burning, drying, and consuming the refuse and garbage of towns usually burnt in destructor furnaces, and in steam-generating furnaces in which rubbish is wholly or largely used as fuel, and for raking the ashes therefrom. June 19.

13,154. W. E. Adeney and W. K. Parry. Improvements in the purification of sewage and other like waste liquids, and in apparatus employed therein. July 5.

13,305. R. C. Tanner. Improvements in the treatment of sewage sludge. July 8.

C.—Disinfectants.

12,276. E. Soy. A new method of using sulphurous acid gas as a disinfectant and vermin destroyer, and for other medical and sanitary purposes. June 22.

12,406. I. S. McDougall and J. T. McDougall. Improvements in fumigants. June 24.

13,219. E. A. White. Improvements in insecticides or preparations for use in the protection of plant life from the attacks of insects or injurious growths. July 6.

13,557. H. N. Lay and W. F. Bower. Improvements in the manufacture of solutions for the destruction of germs and insect or other animal life. July 12.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1893.

9145. L. Hausler. Method of and means for preserving articles of food. July 5.

B.—Sanitary Chemistry.

1892.

14,664. C. Dreyfus. Treatment of sewage and other foul waters of analogous nature for effecting the purification thereof. July 12.

15,285. C. A. Burghardt. Production of a ferric preparation for the purification of sewage or other foul water. June 28.

C.—Disinfectants.

1892.

13,316. C. A. Burghardt. Production of a ferric chloride preparation for the treatment of sewage or other foul water. June 28.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

12,420. W. Borland. Improvements in apparatus for mixing and regulating paper stuff. June 24.

12,927. A. Mitscherlich. *See* Class VII.

13,175. G. Sinclair. Improvements in or connected with boilers for boiling or chemically treating and for washing esparto grass and other grasses, straw, wood, rags, and other fibrous materials for paper making. July 6.

Complete Specifications Accepted.

1892.

15,851. J. Craig and G. J. Wildridge. Manufacture and production of blotting paper or like absorbent paper, and apparatus to be employed therein. July 12.

1893.

6925. J. Holden. Improvements in or relating to the manufacture of paper and apparatus for effecting the same. June 28.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

12,617. H. W. Hart. *See* Class XVIII. A.

12,885. O. R. Bataille. Process for the preparation of malto-peptone. Filed July 1. Date applied for January 9, 1893, being date of application in France.

12,942. H. Baum. Improvements in the manufacture of ortho-halogen-phenol and in the production of pyrocatechine therefrom. July 1.

13,401. J. Bertram. Manufacture of geramiol ($C_{10}H_{12}O$) from citronella-oil. July 10.

13,477. E. Gfeller and the Clayton Aniline Co., Lim. Improvements in the manufacture or production of artificial musk. July 11.

13,478. A. W. MacIlwaine and G. G. M. Hardingham. Improvements in or in connection with the extraction of oil by volatile solvents, and apparatus therefor. June 11.

Complete Specifications Accepted.

1892.

14,715. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Production of iodoso compounds. June 28.

1893.

6959. M. Prentice. *See* Class I.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

12,304. F. W. Edwards and H. Ramsom. An improvement in the manufacture of sensitive plates or films for photographic purposes. Complete Specification. June 22.

12,991. A. J. Boult.—From C. F. Josz, Belgium. Improvements in or relating to the transfer of photographic pictures. July 3.

13,373. J. W. Fawcett. Improved means for regulating the rays of light passing through photographic lenses. Complete Specification. July 10.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

12,168. C. M. Bowman. Improvements in and relating to the manufacture of matches. Complete Specification. June 20.

12,401. H. H. Lake.—From F. Krupp and Co., Germany. Time fuses. Complete Specification. June 23.

Complete Specification Accepted.

1893.

11,073. G. Gillischewski. Improvements in pyrotechnical compositions or fireworks. July 12.

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RESEARCHES ON THE FORMATION OF LAKE PIGMENTS.

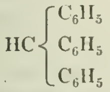
BY CARL OTTO WEBER, PH.D., F.C.S.

The term of acid colouring matters is applied to all those dyes which form pigment lakes by combination with inorganic or organic bases. In the first half of this paper (this Journal, **10**, 1891, 896) I have shown that lake-forming basic dyes must contain at least one amido group capable of forming salts with acids, and that to such amido groups these dyes owe their characteristic dyeing and lake-forming properties. An exactly analogous function is performed in acid dyes by the hydroxyl group, but the relation of this group to the lake-forming properties of the acid dyes is much more complicated than that of the amido group in the basic dyes. The number of amido groups contained in one molecule of a basic dye has no effect upon the lake-forming capability of the dye, but in acid dyes the number of hydroxyl groups present and their relative position in the molecule very materially influences their dyeing and lake-forming properties. This complication is still increased by the fact that the introduction of certain acid radicles in dyes, otherwise incapable of forming lakes, give lake-forming bodies; and further, that by the introduction of the same acid radicles into lake-forming hydroxyl or amido colouring matters their lake-forming properties are often very considerably modified. Acid radicles of this description are the sulphonic group ($SO_2.OH$), the carboxyl group ($CO.OH$), the nitro group (NO_2), the nitroso (quinone-oxime) group—

$$\mathrm{NO},\ \text{or rather} \left\{ \begin{array}{l} =\mathrm{O} \\ =\mathrm{N.OH} \end{array} \right.$$

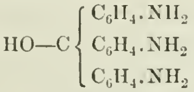
and in a lesser degree the halogens. The sulpho and carboxyl groups are strongly acid and, therefore, salt-forming groups; the nitro group and the halogens possess no lake-forming capabilities, but, none the less, are capable of influencing the acid nature, and, therefore, also the lake-forming property of the hydroxyl group in a considerable degree. From the above it follows that, whereas in basic dyes the formation of the lake always takes place in the amido group, in the acid dyes lakes may be formed in one or more hydroxyl groups, in the sulpho group, the carboxyl group, or the quinone-oxime (nitroso) group. It is consequently evident that in the cases of colouring matters containing two or more of these different lake-forming groups, the formation of the lake often is a very complicated reaction, with regard to which the question offers itself as to whether in the presence of different lake-forming groups in one molecule of a dye the specific lake-forming tendencies of each of these groups have to be provided for, or whether only one group will take part in the reaction producing the lake pigment.

Of the above-mentioned lake-forming groups only the hydroxyl* and the amido group can occur by themselves in the molecule of a dye, while the sulpho, carboxyl, or nitro group cannot form dyes unless either a hydroxyl or amido group be present at the same time. The well-known reason of this fact is that the amido and hydroxyl group are chromogenes, converting certain coloured or colourless aromatic bodies into dyes. This is exemplified by the following well-known constitution formulæ:—



$$HC\begin{cases}C_6H_5\\C_6H_5\\C_6H_5\end{cases}$$

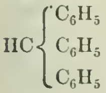
Triphenylmethane, colourless.



$$HO{-}C\begin{cases}C_6H_4.NH_2\\C_6H_4.NH_2\\C_6H_4.NH_2\end{cases}$$

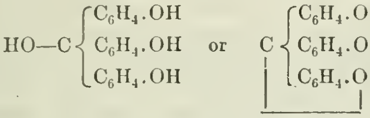
Colour-base of magenta rosaniline.

The conversion of the hydrocarbon into the colouring matter is caused here by the entrance in the molecule of one hydroxyl group and three amido groups. The result is a basic dye—



$$HC\begin{cases}C_6H_5\\C_6H_5\\C_6H_5\end{cases}$$

Triphenylmethane, colourless.



$$HO{-}C\begin{cases}C_6H_4.OH\\C_6H_4.OH\\C_6H_4.OH\end{cases} \quad \text{or} \quad C\begin{cases}C_6H_4.OH\\C_6H_4.OH\\C_6H_4.O\end{cases}$$

Carbinol. Anhydride

Aurin.

In this case by the entrance of three or, respectively, four hydroxyl groups in the hydrocarbon an acid dye results. The relations between rhodamine and eosine are of a strictly analogous kind.

$C_6H_5.N = N.C_6H_5$
Azobenzene
bright orange; no dye.

$C_6H_5.N = N.C_6H_4.NH_2$
Amidoazobenzene
aniline-yellow; basic dye.

$C_6H_5.N = N.C_6H_4.OH$
Hydroxyazobenzene, tropaeoline, acid dye.

Perhaps still clearer expressed is the chromogenic function of these two groups in the case of the dyestuffs derived from azobenzene. This compound possesses a remarkably bright orange colour, but no dyeing, salt, or lake-forming properties whatever. By the introduction of the amido group in this compound we obtain amidoazobenzene, a strong base, and possessing the salt and lake-forming properties of a strong basic dye. If, instead of the amido group, we introduce the hydroxyl group in the molecule of azobenzene we again obtain a dye, also capable of forming salts and lakes in the manner of acid dyes.

If we introduce into molecules capable of forming dyes the carboxyl group or the sulpho group no dyes are produced thereby, but by introducing these groups in the molecules of dyes themselves, their lake-forming properties are, without exception, very materially modified. Both these groups are, in general, more energetic salt formers than either the amido or the hydroxyl group, and consequently their presence in a basic dye practically always changes the character of these dyes into that of an acid dye, and considerably increases the acid nature of acid dyes. The great number of oxyazo dyes owe their great importance very essentially to this action of the sulpho group, without which most of these dyes would be practically valueless. Without the sulpho group the large majority of the oxyazo dyes are such weak acids that they are quite incapable of forming lakes, and very often are insoluble even in solutions of caustic soda or potash. Naturally weaker bases like lime, baryta, or alumina are still less able to form salts or lakes with these weak dye-acids. By the introduction, however, of the sulpho group into these dyes they are converted into strong dye acids, the alkali salts of which, almost without exception, are easily soluble in water, and which by double decomposition, particularly with salts of the alkaline earths or of the heavy metals, form insoluble lake precipitates. But also those hydroxyl dyes, which sometimes are, not very appropriately, termed phenolic dyes, and which by themselves are capable of forming lakes, by the entrance of the sulphonic group suffer a considerable increase of their acidity generally, and, as will be shown later on, material addition to, and modification of, their lake-forming properties.

The importance of the sulphonic group is, however, not restricted to the hydroxyl-dyes, as it is of the same importance for the amido-dyes and particularly for the amido-azo colouring matters. The basic nature of the latter, with few exceptions, is so little pronounced as to render them in many cases quite incapable of forming salts or lakes. But whether an amido dye be one of the strong basic dyes or one of the almost indifferent amido-azo dyes, the entrance of the sulpho group into their molecule converts them all into strong acid dyes, apparently altogether annihilating the basic nature of the amido group.

The introduction of the carboxyl group into hydroxyl and amido dyes is accompanied by results very similar to those observed on the influence of the sulpho group, *i.e.*, the general acidity of the hydroxyl dyes is increased, while the basic nature of the amido dyes disappears more or less completely. Nevertheless will it be found that the carboxylated dyes possess properties which distinguish them clearly from the sulphonated dyes. The specific lake-forming capabilities of these two classes of colouring matters show very characteristic differences, and we shall have occasion to show later on that the carboxylated dyes really are the connecting link between the hydroxyl dyes and the sulphonated dyes.

In the above only the artificial colouring matters have been taken into account; no mention has been made of the numerous natural dyestuffs. The reason for this is that while we possess a very complete knowledge of the chemical constitution of almost all artificial dyes, the same cannot be said of the natural dyes. With regard to the chemical constitution of the latter we know, however, with certainty, that it differs in no other way from that of the artificial colouring matters, than the latter differ amongst themselves in this respect. The two most important natural dyestuffs are alizarin and indigo. The artificial alizarin has altogether outrivalled the natural product; artificial indigo has already been in the market, and if it has not become a commercial success yet, the reason is only the impossibility as yet to obtain satisfactory yields in its manufacture. But if we remember that for similar reasons not so very many years ago magenta or eosine sold for as many pounds as they command shillings to-day, it is not difficult to prophesy that in time artificial indigo will be sold at, if not below, the price of the natural product. Altogether we may safely say that if we were in possession of a complete knowledge of the constitution of all the important natural dyestuffs, their artificial production from coal-tar products would be a comparatively easy matter. In the meantime, however, sufficient is known of the natural dyestuffs to enable us to say that without exception they belong to classes of such dyestuffs as are already manufactured to-day in great variety. In the face of these facts it is most surprising to find that there exists still a certain class of writers who maintain that only the natural dyestuffs are capable of forming "true" lakes, a statement which shows as much ignorance about the nature of a lake as about the chemical process of lake formation from colouring matters in general. The statement is as baseless as the well-known assertion that natural dyestuffs produce faster shades in dyeing than the artificial colouring matters.

I. *Lake Formation in the Hydroxyl Group.*

Colouring matters containing as lake-forming groups only one or more hydroxyl groups are very numerous; indeed we may safely say that numerically the hydroxyl dyes are far in excess of the amido dyes. This not only holds true for the artificial colouring matters, but also for the natural dyestuffs. All the latter, with the exception of indigo and berberine, $C_{20}H_{17}NO_4$, are hydroxyl dyes. Of the 16 classes into which, according to their constitution, all colouring matters are divided, hydroxyl colouring matters are found in the following of them:—

---

* Including the quinone-oxime group.

(*a.*) Nitro colouring matters.
(*b.*) Hydroxyazo colouring matters.
(*c.*) Quinone-oxime colouring matters.
(*d.*) Oxyketone colouring matters.
(*e.*) Triphenylmethane colouring matters.
(*f.*) Oxazines.
(*g.*) Natural colouring matters of unknown constitution.

Of these dyes all the nitro colouring matters and most of the hydroxy-azo colouring matters are mono-hydroxyl compounds, all the rest are di- or poly-hydroxyl compounds. Of the mono-hydroxyl dyes the nitro colouring matters are much more important than the hydroxy-azo dyes. The acid nature of the hydroxyl group is of such a weak description as to make the hydroxy-azo dyes unavailable for dyeing purposes. As long as their molecular weight is comparatively low, they are soluble in dilute solutions of the caustic alkalis, and may be precipitated from these solutions by means of the salts of the earthy alkalis (lime, baryta) and of the heavy metals, but these lakes altogether lack beauty and fastness and are readily decomposed by treating them with dilute acetic acid or alkalis. The barium, lime, and zinc lakes of such dyes are, however, quite insoluble in absolute alcohol, which leaves no doubt as to the lake nature of these precipitates. A lake obtained by treating Sudan I. (a typical hydroxy-azo dye, obtained by the action of diazotised aniline upon β-naphthol) in alkaline solution with a solution of barium chloride, must therefore possess the constitution—

$$\left.\begin{matrix} C_6H_5.N = N.C_{10}H_6.O \\ C_6H_5.N = N.C_{10}H_6.O \end{matrix}\right\} Ba$$

In precipitating the alkaline solution of Sudan I. with the solution of aluminium or chromium chloride a precipitate is obtained, in appearance very much like the above barium lake. On closer examination we find, however, that this precipitate merely consists of an intimate mixture of the free colouring matter with alumina or chromic hydrate. On treating this precipitate with alcohol the whole of the colouring matter is dissolved, the metallic oxides remaining behind without the faintest trace of colour. This very clearly demonstrates the fact that the monohydroxylated hydroxy-azo dyes are lake formers of a very low order, forming very poor lakes with strong bases and none at all with the weak ones like alumina, chromic oxide, and ferric oxide. This is a very significant fact, as it will be shown later on that exactly these three oxides are the typical lake formers with all those colouring matters from which the fastest lakes are obtained.

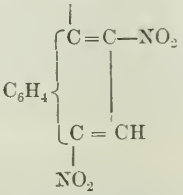
Owing to their more pronounced acid nature the nitro-colouring matters show much greater affinity for inorganic bases, than the hydroxyazo dyes. There are practically only three representatives of this class of colouring matters, viz:

$$C_6H_2\left\{\begin{matrix} OH \\ NO_2 \\ NO_2 \\ NO_2 \end{matrix}\right.$$

Tri-nitro-phenol
Picric acid.

$$C_6H_2\left\{\begin{matrix} OH \\ CH_3 \\ NO_2 \\ NO_2 \end{matrix}\right.$$

Di-nitro-cresol
Victoria yellow.



Di-nitro-naphthol
Manchester yellow.

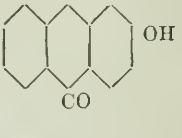
The above formulæ represent the free colour acids. All these dyes are very strong acids, well illustrating the remarkable influence of the nitro group upon the *acidity* of the hydroxyl group, although the nitro group in itself is absolutely devoid of acid or salt forming properties. This influence of the nitro group upon the acidity of a compound goes even so far, as to give to hydrocarbons the properties of an acid, and moreover a number of bases are known which through the entrance of nitro groups into their molecules are converted into strong acids. Aurantia, the ammonia, salt of hexa-nitro-diphenylamine—

$$N\left\{\begin{matrix} C_6H_2(NO_2)_3 \\ C_6H_2(NO_2)_3 \\ NH_4 \end{matrix}\right.$$

is probable the most remarkable instance of this action of the nitro group.

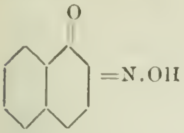
Although the above-mentioned compounds are very powerful acids their lake-forming capacities are by no means prominent, their lakes with alumina, chromic oxide, baryta, lime, and oxide of zinc all being very soluble salts. Insoluble precipitates can only be obtained with the salts of the heavy metals, especially with acetate or sub-acetate of lead. These precipitates do not commend themselves by beauty of shade and still less by fastness, all being highly sensitive to light and readily suffering decomposition through dilute acids or alkalis. Notwithstanding their strongly acid nature, it appears that these dyes are of very minor importance for the manufacture of lake pigments. This leads to the conclusion that the lake-forming capability of a dye bears no relation to the comparative strength of its colour acid, although the saltforming capacity of the dye may depend upon this point. This is a conclusion of not inconsiderable importance which places lake formation in the hydroxyl group on quite a different footing from lake formation in the amido group, the lake-forming capacity of the basic dyes being directly proportionate to their salt-forming capacity.

The lake-forming capacity of the hydroxyl group offers quite a new aspect if we examine the formation of lakes in colouring matters containing two or more hydroxyl groups. Frequently in this case we have occasion to observe that of two colouring matters, exactly identical in point of composition, and only differing as regards the respective location of the hydroxyl groups, the one possesses lake-forming properties in the highest degree, the other no more than any monohydroxyl dye. On this subject some very valuable papers by Liebermann, Kostanecki, and Noelting have been published. The two first-named writers showed that of the numerous dihydroxyanthraquinones only one, alizarin—

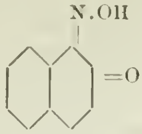


is capable of dyeing mordanted cotton, in other words of forming fast lakes with alumina or chromic oxide. All the other dihydroxyanthraquinones combine neither with alumina nor with chromic oxide, although they form lakes with lime, baryta, and oxide of zinc. These lakes however are in point of beauty and fastness quite as unsatisfactory as any of the lakes obtained from monohydroxylated dyes. Generally it was found that the dihydroxyanthraquinones and their higher substituted derivatives (tri- and tetrahydroxyanthraquinones) form fast lakes only if at least two of the hydroxyl groups they contain are placed in the ortho position.

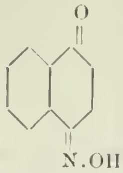
Exactly analogous results were obtained by Kostanecki in his investigation on the nitrosonaphthols or quinone-oxime colouring matters. This class of dyestuffs contains some members of very considerable lake-forming capacity, and all these contain the substituting groups in the ortho-position. Where the substituting groups do not occur in the ortho position the lake-forming capacity is of a very low order, no alumina or chromium lakes being obtainable.



β-nitroso-α-naphthol
Strong lake-former.

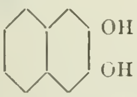


α-nitroso-β-naphthol
Strong lake-former.



α-nitroso-α-naphthol
Very indifferent lake-former.

Similar relations between the ortho position of the substituents and the lake-forming capacity were observed on nitro and nitroso derivatives of quinoline. Particularly interesting, however, is an observation made by the Bad. Soda and Aniline Fabrik (Germ. Pat. 57,525, August 3, 1890) by which the characteristic lake-forming properties of the ortho-dihydroxyl group have also been obtained in hydroxyazo dyes. This result was obtained by producing ortho-dihydroxy-naphthalene—



and combining it with diazo compounds. In this manner azo colouring matters are obtained, which in the same degree as alizarin are distinguished by their great lake-forming capacity. They yield lakes of very remarkable fastness, and are capable of dyeing mordanted fibre exactly like alizarin. There is no doubt that these dyes owe their excellent qualities purely to the presence of the ortho-dihydroxyl group.

It follows from the above that the lake-forming capability of the ortho-dihydroxyl dyes is simply a function of their particular constitution. The actual process of lake-formation, however, is a very complex reaction which is not by any means fully understood yet, although the researches of Liechti and Suida have thrown much light on this subject. In their investigations they experimented with alizarin, the classical orthodihydroxyl dye, and in the first instance discovered the remarkable fact, that perfectly pure alumina hydrate is incapable of combining with free alizarin, even on heating the mixture in a sealed tube with water at 150° C. In the presence of acetate of soda combination (lake formation) rapidly takes place, but alumina alizarates of definite composition are best obtained by double decomposition of ammoniacal solutions of alizarin with solutions of sulphate of alumina. In this manner the following alizarates were prepared:—

$Al_2O_3(C_{14}H_6O_3)_3$	normal alizarate.
$Al_2(OH)_3(C_{14}H_6O_3)$ 1·5	tri-basic alizarate.
$Al_2(OH)_5(C_{14}H_6O_3)$ 0·5	penta-basic alizarate.

The normal alizarate is very easily soluble in water, ammonia vapours rapidly liquefy it. The tri- and penta-basic alizarates are perfectly insoluble in water, but they dissolve in ammonia, the former very easily, the latter with some difficulty, producing magnificently coloured solutions. In itself the solubility of these alizarates in ammonia without any alumina being separated appears rather remarkable, still more so that on addition of sodium or ammonium phosphate to these solutions no precipitation of aluminium phosphate occurs, the solutions remain clear, and their colour unaltered. On addition of acetic acid very beautifully coloured precipitates are obtained, which contain alumina, alizarin, and phosphoric acid. By treating the dry precipitates obtained in this manner with ether no alizarin is dissolved, so that evidently the alizarin exists in the above precipitate in chemical combination with the aluminium phosphate, an assumption which is fully borne out by the bright red shade of the precipitate, which, if containing any alizarin in the free state, would have a more or less dull brownish tinge.

Solubility in dilute ammonia is a property more or less common to all alumina lakes of the ortho-dihydroxyl dyes. The same property is still to be found in the ferric, but not in the chromic lakes of these dyes. But whether solution under these circumstances takes place or not, in all cases will it be found that ammonia cannot decompose any of these lakes. Dilute organic acids no more affect these lakes than ammonia, and only on prolonged boiling with dilute mineralic acids is anything like complete decomposition obtained. Alumina, iron, and chromium lakes of these dyes behave alike in this respect, but it is a noteworthy fact that calcium lakes already succumb to a treatment with cold dilute acetic acid.

In discussing the formation of lakes from basic dyes, I called attention to the fact that their primary tannin lakes are rather deficient in fastness, and that the fastest lakes obtainable from basic dyes are compound lakes containing besides tannic acid a metallic oxide. Indeed the so-called tannin lakes are no lakes at all, but merely more or less insoluble tannates of the basic dyes. Exactly analogous is the case of the lakes from orthodihydroxyl dyes, many of which as we have seen above are to a considerable degree soluble in water. In order to obtain fast lakes from these dyes we also must convert them into compound lakes. In the same sense in which tannic acid was characterised as the typical lake-former with basic dyes, can we describe alumina, ferric and chromic oxide as the typical lake-formers with the basic dyes. And just as in the case of tannin lakes oxide of antimony proved the best means for the formation of fast compound lakes, calcium oxide is the most suitable agent for the conversion of the primary alumina, iron, or chromium lakes of the orthodihydroxyl-dyes into fast compound lakes. Perhaps it might appear as if this parallel between tannic acid and oxide of antimony on the one hand, and alumina and lime on the other hand, was only very doubtfully accurate, the two lake-formers in the former case standing in the relation of acid and metallic base, whereas in the latter case both lake-formers, alumina and lime, are bases. This is one of those cases which clearly illustrates the inadequacy and insufficiency of the terms of acid and base. Indeed it is well known that although alumina, chromic, and ferric oxides are better known as bases, they are all three able in the presence of strong bases to play the part of decidedly acid bodies, and certainly calcium aluminate, ferrite, and chromite are thoroughly well-defined compounds in which respectively alumina, ferric oxide, or chromic oxide assume the part of an acid. The analogy above pointed out therefore undoubtedly exists. The important part lime plays in the formation of alizarin lakes is well known to every Turkey-red dyer, and may also easily be inferred from the action of lime and lime salts upon the solutions of the aluminium alizarates, which are thereby immediately precipitated in the form of aluminium-calcium lakes. The properties of these precipitates, especially their beauty of shade, depend essentially upon the proportions of lime and alumina contained in the lake. The lakes of the formulæ—

$$(Al_2O_3)_3(CaO)_4(C_{14}H_6O_3)_{10}$$
$$(Al_2O_3)_3(CaO)_3(C_{14}H_6O_3)_8$$
$$(Al_2O_3)_3(CaO)_3(C_{14}H_6O_3)_{7\cdot5}$$

are very soluble in dilute ammonia. The lakes—

$$(Al_2O_3)_3(CaO)_3(C_{14}H_6O_3)_{6\cdot75}$$
$$(Al_2O_3)_3(CaO)_{1\cdot5}(C_{14}H_6O_3)_{3\cdot6}$$
$$(Al_2O_3)_3(CaO)_{2\cdot75}(C_{14}H_6O_3)_{6\cdot45}$$

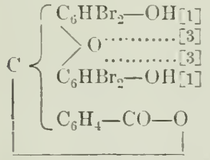
are only partially soluble in dilute ammonia. The lakes—

$$(Al_2O_3)_3(CaO)_{4\cdot5}(C_{14}H_6O_3)_{10}$$
$$(Al_2O_3)_3(CaO)_{4\cdot2}(C_{14}H_6O_3)_{10}$$

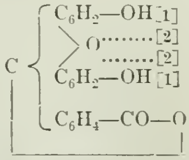
are perfectly insoluble in ammonia. Excess of alumina has no influence upon the fastness, nor upon the beauty of these lakes. Excess of lime, however, proves very detrimental to the shade of the lakes. Alumina lakes are the most important lakes of alizarin, the chromium lakes producing chocolate and the iron lakes purple shades. Although the two last-named lakes are largely used in calico printing, they are scarcely ever prepared as lake pigments. It appears, however, that the chrome lakes of the yellow, blue, violet, and green orthodihydroxyl dyes are in point of beauty generally much superior to the corresponding alumina lakes.

It is evident from the above that in the manufacture of alizarin lakes contamination with iron in any shape or form must be most carefully guarded against, and further that never more than one molecule of lime ought to be used for one molecule of alumina. It is best always to employ a considerable excess of alumina, which, if anything, is advantageous as regards beauty of shade. The chromic oxide lakes and the ferric oxide lakes, like those of alumina, always ought to contain lime as an essential constituent which not only improves their fastness but also their beauty. The same obtains for most of the natural colouring matters of unknown constitution, all of which appear to be orthodihydroxyl compounds. In the manufacture of lake pigments from these dyes the presence of lime during the formation of the alumina lake is indispensable. The lakes produced from cochineal and Brazil wood are familiar instances. There is, however, one group of colouring matters which also, strictly speaking, belong to the orthodihydroxyl dyes and which form remarkably fast primary lakes, and only in certain cases show any tendency at all to form compound lakes. These dyes are the nitroso or quinone-oxime dyes (di-nitroso-resorcinol, gambine Y and R, and dioxine) which form almost valueless brown or chocolate lakes with alumina, chromic and ferric oxide, but produce very fine, and above all, exceedingly fast lakes with ferrous oxide. The lakes obtained from alumina, chromic and ferric oxide, however, form with lime compound lakes, but the ferrous oxide lakes do not form any compound lakes at all. This is most interesting, as it evidently shows that although the formation of the primary lakes is essentially a function of the constitution of the lake-forming dye, the formation of the compound lakes has nothing whatever to do with the constitution of the dye, but depends entirely upon the nature or constitution of the base forming the primary lake.

By discussing a number of dyes of the triphenylmethane group and of the oxazine group, our examples for the great lake-forming capability of the orthodihydroxyl colouring matters could be considerably added to without, however, eliciting any fresh points of interest or importance. Merely to show that lake formation in the dihydroxytriphenyl-methane derivatives is regulated by the same laws as in the above-discussed azo, oxyketone, and quinone-oxime dyes, I quote as examples the two following triphenylmethane dyes:—



Meta-dihydroxy-derivative.
Eosin.

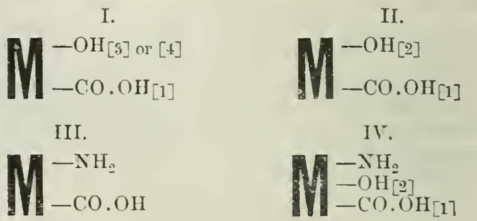


Ortho-dihydroxy-derivative.
Galleïn.

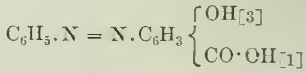
These two dyes are absolutely identical in constitution with the only difference of the 1—3—position of the hydroxyls in the eosin, and the 1—2—position of the hydroxyls in the galleïn. But this apparently very small difference in the constitution renders them in their lake-forming properties as different as any two dyestuffs well can be. Eosin forms no lakes with either alumina, chromic oxide, or ferric oxide, and its zinc oxide and lead oxide lakes are proverbially fugitive. Galleïn forms lakes and compound lakes exactly like the alizarin dyes, and the fastness of these lakes is of the very highest order.

II.—*Lake Formation in the Carboxyl Group.*

As already mentioned the carboxyl group can occur in colouring matters only if at the same time one or more hydroxyl or amido groups are present. Like the sulphonic group the carboxyl group consequently is devoid of chromogenic properties, but being an energetic salt-forming group it possesses very pronounced lake-forming properties. The carboxyl group may also be looked upon as a hydroxyl group with a carboxyl group, CO, interposed between it and the dye radicle. By looking upon it in this way it is easier to understand its dual function, first as an independent strong lake-forming group, and further as a group influencing the lake-forming capability of a hydroxyl group in the molecule like a second hydroxyl group. Therefore whenever a carboxyl group occurs in orthoposition to a hydroxyl group colouring matters result possessing essentially the lake-forming properties of an orthodihydroxyl dye, somewhat modified only by the independent lake-forming capability of the carboxyl group. We have, therefore, to consider in this case the following combinations of lake-forming groups in one molecule of a colouring matter:—

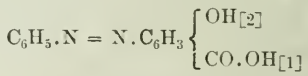


If as in the first of these diagrams carboxyl and hydroxyl group occur in meta- or para-position, only the carboxyl group is capable of forming lakes. Colouring matters of this constitution produce lakes however which, neither in beauty nor in fastness, are particularly satisfactory, this is also very clearly expressed in the observation that their dyeing properties are practically nil. Dyes of this constitution, as a matter of fact, are not in the market. I have prepared one by coupling diazobenzene hydrochloride with *m*-hydroxybenzoic acid.



$$C_6H_5.N = N.C_6H_3\begin{cases}OH_{[3]}\\ CO\cdot OH_{[1]}\end{cases}$$

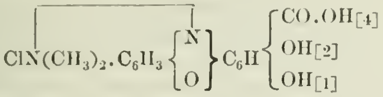
This compound is a yellow dye, rather difficultly soluble in dilute alkalis. It dyes wool or chromed wool in a faintly acid bath a rather dull yellow shade, which on soaping is again almost completely discharged. Employing for the production of this dye nitraniline in place of aniline a rather better product is obtained as far as shade is concerned, but the dyeing and lake-forming properties are not improved thereby. If, however, we combine the diazotised aniline with *o*-hydroxybenzoic (salicylic) acid—



$$C_6H_5.N = N.C_6H_3\begin{cases}OH_{[2]}\\ CO.OH_{[1]}\end{cases}$$

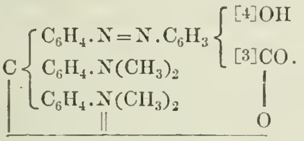
We obtain a colouring matter differing from the former only in the position of the hydroxyl group, but this apparently small difference involves a fundamental alteration in the lake-forming and dyeing capabilities of this compound, which now with alumina and chromium forms lakes of very excellent qualities, and produces fine and fast yellow shades on chromed wool. All dyes containing a carboxyl group in orthoposition to a hydroxyl group behave in a like manner, and consequently all dyes, especially the numerous direct dyeing dyes, containing salicylic acid as a component, are available for the manufacture of fast lakes and produce very fast and fine shades on chromed wool. The chromium lakes of these dyes are without exception preferable to their alumina lakes.

Colouring matter containing besides the carboxyl group one or more amido groups are very scarce and always possess the character of a weak acid, consequently they are always capable of forming a lake in the carboxyl group, the amido group generally having lost its lake-forming properties. But in the presence of several amido groups one of them is always capable of lake formation. Colouring matters of this kind therefore form compound lakes of a kind we have not met with before. The same obtains, of course, for colouring matters corresponding to the fourth of our above given diagrams, *i.e.*, containing besides the carboxyl group also the amido and hydroxyl group. If the latter be not in orthoposition the carboxyl group or to a second hydroxyl group which may be present, the lake-forming properties of the dye are merely those of a dye answering the third of our diagrams, but if orthopositions of the before-mentioned kind occur the colouring matter possesses the lake-forming properties of an alizarin dye and frequently also the amido group retains its lake-forming capacities. To obtain a fast lake from dyes of this description does, however, not seem to be subject to all these lake-forming groups being specifically catered for. A characteristic example of this kind of dyes is gallocyanine.



$$ClN(CH_3)_2.C_6H_3\left\{\begin{matrix}N\\O\end{matrix}\right\}C_6H\left\{\begin{matrix}CO.OH_{[4]}\\OH_{[2]}\\OH_{[1]}\end{matrix}\right.$$

The dimethylamido group on the left side of the formula possesses pronounced basic properties. It is capable of forming salts and consequently forms lakes like the amido group of basic dye. There is no orthoposition between the carboxyl group and either of the two hydroxyl groups present, but these two are in orthoposition amongst themselves. This colouring matter is therefore an orthodihydroxyl dye and possesses the high lake-forming properties of one. Another colouring matter of a similar order is azo-green—



$$C\left\{\begin{matrix}C_6H_4.N=N.C_6H_3\left\{\begin{matrix}[4]OH\\ \\ [3]CO.\end{matrix}\right.\\C_6H_4.N(CH_3)_2\\C_6H_4.N(CH_3)_2\end{matrix}\right.$$

owing to the orthoposition in this dye of the carboxyl and hydroxyl group it forms very bright and fast lakes with chromium oxide, but neither of the amido groups is of a sufficiently basic nature to form salts or lakes. We must therefore at present leave the question undecided as to the circumstances and conditions under which lake-forming groups of subordinate energy can or must be provided for besides the group which imparts to a dye its specific lake-forming properties.

III.—Lake Formation in the Sulpho Group.

Like the carboxyl group the sulphonic group is no chromogen and its presence in dyes requires the co-existence of amido or hydroxyl groups. By the entrance of the sulphonic group into their molecule all colouring matters are converted into very strong colour acids and undergo a very material alteration in their lake-forming properties. As we shall see directly, in all sulphonated dyes the lake-forming capability of the sulpho group, which overpowers and masks that of any other lake-forming group, must of necessity be provided for, and we shall see later on to what extent co-existing lake-forming groups have to be taken into account. The following combinations of lake-forming groups may occur in sulphonated dyes:—

I.

$$\mathbf{M}\begin{matrix}-OH\\-SO_2.OH\end{matrix}$$

II.

$$\mathbf{M}\begin{matrix}-NH_2\\-SO_2.OH\end{matrix}$$

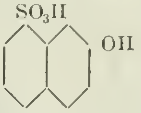
III.

$$\mathbf{M}\begin{matrix}-OH_{[1]}\\-OH_{[2]}\\-SO_2.OH\end{matrix}$$

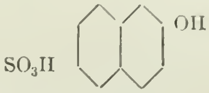
IV.

$$\mathbf{M}\begin{matrix}=O_{\quad[1]}\\=N.OH_{[2]}\\-SO_2.OH\end{matrix}$$

On examination of the lake-forming power of the sulphonic group the fact very soon reveals itself, that in spite of its energetic acid nature, the latter is rather restraining than conducive to the formation of fast lakes. This observation it will be seen is practically identical with conclusions formerly arrived at regarding the influence of the nitro group upon the lake-forming capability of certain nitro-colouring matters. I pointed out that although the acid nature of phenolic hydroxyls is very much increased by the entrance of nitro groups into the molecule, it is accompanied by a considerable decrease of the lake-forming properties of these dyes. In a similar manner we observe that with an increasing number of sulphonic groups in the molecule of a dye, the lake-forming capabilities of the latter steadily decrease and eventually vanish altogether. At the same time, however, it appears that also the constitution of these sulpho acids is of considerable influence upon their lake-forming properties. This is especially noticeable in the azo-colouring matters derived from naphthol sulphonic acids. Of the two β-naphthol sulphonic acids—

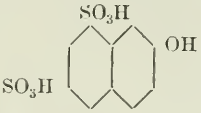


β-naphthol-α-sulphonic acid.

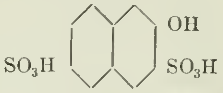


β-naphthol-β-sulphonic acid.

the first forms colouring matters, the complete precipitation of which through lake formation in the sulphonic group is often attended by considerable difficulties, while the colouring matters obtained from the second of these acids (Schaeffer's acid) can be completely precipitated with the greatest ease. Very similar is the behaviour of the β-naphthol-disulphonic acids.



β-naphthol-disulphonic acid G.

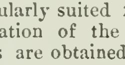


β-naphthol-disulphonic acid R.

The first of these acids forms with α-diazo-naphthalene crystal ponceau 6 R, a colouring matter which it is impossible to convert into a good lake. The R-acid with the same diazo-compound forms Bordeaux B, a dye which very easily yields excellent lakes. Exactly similar observations can be made with regard to the sulphonic acids of α-naphthol and the naphthylamines, all unmistakably demonstrating the considerable influence of molecular constitution upon lake formation in the sulphonic group. If we further take into account that instead of diazo-compounds frequently sulpho-diazo compounds are employed, the constitution of which also considerably modifies the lake-forming properties of the dyes formed by means of them, it becomes evident that the lake-forming capacity of the sulpho group is indeed not the simple reaction it appears, but an eminently complex function, influenced by such a great number of factors, that, with exception of the above given rule referring to the number of sulpho groups in one molecule of a dye, no rules of general applicability regarding lake formation in the sulpho group can be given.

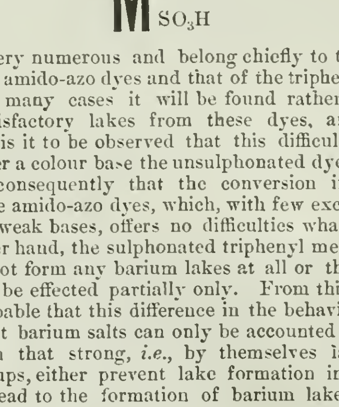
Barium salts, especially barium chloride, are almost exclusively used for the formation of lakes in the sulphonic group, although complete precipitation is much easier obtained by means of lead salts. But neither are the shades obtained by the last-named precipitant, nor the fastness of the lakes produced with it in the least comparable with the barium lakes. Very often basic acetate of lead has been recommended for the precipitation of the sulphonated dyes, and there is indeed not a single instance of a colouring matter not being completely precipitated by means of this salt. But its indiscriminate use is objectionable in the highest degree, and this salt as a class precipitant for sulphonated dyes can only be described as a chemical kind of bed of Procrustes, disregarding all individuality in sulphonated dyes. The cases where the basic acetate of lead is legitimately applied are very few, and are restricted to such dyes which by no other means are amenable to lake formation. Barium salts, or rather barium oxide, are the typical lake formers of the sulphonated dyes, and the question arises now as to the treatment of such dyes containing other lake-forming groups besides the sulpho group. We shall first consider the behaviour of dyes answering in constitution the first of our above-given diagrams, *i.e.*, containing besides the sulpho group one or more hydroxyl groups not in ortho-position amongst themselves. We have seen before that the lake-forming capability of colouring matters containing either only one hydroxyl groups, or several of them, but none in ortho-position to another, is extremely small. If lakes are formed at all, they are readily decomposed by even the weakest acids. Under these circumstances, it is not surprising to find that in the presence of such a strongly acid group as the sulphonic group, the hydroxyl groups entirely lose what small lake-forming capability they may have possessed in the unsulphonated dye. In dyes of the above description, lake formation is therefore only possible in the sulpho group. The very numerous class of sulpho-hydroxyazo dyes furnishes an abundance of examples illustrating this behaviour. Worth mentioning is the fact that in preparing lakes from these dyes good results are only obtainable if the precipitation of the lake with the barium salt is performed in a boiling and slightly acid solution. For this purpose the solution of the dye may be acidulated with acetic acid or with the solution of an inorganic salt of strong acid reaction, such as aluminium sulphate or chloride. In consequence of the acid reaction of the solution, a considerable portion of the dye remains in solution after the addition of the barium salt, but is subsequently also precipitated as a barium lake on carefully neutralising with soda carbonate. Lakes prepared in this manner possess very great brillancy, although their fastness is not altogether satisfactory. Of course if the precipitation has been performed in the presence of aluminium chloride the lakes ultimately obtained contain a certain amount of alumina hydrate or even barium sulphate and alumina hydrate if aluminium sulphate were added to the solution of the dye. These admixtures do not in any way contribute to the actual formation of the lake, but are, if anything, highly beneficial to it, giving it considerable body and a number of qualities which render it particularly suited for its future technical uses. If the precipitation of the lake is performed in neutral solutions, lakes are obtained possessing rather dull shades and other undesirable properties, making them for most purposes almost unsaleable.

Colouring matters corresponding in constitution to the second of our diagrams above referred to—



$$\mathbf{M}\begin{matrix}-NH_2\\ SO_3H\end{matrix}$$

are also very numerous and belong chiefly to two groups, that of the amido-azo dyes and that of the triphenylmethane dyes. In many cases it will be found rather difficult to obtain satisfactory lakes from these dyes, and without exception is it to be observed that this difficulty increases the stronger a colour base the unsulphonated dye represents. We find consequently that the conversion into barium lakes of the amido-azo dyes, which, with few exceptions, are extremely weak bases, offers no difficulties whatever, while on the other hand, the sulphonated triphenyl methane bases either do not form any barium lakes at all or their precipitation can be effected partially only. From this it appears rather probable that this difference in the behaviour of this dye against barium salts can only be accounted for by the assumption that strong, *i.e.*, by themselves lake-forming amido groups, either prevent lake formation in the sulpho group, or lead to the formation of barium lakes soluble in water. These observations are remarkably well illustrated by the behaviour of thiocarmine (Cassella) against lake-forming precipitants. This blue dye is obtained from ethyl-benzyl aniline sulphonic acid by the same reactions which are implied in the manufacture of methylene blue. Consequently the constitution of this colouring matter is expressed by the formula—



showing it to be the di-sulphonic acid of a methylene blue, *i.e.*, of a strongly basic dye. Being a disulphonic acid it is of course an acid dye. This colouring matter possesses the remarkable property of giving precipitates with either barium salts, the typical lake formation in the sulphonic group, or tannic acid, the typical lake-former in the amido group. But in every case the precipitation is very incomplete. If we use, however, for the precipitation a solution containing for one molecule of barium chloride one molecule of tannic acid the dye can be quantitatively precipitated without any difficulty. Thiocarmine in dyeing is exclusively employed on wool and silk as an acid dye, and in this application the basic nature of the dye seems to remain altogether latent, but in the formation of lakes from this dye it unmistakeably asserts its true character as a kind of amido acid by combining with bases (baryta) as well as with acids (tannin).

It appeared interesting to test this observation with regard to its applicability in dyeing, and I may say that the results of these experiments are most surprising and throw some interesting light upon the part played in dyeing by the various textile fibres, colouring matters, and mordants respectively. Our observations on the formation of lakes from thiocarmine prove that the basic nature of the amido groups of a basic dye is invariably considerably diminished by the entrance of one or more sulphonic groups into the molecule of such a dye, and although the salt-forming nature of the amido group may thus become temporarily latent, it can never become altogether extinct. This is in perfect accord with the well-known fact that the amido acids of the fatty as well as of the aromatic series are generally stronger acids than bases, without, however, the typical properties of the latter ever being entirely suppressed. We might, therefore, expect that in subjecting a colouring matter of the nature of an amido-sulphonic acid, like thiocarmine, to a treatment suspending its acid nature a product should be obtained behaving in every respect like a basic dye pure and simple. The possibility of such a dual function of the sulphonated amido dyes appears to have been hitherto altogether overlooked. Of what an interest it is for the theory and practice of dyeing and lake-making will be seen below.

If a skein of mordanted cotton is immersed into a neutral or faintly acid bath of thiocarmine it is dyed a very pale blue shade. The strength of the bath is not perceptibly diminished, and on washing the skein in warm water, or quicker still in a weak soap bath, the whole of the dye is again discharged. This is only as might be expected, the acid nature of the dye, as in all suphonated basic dyes, practically suppressing the function of the amido group. But this acid nature may be rendered latent by converting the dye into its barium salt, which behaves exactly like a basic dye. It is difficult to understand why the barium salt should behave like a basic dye, but not the sodium salt nor, what is perhaps more surprising, the calcium salt. An investigation of the behaviour of different salts of thiocarmine showed at once that with the increasing molecular weight of the bases employed for salt or lake formation the basic properties of the compound become more and more apparent. Accordingly we find that the magnesium and aluminium salts of thiocarmine possess no more basic properties than the sodium salt, but already the potassium and calcium salts show an increase in the basic energy of the dye, which is further developed in the zinc and strontium salts, and reaches its climax in the salts of barium and lead. The two last-named salts are completely precipitated by tannic acid, a most beautiful blue precipitate being obtained. If we now again prepare a thiocarmine dye-bath and add to it one molecule of barium chloride the solution keeps perfectly clear; the barium lake which has been formed remains in solution. On immersing in this dye-bath, at a temperature of about 60° C., a skein of mordanted cotton, our dye-bath behaves exactly like the solution of any other basic dye, *i.e.*, the cotton dyes very rapidly to a bright and strong shade, the dye-bath being completely exhausted. The shade so dyed leaves nothing to be desired in point of beauty, and is also tolerably fast to soap.

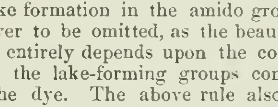
We are now justified to assume that the sulphonic acids of all colour bases will behave in a like manner. Certain differences in the constitution of these sulphonated colour bases may be expected to modify to some degree their behaviour, as illustrated above by the example of thiocarmine. But it is highly probable that the broad principle contained in the above observations holds good for all these dyes; in other words, that in sulphonated basic colours, after lake formation in the sulphonic group, the amido group fully recovers its lake-forming property, and consequently requires its specific treatment for lake formation. Experiments have shown that it is indeed possible to dye on mordanted cotton with very satisfactory results, and by the same treatment as that used above for thiocarmine, acid magenta, acid violet, acid green, and Basle blue S.

Moderately concentrated solutions of acid violet, acid green and Basle blue S can be almost completely precipitated with barium chloride. In comparing the shades of the lakes thus produced with the shades obtained with these dyes upon mordanted cotton in the above manner, or upon wool in an acid dye-bath, we observe at once that not only are the lakes rather dull in comparison, but further that the lakes from acid violet and Basle blue S are much redder in shade, and the lake from acid green much bluer in shade, than the corresponding dyeings on cotton or wool. A moment's thought at once reveals the fact that the unsatisfactory shades of these lakes are exactly of the same kind as those of the "lakes by disassociation" of the basic colours, which we discussed in the first part of this paper (this Journal, 1891, 896). These lakes show without exception the same difference in shade from their respective true (tannin) lakes as the barium lakes of the sulphonated basic dyes from their compound (barium-tannin) lakes we produced upon the mordanted cotton. If we add to those barium lakes tannic acid, the reddish cast of the acid violet lake and of the Basle-blue S lake instantly disappears, and lakes of perfect purity of tone are obtained. By the same treatment the dull bluish-green shade of the acid green lake is changed into a magnificent bright green. We necessarily come now to the conclusion that the barium lake of a sulphonated basic dye behaves precisely like a mechanically fixed basic dye, or as a matter of that like a free basic dye. The above-named barium lakes are scarcely more worthy of the name than the lakes obtained by tinting china-clay or alumina hydrate with solutions of basic dyes. Not until these barium lakes have combined with tannic acids is their lake formation as a chemical reaction completed. These observations afford a very clear insight into the chemical mechanism of the dyeing processes, and explain why the sulphonated basic dyes are no longer able to dye direct on a tannin mordant. The reason is to be found in the peculiar dual nature of the lakes of these dyes, the production of which upon the fibre is only possible if the two different lake-forming groups simultaneously undergo lake formation, a condition which we fulfilled above by dyeing the tannin-mordanted cotton in the presence of barium chloride. At first sight this explanation seems to be utterly at variance with the generally adopted method of applying these dyes to wool. From Knecht's investigations we know, however, that the peculiar behaviour of wool with dyes is due to the presence in the former of certain bodies possessing the nature of an amido acid.* In dyeing wool, therefore, with one of our sulphonated basic dyes the sulphonic group of the latter forms a lake with the amido group of that amido-acid, whilst the amido group of the dye combines with the carboxyl group of the amido acid, and in this manner these dyes are fixed also upon wool in the form of dual or compound lakes. That this really is so is proved by the fact that neither barium salts nor tannin are capable of combining with the dye which is fixed upon the wool, and such a combination would inevitably take place if either of the two lake-forming groups had not already undergone lake formation with the lake-forming radicles of the wool.

Having now arrived at an exhaustive explanation of the process of lake formation from sulphonated strong colour-bases, the inferences from which with regard to dyeing and lake-making are obvious, we will now consider the formation of lakes from sulphonated weak basic colours. The vast majority of the amidoazo dyes of commerce are the sulphonic acids of very weak colour bases, *i.e.*, amido-azo compounds. The basic nature of all these amido-azo compounds is, with two or three exceptions only, so weak as to make them quite useless for practical purposes. By the entrance of the sulphonic group into these amido-azo compounds they are changed into acid dyestuffs applicable to the dyeing of wool, but the rudimentary basic properties of the unsulphonated compounds almost completely disappear in the sulphonated dyes. Only very few of them after being converted into barium lakes, show still some little affinity for tannic acid, without, however, the addition of tannic acids to such lakes improving their shade in a perceptible degree. Some of these barium lakes, especially those of Bayer's Wool black (sodium salt of disulpho-amido-azo-benzene-azo-*p*-tolyl-β-naphthylamine) and Cassella's naphthylamine black D (sodium salt of disulphonaphthyl-amine-azo-α-naphthylamine-azo-α-naphthylamine), still possess the property of dyeing tannin-mordanted cotton, but no full shades can be obtained. This, however, may be due to the great insolubility of the barium lakes of these dyes, although just this insolubility on the other hand is additional evidence of the inertness of the amido group in these dyes, the barium lakes of the sulphonated and strongly basic dyes all being very soluble in water.

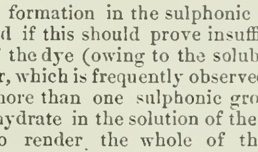
The observations made above enable us to formulate the rule that in forming lakes from the sulphonated basic dyes good results are obtainable only if both the sulphonic group and the lake-forming amido group undergo lake formation. With regard to lake formation in the sulphonic group it cannot be doubted that the barium salts are best adapted for this purpose. Lake formation in the amido group is always best obtained with tannic acid. Even in cases where the precipitation of a sulphonated amido dye with barium chloride converts the whole of the dye in an insoluble compound, lake formation in the amido group with tannic acid ought never to be omitted, as the beauty and fastness of these lakes entirely depends upon the complete neutralisation of all the lake-forming groups contained in the molecule of the dye. The above rule also applies in a minor degree to the sulphonated amidoazo dyes, although it will frequently be found that the amido group in these dyes is incapable to combine with tannic acid. In this case of course lake formation in the sulphonic group is all that is required, and if this should prove insufficient to precipitate the whole of the dye (owing to the solubility of the barium-lake in water, which is frequently observed in the case of dyes containing more than one sulphonic group), a precipitation of alumina hydrate in the solution of the lake will generally be found to render the whole of the lake sufficiently insoluble for practical purposes; of course, no alumina lake is formed by this operation, the finely-divided alumina hydrate in this case simply acting in the manner of a decolourising agent.

The above process of converting the sulphonated basic dyes into compound lakes is, however, rather unsatisfactory in its results in the somewhat rare case of dyes containing, besides the sulphonic and amido group, also a phenolic hydroxyl group. Such a colouring matter is Patent Blue Extra BN (Meister, Lucius, and Brüning) of the formula—



$$HO{-}C\begin{cases} C_6H_2\begin{cases} OH \\ SO_3\diagdown Ca \\ SO_3\diagup \end{cases} \\ C_6H_4.N(CH_3)_2 \\ C_6H_4.N(CH_3)_2 \end{cases}$$

This blue differs from Helvetia-green—



$$HO{-}C\begin{cases} C_6H_3\begin{cases} SO_3Na \\ SO_3Na \end{cases} \\ C_6H_4.N(CH_3)_2 \\ C_6H_4.N(CH_3)_2 \end{cases}$$

only in one phenolic hydroxyl group. On adding barium chloride to a solution of the green the dye is in the cold partially precipitated as a barium lake, but on heating this precipitate is easily dissolved. On adding now to the hot clear solution a solution of tannic acid complete precipitation of the compound lake, in accordance with our above-established rule, at once takes place. In adopting the same treatment for the precipitation of patent blue we observe in the first instance that barium chloride, even in the cold solution of the dye, produces no precipitate, and on adding tannic acid only a slight precipitation occurs, the bulk of the dye remaining in solution. In looking at the formulæ of these two dyes it is evident that the phenolic hydroxyl contained in the blue must be held responsible for its refractory behaviour. This hydroxyl group being, as we have seen before, a lake-forming acid group, which owing to its weak nature is unable to assimilate barium oxide from barium chloride, unless the hydrochloric acid which would thereby be liberated is at the same time neutralised by some suitable means. Indeed, if we add to a solution of one molecule of this dye a solution of one molecule of barium chloride and half a molecule of barium hydrate, partial precipitation at once takes place, and on adding subsequently a solution of one molecule of tannic acid complete precipitation of the dye in the form of a triple lake is easily obtained. This case affords an extended and very striking illustration of the repeatedly emphasised observation that every lake-forming group contained in the molecule of a dye has to be specifically provided for. It is a matter of course that the dyeing of these colouring matters upon mordanted cotton is subject to the same conditions which are required for their conversion into lakes. Consequently Helvetia-green dyes mordanted cotton in the presence of barium chloride a fine deep and brilliant shade of green, completely exhausting the dye-bath Under the same conditions patent blue dyes only a very weak shade of blue, which does not even stand washing in water. But by adding to the dye-bath barium chloride and barium hydrate in the above-mentioned proportions a fine strong blue shade is obtained on the cotton. It is scarcely necessary for me to point out that these triple lakes are not very tempting to the manufacturer, on account of their expensive and rather tedious production. This objection generally applies also to all those sulphonated amido dyes containing a lake-forming amido group, although on the other hand all these lakes have the great advantage of being very insoluble in alcohol, and consequently are specially suited for the manufacture of lakes for lithographic chromo-printing, most of which has to be varnished subsequently with spirit varnish. Moreover, many of these lakes are of an exceptionally bright and clear shade.

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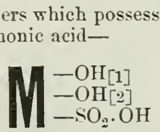
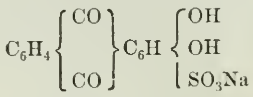
* Whether this be lanuginic acid or some more complicated compound is immaterial.

The facts established in the foregoing also obtain for those colouring matters which possess the constitution of an orthodihydroxysulphonic acid—



$$\mathbf{M}\begin{array}{l}-OH_{[1]}\\-OH_{[2]}\\-SO_2.OH\end{array}$$

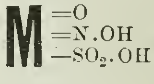
The typical representative of this class of dyes is alizarin S (alizarin sulphonic acid)—



$$C_6H_4\left\{\begin{array}{l}CO\\ \\CO\end{array}\right\}C_6H\left\{\begin{array}{l}OH\\OH\\SO_3Na\end{array}\right.$$

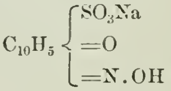
which contains the sulphonic group and the orthodihydroxyl group, the lake-forming properties of both of which we have already discussed. We find, consequently, that this colouring matter behaves in exactly a similar manner as thiocarmine and the rest of the sulphonated basic colours, but of course there is the difference of the specific lake-forming properties of the orthodihydroxyl group as compared with the amido group to be taken into account. If we add to a solution of alizarin S a solution of barium chloride we obtain a dirty orange-brown precipitate, the barium lake of the dye. This lake is rather soluble in cold water, easily soluble in hot water. If we add to the solution of the dye aluminium sulphate and neutralise subsequently with ammonia, we obtain a bright scarlet precipitate, which is the alumina lake of the dye. The sulphonic group remains intact in this treatment. The lake is easily soluble in dilute ammonia, and dilute acids decompose it immediately. But on adding to the dye a solution of barium chloride and subsequently a solution of acetate of alumina we obtain at once a bright red precipitate, the compound lake of the dye. This lake is exceedingly fast against light, acids, and alkalis, a result which evidently is due to the fact of both the lake-forming groups of the dye having been satisfied. Alizarin S cannot be used for dyeing cotton mordanted for Turkey-red, owing, of course, to the presence of the sulpho group in the dye. But if we dye a skein of cotton yarn mordanted with alumina in a solution of the barium lake of alizarin S, a very good shade of Turkey-red is obtained on the cotton.

The behaviour of the sulphonated quinone-oxime dyes—



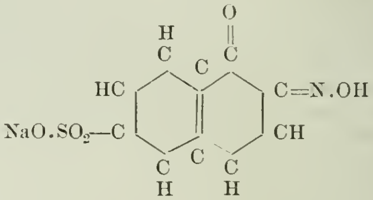
$$\mathbf{M}\begin{array}{l}=O\\=N.OH\\-SO_2.OH\end{array}$$

of which Cassella's naphthol-green—

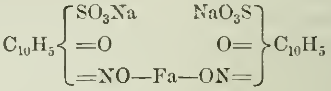


$$C_{10}H_5\left\{\begin{array}{l}SO_3Na\\=O\\=N.OH\end{array}\right.$$

or



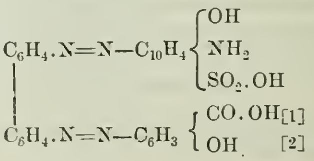
is the only representative at present, are no exception to the rules we laid down. The sulphonated quinone-oxime dyes contain two strong lake-forming groups, the quinone-oxime group and the sulpho group. Lake formation in the sulphonic group alone results only in the production of worthless brown lakes. Lake formation in the quinone-oxime group leads to lakes varying in colour from fustic-yellow to claret-brown, according to the metallic base employed. By using, however, ferrous salts we obtain a lake of a fine deep green colour—



$$C_{10}H_5\left\{\begin{array}{lr}SO_3Na & NaO_3S\\=O & O=\\=NO-Fa-ON= & \end{array}\right\}C_{10}H_5$$

This lake is so easily soluble in water that on no condition can it be obtained as a precipitate. As a matter of fact, the naphthol-green of commerce is sold in the form of this lake, its solution being evaporated to dryness. This is the only example of a dye being sold in the form of a lake. We remarked before that the stability of a partial lake is generally rather unsatisfactory, and we find that this partial lake under the influence of the atmosphere by-and-by decomposes into ferric oxide, and the sodium salt of the quinone-oxime sulphonic acid. As soon, however, as we complete the formation of the lake, either by dyeing it upon wool (lanuginic acid and iron lake) or by forming a lake in the sulphonic group, preferably by precipitation with basic lead acetate, we obtain compound lakes of extraordinary fastness.

Dyes containing besides the sulphonic group also a carboxyl group must, for reasons before mentioned, always also contain either a hydroxyl group or an amido group, or they may contain both. There are not many dyes of this description, and they belong almost exclusively to the class of the "mixed" tetrazo dyes. A colouring matter of this description is Cassella's Diamine Fast Red.



$$\begin{array}{l}C_6H_4.N=N-C_{10}H_4\left\{\begin{array}{l}OH\\NH_2\\SO_2.OH\end{array}\right.\\ | \\ C_6H_4.N=N-C_6H_3\left\{\begin{array}{ll}CO.OH & [1]\\OH & [2]\end{array}\right.\end{array}$$

The explanations given above leave no doubt as to the number of lake-forming groups in the molecule of this dye. In the first instance we know that the sulpho group and the orthohydroxy-carboxyl group are certainly amenable to lake formation. No more doubtful is it that the hydroxyl group in the residue of the amido-naphthol sulphonic acid must be devoid of lake-forming properties. With regard to the amido group we know that wherever it occurs in amido-azo dyes of a high molecular weight it has lost its lake-forming capability, and we must therefore assume that also in this case it is no longer a lake-forming group, a conclusion which is fully borne out by experiments to test it. We therefore convert this dye into a compound lake by acting upon the sulpho group with barium chloride and upon the hydroxy-carboxyl group with chromium chloride. The lake obtained is in fastness equal to an alizarin lake.

In the above we have taken a complete survey comprising practically all the lake-forming colouring matters, and I believe that several of the new observations we made will afford additional means of placing the manufacture of lakes on a more rational basis than it hitherto occupied. I purposely refrained from fully discussing the bearing of those results upon textile dyeing. Dyeing, however, being merely a special case of lake production in general, it is evident that many of my observations will be capable of useful application also in this industry. In attempting to examine the extent and degree of their applicability for this purpose, occasion may offer to assign Witt's rather fanciful, not to say fantastic, "solution theory," a proper place, and it will then be found that this place is very narrowly confined indeed.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Dyeing Sand with Azo Colouring Matters. R. Möhlau. Zeits. ang. Chem. 1893, 255.

See under VI., *page* 675.

PATENTS.

A New or Improved Apparatus and Process for Directing the Passage and Controlling the Speed of Gases, Air, or Fluids ascending through other Fluids or Liquids for the Purpose of causing Absorption of said Gases, or for Sterilising or otherwise treating the Liquids through which the Gases ascend, for treating Water for Brewing Purposes or Aërating Malt Worts, but is also applicable for other Purposes. R. G. Ross, J. B. Hilliard, and W. Paterson, all of Glasgow. Eng. Pat. 10,836, June 8, 1892.

The invention has reference to an improved apparatus and process for directing the passage of gases through liquids or other fluids, for the purpose of causing the absorption of the former, or for sterilising or otherwise treating the liquids through which the gases pass. The invention may be applied to the manufacture of solutions of sulphurous acid, solutions of chlorine, or heating fluids by hot air, aërating malt worts, and many other like processes detailed in the specification.

The method is particularly applicable to treating water for brewing purposes, as described in Eng. Pat. 9165 of 1892. In a closed tank, preferably of rectangular form, a number of inclined planes are mounted, having guiding channels upon their under surfaces. The tank is filled with the liquid to be operated upon, and the gas is led underneath the lowest inclined plane by means of a pipe, and after passing along the channels, it escapes and is immediately caught by the plane next above it, which latter plane is inclined in the opposite direction. In this way the gas passes along all the planes in contact with the liquid, finally escaping by means of an outlet pipe.—E. G. C.

Improvements in Steam or Air Superheaters. W. Schmidt, Cassel, Germany. Eng. Pat. 11,721, June 23, 1892.

The object of this invention is to prevent the walls of the superheater being injured by excessive heating, and is effected (1) by introducing very wet steam into the superheater; (2) by causing the steam to travel through it with considerable velocity; (3) by arranging the superheater so that the wettest steam, passing through the first part of the superheater, is subjected to the hottest products of combustion, and thereby absorbs the greatest part of their heat, both travelling in the same direction, whilst in the second part they travel in opposite directions.

Fig. 1 (see next page) shows a superheater. Steam enters at *a* direct from a boiler, and passes through the coiled tube a^1, the turns of which are in contact, so that the products of combustion from *c* can only pass inside the coil a^1; they then pass down between the coils a^1 and a^2, whilst the steam passes down through a^2. The hot products of combustion then pass up between coil a^2 and the outer shell, and the steam passes down through the coil a^3. In place of the coils shown, flat spirally-coiled tubes may be used.—R. B. P.

An Improved Filter for Wine and other Liquids. W. Parkinson, London. Eng. Pat. 12,556, July 7, 1892.

See under XVII., *page* 704.

Improvements in Heating Apparatus for Heating and Drying Chambers. Z. A. Berry, Westminster. Eng. Pat. 14,106, August 4, 1892.

At one end of the chamber below the floor is a furnace, the flue of which extends horizontally across the under side of the floor, through which several openings are pierced. Over these are placed inverted ∪-shaped metal flues, closed at both ends, which extend the whole length of the chamber, parallel to each other, their lower edges resting in narrow recesses cut in the floor and filled with sand to form an air-tight joint. At the opposite end of the furnace, covered by the metal flues, are openings through the floor leading to a flue communicating with the chimney. The products of

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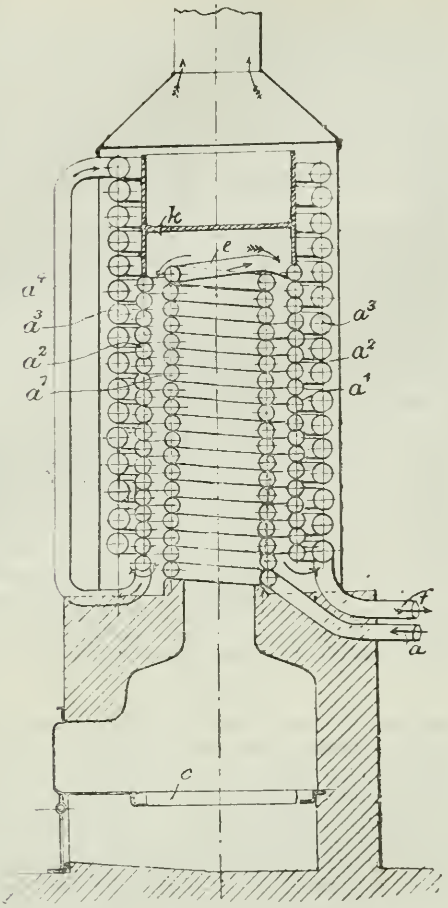
* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

Fig. 1.



Improved Steam and Air Superheaters.

combustion from the furnace thus rise through the first set of openings, pass along under the U-shaped flues, giving off here their heat, and pass down the second set of openings into the chimney flue. The U-shaped flues are preferably corrugated. Air is admitted through pipes passing through the chamber floor and situated between two adjacent U-shaped flues. Over the top of these air inlets is placed a baffle, which causes the air to be deflected against the sides of the U-shaped flues.—R. B. P.

An Improved Apparatus for Filtering Liquids. B. M. Santurio, of Buenos Ayres, in the Argentine Republic. Eng. Pat. 14,594, August 12, 1892.

The invention relates to an apparatus in the form of a filtering press for filtering liquids. Upon a hollow perforated shaft are strung a number of corrugated hollow discs of earthenware or other permeable material, the joint between each disc being made liquid-tight by means of leather washers and nuts at each end. The shaft with its attached discs is pivotally supported by the vertical covers of a chamber partly filled with sand, through which the liquid is allowed to flow. The water or other liquid in the chamber percolates to the interior of the discs, and is drawn off filtered from the base of the shaft in any convenient manner. The surfaces of the discs are cleaned from impurities by causing the shaft to rotate in its bearings, and thus allow the sand to scrub the surfaces of the corrugated discs clean. To clean the sand an outlet at the bottom of the casing is opened and water forced through.—E. G. C.

Improvements in and relating to Multiple Effect Evaporators for Treating Sugar and other Liquids. A. G. Berry, Aberdeen. Eng. Pat. 14,675, August 15, 1892.

See under XVI., *page* 703.

Improvements in or relating to Vacuum Pans and other Apparatus heated by Steam Worms. A. Chapman and S. Vickers, both of Liverpool. Eng. Pat. 15,773, September 2, 1892.

The object of the present invention is to increase the efficiency of the worm surface in steam-heated vacuum-pans, by shortening the length of each section of the worm, and by drawing off the condensation water therefrom.

A distributing-box or steam-chest is provided for each worm, and each coil of the worm is carried round from one side of the steam-chest in a true circle till it meets the other side, to which it is bolted. A partition plate divides each steam-chest into two halves, so that the steam admitted on one side of the plate enters the upper end of each coil, and the condensation from each coil enters the distributing-box on the other lower side of the dividing plate, whence it is conducted by a tail-pipe to a steam trap or otherwise. To facilitate construction and repair and for convenience of transit, each coil may be divided into two or more parts, with flanged ends for bolting together. Any number of worms as above described may be used in the pan.
—E. G. C.

Improvements connected with Machinery for Drying Powdered Substances, particularly applicable for the Manufacture of Fruit Salt. J. C. Eno, New Cross, London, and R. Jackson, Peckham Rye, Surrey. Eng. Pat. 23,217, December 16, 1892.

The sides of the drying chamber are formed of an inner iron lining, then a layer of asbestos, and a wood casing, with an opening at the top near one end, to admit the material to be dried, there being a trough at the opposite end at the bottom, into which the material falls, to be carried by an Archimedean screw to a shoot at the end. The chamber contains a number of sets of plates or aprons, each set attached to an endless chain, inclined at an angle to the horizon, but reverse ways for each successive tier. The movement of the material is upwards on each set of plates, so that it falls over at the upper end on to the lower end of the next set. Above all the sets of aprons except the first, revolving shafts are placed, carrying arms to disturb and agitate the material as it is being taken upwards. The shafts are driven in an opposite direction to the travel of the aprons. Another shaft carries a depending blade to smooth the material before it passes over the end of the set of aprons, adjusted by means of a counter-weighted arm on a rod keyed to the outside of the shaft. The material is thus carried over all the sets of aprons, being agitated on each set, smoothed, and broken up on falling on to the next set, until it reaches the trough. Devices to keep the material from undue scattering, and the necessary gearing arrangements, are described and shown. The apparatus may be supplied with heated air.—E. S.

Improvements in Pyrometers. A. J. Boult, London. A communication from E. Brown, Philadelphia, United States of America. Eng. Pat. 6655, March 29, 1893.

The essential feature in this form of pyrometer is the combination of a thin light expansion bar of highly refractory metal, such as platinum, connected to a heavy frame or stem, so that the slight expansion bar is exposed to the full heat of the furnace while the heavy frame is shielded therefrom as much as possible. The expansion bar thus quickly acquires the temperature of the furnace, and its elongation is used to measure the temperature; the expansion of the heavy frame is negligible since the exposure lasts but a few seconds. Figs. 2, 3, and 4 show sectional views of one form of this pyrometer, while Fig. 1 is an external view. E^2 is the expansion bar connected to the thick heavy frame

G by means of the cross bar H^4. The frame G is surrounded by asbestos paper, and still further protected by a metal casing. It is connected to the long tube handle M^2 by means of the annulus D^7. The tube M^2 encloses the connecting link K, which transmits the elongation of the rod E^2 to the dial mechanism ; K^1 are circular guides upon the rod K to prevent the latter from bending. The thick tube handle M^2 is protected from injury by a covering of asbestos paper and a casing m^1.

Fig. 1.

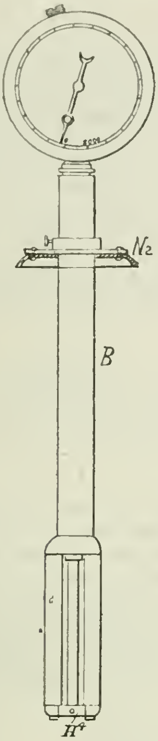
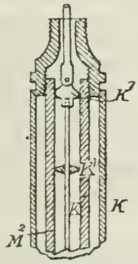


Fig. 2.



The mechanism of the dial is shown in Fig. 4. The pinion d^6 of the pointer gears with the segment D^4, which latter segment is connected to the link c^2 of the expansion rod by means of the small slotted lever c^8, pivoted to the segment, and adjustable by means of the set screw c^4, working in the nut c^3 on the segmental spur wheel ; a spring c^5 keeps the lever c^8 in contact with the set screw c^4. An opening c^6 in the case admits of the insertion of a screwdriver for setting the pointer, and a spring S^2 keeps the expansion rod link in tension. The instrument is used by inserting the end H^4 through a hole in the wall of the furnace for a few seconds, until the expansion bar has acquired the full temperature ; the pointer then indicates upon the graduated scale the temperature of the furnace.

Fig. 3.

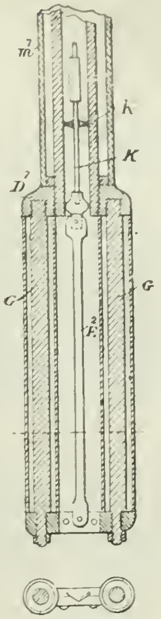
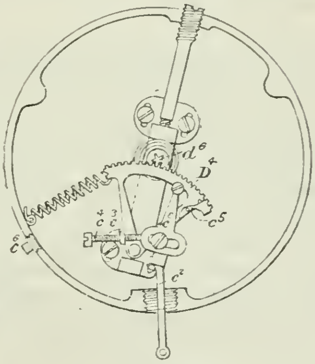


Fig. 4.



A washer N^2, sliding on the handle B, serves to shut off the heat from the operator. A modified form of pyrometer is described and illustrated.—E. G. C.

Improvements in Boiler Compositions or Solutions for Internal Application to Steam Boilers. F. A. Clayton, Bootle, Liverpool. Eng. Pat. 7622, April 14, 1893.

Sodium hydroxide solution is digested over scrap zinc until saturated, and then, before cooling, about 5 per cent. sodium tannate is added and thoroughly mixed, to form a solution for application to the interior of steam boilers while under steam.—E. S.

Improvements in Hot-Blast Stoves. H. Barlow-Massicks and W. Crooke, both of Millom, Cumberland. Eng. Pat. 8763, May 2, 1893.

This relates to further improvements in the inventors' patent hot-blast stoves (Eng. Pat. 1312, March 24, 1881). The improvements are :—(1.) The method of discharging air into any of the radial passages connected with the chimney flue. (2.) The manner in which the air is made to circulate, so as to take up the heat from the outer casing and wall. (3.) The construction of the hot-blast valves so that the water-cooling pipes may be cleaned of all sediment by means of rods without interfering with the working of the valves.—R. B. P.

Improvements in Apparatus for Evaporating, Boiling, Heating, and Cooling Liquids. C. C. A. Forstreuter. Prussia, Germany. Eng. Pat. 9838, May 17, 1893.

This invention is for an improved apparatus for evaporating and boiling liquids in a vacuum, and also for heating or cooling liquids. The vacuum pan is a vertical cylinder with a conical base, provided with annular chambers for attaching the coils through which the heating or cooling medium is to circulate. The piping of each coil ascends vertically from the conical bottom and then bends over and descends in a coil to the outlet. A number of coils are used, each being independent of the other. With this arrangement the heating or cooling effect can be regulated by cutting off one or more sets of coils.—E. G. C.

Improvements in the Manufacture of Mineral or Slag Wool. H. J. White, Brooklyn, New York, U.S.A. (Communicated by T. E. Halford, Bedford Park, Middlesex.) Eng. Pat. 10,358, May 25, 1893.

See under X., *page* 696.

Improvements in Means or Apparatus for Distilling or Obtaining Volatile Constituents or Products. M. Prentice, Stowmarket, England. Eng. Pat. 6959, May 26, 1893.

For the purpose of obtaining the volatile products of distillation in a continuous manner, or at different temperatures, a still is provided with an inlet for the matter to be distilled, and an outlet for the matter after distillation. The still is divided up into a number of separate chambers by partitions with openings beneath them, so that the matter to be distilled fills up the said openings as it passes through the chambers in its progress from the inlet to the outlet. The volatile constituents obtained by heating are conducted away by separate outlets from each chamber. The still can be heated by any suitable heating apparatus, such as by a furnace, steam coils, or the like. In a modification the chambers are separate and communicate with one another by means of pipes below the level of the contained liquid. —E. G. C.

An Improvement in Evaporating Apparatus. E. B. Caird and T. J. Rayner, London. Eng. Pat. 10,700, May 31, 1893.

The invention relates to improvements described in Eng. Pat. 5972 of 1888, in which steam passing through volute coils immersed in water is used to generate steam, which is afterwards condensed to supply fresh water for feeding boilers or for other purposes. In the present invention the baffle plates for separating the vapour from the water which rises with it, are improved by forming the lower one in the shape of a truncated cone and the upper one as an inverted basin. The vapour rising through the aperture of the lower cone, impinges on the basin above, causing the water to separate from the vapour and run down the cone, back into the containing vessel.—E. G. C.

II.—FUEL, GAS, AND LIGHT.

A Study of the New Siemens Furnace, and of the Utilisation of Heat in Regenerative Furnaces. E. Damour. Ann. des Mines, **3**, 1893, 84; Proc. Inst. Civil Eng. **113**, 64—72.

This paper contains a description of the new Siemens furnace, or Biedermann and Harvey furnace in its latest modification, where the producer is partially supplied with heated air from the top of the regenerator. The author also treats of the working of a two-pair regenerator Siemens furnace used for glass-melting, and consuming 14·85 tons of coal during the experimental period of 36 hours. The temperature of admission of the fuel-gas, and of the burnt gases issuing from the air and gas regenerators, were taken at short intervals during this period by the Le Chatelier pyrometer; that of the furnace was estimated by the optical pyrometer of Mesuré and Nouël, while the temperatures of air and gas at the points of admission to the furnace were assumed to be the same as those found by H. Le Chatelier in a previous investigation. These figures are as follows:—

	° C.	
Temperature of gas-admission to regenerator	620	
„ burnt gas from gas-regenerator	440	average 415°.
„ „ air-regenerator	410	
Average temperature of furnace	1,520	
Temperature in gas admission-port	1,150	
„ air „	1,100	

From these figures, and the composition of the fuel and burnt gases, the heat-units brought into the furnace by the gas and air, and those carried out by the chimney current, may be computed, and the difference between these quantities when compared with the calorific value of the unit of coal contained in a standard volume of gas, gives the fraction of heat actually utilised in the furnace. For the details of the calculation, which are given in full, reference must be made to the original. The results are:—

	Calories.
Heat available by the gas at 1,150°	3,667
„ „ air at 1,100°	800
	4,467
Heat carried out in burnt gases	2,945
Heat utilised in the furnace	1,522
The unit of fuel (0·475 grm.) contains	3,900
Coefficient of heat-utilisation	39 per cent.

leaving 61 per cent. as the total loss of heat from all causes, including radiation, imperfect combustion of coal, waste flame from glass-working holes, and excessive chimney-heat. Some of these are inevitable, as, for instance, the cooling by radiation from the furnace, which is essential to its preservation, while others may, do doubt, be largely reduced by modifications in the design and proportions of the structure.

What may be considered to be the useless losses of heat are:—

	Per Cent.
Loss by cooling of gas between producers and regenerators	1·8
„ evaporation of water in ashpits	4·8
„ imperfect combustion of coal	19·4
„ excessive chimney-heat	13·3
	30·3

The first of these depends upon the fact that the gas loses by radiation in the main gas-flue and passages 80° (700°—620°) of sensible heat between the producer and its admission to the regenerator. This is attended with a large production of steam (67 per cent. of the weight of the fuel), a portion of which passes into the producer, while the remainder escapes into the air. The imperfect combustion is due to a large production of cinders and breeze, which, although collected and sold, represents more than 10 per cent. diverted from direct use in the furnace.

The excessive chimney-heat represents the difference between that actually observed—440° and that assumed to be sufficient, namely, 100°.

These are evidently minimum figures, and are far from giving the total of unemployed heat; but they fairly represent what may be called useless losses, and such as it may be hoped to recover by improvements in the furnace.

By comparison with the figure of total loss previously given amounting to 61 per cent., it appears that 30 per cent. remains unaccounted for. The chief contributory items to this are the loss by flame from the working-holes, and by radiation from the regenerator walls. The latter is the most important item, and clearly indicates the advantage of keeping down the size of these chambers. The saving resulting from the suppression of one pair of regenerators may be from 5 to 10 per cent. or more, and under these conditions the heat wasted will be from 35 to 40 per cent. How far this may be remedied by the new furnace will next be considered.

By the combination of the furnace and producer into one structure, the loss of 1·8 per cent. by cooling is avoided, and the suppression of the gas regenerator reduces the loss by radiation by a much larger amount, which cannot, however, be exactly defined.

As regards evaporation of water, there is not much difference, the heat for that purpose being furnished in one case by the furnace itself, and in the other by an outside boiler, so that the saving of fuel is more apparent than real. In the new furnace, with closed ash-pit and hot-air feed, the carbon of the fuel is entirely consumed, the ash being merely burnt slate, so that the 10 per cent. in the cinders is saved. There is thus a saving of 12 per cent. in addition to that gained by doing away with the gas regenerator.

The loss in the burnt gases by imperfect recuperation, which is the most important factor, cannot be so categorically determined from experimental data, the temperature at the bottom of the chimney being dependent upon many causes not related to the structure of the furnace, and therefore it is necessary to study the question theoretically in the manner laid down in the following section:—

On Regeneration in Gas Furnaces.—The regeneration of heat, that is, the art of utilising the heat lost in furnaces, is subject to a few very simple and evident laws, which, however, must be constantly kept in view in the study of the question.

1. In a gas furnace the single source of heat is the fuel burnt on the grate; burnt gases, such as water and carbonic acid, are not combustible, and are incapable of supplying a single thermal unit to the furnace. Decomposed at any one point with absorption of heat, they recombine in another, developing an equal quantity without in any way modifying that contributed by the fuel. They are carriers transforming sensible into latent heat, and *vice versâ*, and therefore, useful auxiliaries in the distribution of temperature in the different parts of the furnace, whereby the regeneration may be improved, but nothing more can be expected of them.

2. The only gas serving to burn the coal is atmospheric air. Water and carbonic acid are not oxidising gases, for decomposed at one place they recombine in another without in any way contributing to the oxidation of the fuel. Therefore, whatever combination of furnace or producer may be employed, the total quantity of air consumed per unit of coal burnt is always the same. The manner in which it is applied, that is, the proportion between primary and secondary air, or that employed for gasification in the producer and combustion in the furnace may vary, subject always to the sum of both quantities being constant.

3. Lastly, all the reactions of combustion are reduced to a single one, that of the burning of the coal; the total heat produced is that obtainable by combustion with cold air, and it is with this quantity, which is nothing else than the calorific power of the coal, that all the thermal comparisons of heat saved or lost have to be made.

The regeneration of heat is equally governed by the two simple laws following:—

(1.) Complete regeneration supposes that no heat is carried away by the burnt gases, that is, that they must leave the chimney at or near the external temperature, which implies that the gas and air to be heated enter the regenerator at the same low temperature. This is the case with the air, but not with the gas, which comes from the producer at 600° to 800°. Consequently, in the ordinary two-pair regenerative furnace total recuperation is impossible.

(2.) In order that there may be complete thermal exchange between two gaseous masses, the total amount of augmentation of heat in the absorbing mass must be at least equal to that given up by the spent gases.

The application of these principles will be seen in the following consideration of the different cases possible in practice. For convenience in discussion the combustible is supposed to be carbon; but the conclusions are equally applicable to fuels containing hydrogen, if the calculations are based upon their calorific power:—

A. *Gasification by Air alone.*—Three cases are possible. —1. *The Secondary Air only is Heated.* Here the recuperation is evidently incomplete, the volume of the burnt gases being very much larger than that of the air. The former $C_2O_4 + 4N_2$ at 1,600° contain 72·5 cal.; while the latter, $O_2 + 2N_2$, or half that employed for the combustion in both stages when raised to the same temperature, contains only 30°. The difference, 72·5 − 30 = 42·5 cal., compared with 97 cal. of total heat developed, corresponds to a loss of 43 per cent. At 1,400° the figures are 53 − 27 = 36, or 36/97 = 37 per cent. These figures are increased in practice by the presence of carbonic acid in the producer gas, which acts in diminution of the amount of secondary air required.

Therefore, in furnaces using air alone in the producers, and with only one set of regenerators, the minimum loss in the burnt gases is from 37 to 43 per cent.

2. *Both Secondary Air and Gas are Heated.*—This is the case of the original Siemens furnace with the cooling siphon. Here the work of the recuperation is limited by the sensible heat of the gas coming from the producer, about 700°, and which has only to be raised in temperature from 700° to 900° as compared with the 1,400° to 1,600° augmentation in the air.

The calculated co-efficients of utilisation are at 1,600° 65 per cent., and at 1,400° 60 per cent., or a reduction of the loss upon the figures given above of 15 per cent. These are, of course, only theoretical figures; but by comparison with those obtained in the preceding case they give an idea of the advantage resulting from the heating of the gas. They also support the statement made by F. Siemens, that there is no inconvenience in the use of the siphon, the cooling action being compensated by the passage of the gas in the chamber. This is perfectly true in a furnace where air alone is used under the grate, because, even with the most perfect recuperation, from 11 to 14 per cent. of heat is disposable, while the cooling effect of the siphon is only from 5 to 7 per cent.

3. *Both Primary and Secondary Air are Heated.*—This would be represented by the Biedermann and Harvey furnace, supposing the producer capable of resisting a heat of 1,000° to 1,200°, and fed with hot air alone from the tops of the regenerators. Even in this case complete recuperation is impossible, owing to the specific heat of carbonic acid being higher than that of oxygen. The difference being—

At 1,400° .... 20 − 10·7 = 9·3
At 1,600° .... 24 − 12·1 = 11·9

or, compared with the heat of combustion of carbon, 97 co-efficients of loss of 9·6 and 12·2 per cent. respectively, a slightly better result than the preceding ones.

In any case total recuperation is impossible when air alone is used in the producer, and the loss of heat must be at least 10 per cent. The most advantageous result is obtained when the whole of the air is heated.

B. *Gasification with the Help of Water.*—The functions of water in the gas-producer are of two kinds: first, by replacing free oxygen it diminishes the quantity of air consumed, with a corresponding increase of that required for combustion in the furnace; and secondly, it reduces the temperature of the gas by the quantity of heat required for its decomposition, increasing the fuel value of the gas by an amount which, on subsequent combustion, exactly restores the heat so absorbed, without, however, in any way modifying the total heat of the fuel or the temperature of combustion with cold air.

An examination of the relative importance of these factors in the different methods of recuperation will serve to give the exact measure of the advantage obtainable from water-gas.

1. *Recuperation confined to the Secondary Air.*—This is represented by the Lencauchez furnaces, used by the Paris Gas Company, where the air is heated by pipe-stoves without reversal, and steam is injected in the producer. In this case, as the gas is not heated, the second function of the steam is inoperative, except in so far that the reduction of temperature in the producer is a loss. On the other hand, the decrease of the primary and consequent augmentation of the secondary air is essentially useful, as by increasing the volume to be heated in the checker work the regeneration is improved.

By a consideration of the figures previously given, it is easy to see that the numerical values of this method of regeneration must lie between the limits corresponding to the heating of one or both portions of the air respectively, that is—

	Per Cent.
At 1,600° the loss will be between	43 and 12·2
At 1,400° „ „	37 and 9·6

Supposing as a maximum the gas to contain equal volumes of hydrogen as carbonic oxide (practically in the best gas it is 18 H to 23 of CO), one half of the primary air will be replaced by water vapour, and the loss of heat will be reduced from 43 to 27·6 per cent. at 1,600°, and from 37 to 23·3 per cent. at 1,400°, apart from the latent heat of water vapour, 4·8 per cent., which, when added, gave 28·1 per cent. as the figure at the lower, and 32·1 per cent. at the higher temperature.

2. *Recuperation by Secondary Air and Gas.*—This is represented in the ordinary Siemens furnace, with two pairs of regenerators and closed ash-pit, blown by a steam-blast. Here both functions of the water are effective, as the increase of secondary air and the lowering of the temperature of the producer-gas contribute to the improvement of the recuperation by increasing its range, and, therefore, the coefficient of utilisation of the heat remaining disposable after the heating of the air, will be better than in the preceding case, and the loss will be reduced to 8·5 per cent., or, taking into account the latent heat of water, 13·3 per cent.

3. *Recuperation by Primary and Secondary Air.*—This would be represented by the Biedermann and Harvey furnace, supposing the producers to be fed with hot air alone. Here water vapour is useless in either way. The whole of the air being heated, there is no object in modifying the proportions of one part to the other, and the cooling of the producer becomes disadvantageous; the heat, therefore, applied in vaporising water will be expended in pure loss.

The application of regeneration to the air of both kinds, and to the gas, has not, to the author's knowledge, been tried in practice, and in any case can be of no particular interest. The amount of heat disposable after completely heating the air is only from 9 to 12 per cent., or, deducting that absorbed by water vapour (5 per cent.), from 4 to 7 per cent., which, taking into account the coefficients of utilisation previously calculated, show a maximum additional saving of 2·5 to 5 per cent., which would probably be more than neutralised by the cooling effect of the additional chamber, which would be required in the application of the method.

C. *Gasification with the Help of Carbonic Acid.*—Carbonic acid in the producer behaves in exactly the same manner as water vapour, but being permanently gaseous at all furnace temperatures, the latent heat of vaporisation does not come into account, which is an advantage in its favour. But, as the burnt gas has to be taken by an aspirator working against the chimney draught, a considerable quantity of steam is required, so that the gas injected is always a mixture of steam and carbonic acid, and never the latter gas alone. This is the essential novelty in the Biedermann and Harvey furnace, which will be considered in its actual or possible methods of working, in order to arrive at the probable maximum of recuperation allowable.

Supposing the producer were to be fed with hot air taken from the top of the regenerators, the secondary air being also heated by the same method, the condition of total heating in the air would be realised, and no injection of decomposable vapours, tending to cool the producers, could do anything but harm, as there are no regenerators provided for heating the gas before combustion.

Supposing the producer to use cold air alone, the effective regeneration would be similar to that of the Lencauchez furnaces, or rather better, on account of the latent heat saved where water vapour is replaced by carbonic acid.

Lastly, when a mixture of hot and cold air is used in the producer, the burnt gas and steam are active in both ways, in addition to keeping down the temperature of the grate bars, which begin to burn at 500°. Taking the latter as the temperature of the air-feed, the heat utilised, as compared with the preceding case, will be at 1,400°, 33, and at 1,600°, 28 per cent. of that which the air would absorb if heated to the maximum, or savings of 5 and 4·4 per cent. respectively, and the loss of heat will be—

	Per Cent.
At 1,600°	27·6 − 4·4 = 23·2
At 1,400°	24·3 − 5·0 = 19·3

From the preceding reasoning it appears that the use of carbonic acid has no value when the whole of the primary air is heated, while, in the other cases, the advantage realised is about the same as with water vapour. The Biedermann and Harvey furnace, in its present method of working, is about 5 per cent. better than the semi-water gas furnace, with air regenerators alone, of the Paris Gas Company, but is inferior, by at least the same proportion, to the ordinary Siemens furnace, with double regenerators and the same class of fuel gas.

The anticipated saving of 50 per cent. in the original description of the furnace supposed that, by the well-known reaction, $CO_2 + C = 2CO$, the use of carbonic acid, instead of atmospheric oxygen, would, from the same weight of coal, give double the volume of carbonic oxide. This is perfectly true, and therefore, supposing the temperature of the furnace to be sufficiently high, it would not be impossible to feed the producers with burnt gas, and so to obtain a larger volume of gas of the same fuel value as that of the ordinary producer. This higher thermal value at the exit of the producer can, however, only be obtained from the disposable heat of furnaces, which is borrowed at one moment to be immediately repaid; the quantity involved, therefore, travels continuously in a closed cycle, without advantage either to the furnace temperature or the recuperation. The quantity of carbonic acid sent through the grate in no way alters that passing out by the chimney, the amount of spent gas being only dependent upon the weight of coal burned, and whatever portion of it may be diverted returns to the furnace, and must ultimately escape to the air. Supposing, therefore, the gasification to be done with carbonic acid alone, every molecule of carbon in the gas will pass twice through the furnace, and, with the doubling of the volume of combustible gas, that of burnt products will be similarly increased, one effect exactly neutralising the other. It therefore appears that the regeneration of carbon is entirely illusory.

The preceding discussion being essentially theoretical, the figures would necessarily be considerably modified in practice. Thus it is assumed that total recuperation is possible, whereas, actually, a difference of 150° to 200° between the gas and the recuperating agent is necessary to effect the thermal exchange, besides that required for the chimney draught. Nevertheless, the results furnish an accurate method of comparing the different systems, and from them it may be concluded that the best of the systems actually in use, the ordinary Siemens furnace, with two pairs of regenerators, is the most efficacious as saving the heat of the spent gases, the loss being only from 10 to 15 per cent., or a maximum calorific yield of 85 to 90 per cent., and the theoretical result is about the same, whether air alone, or a partial admixture with water, is used in the producer, but practically the latter has some advantage.

Furnaces in which only the secondary air is heated have only a maximum yield of 70 to 75 per cent. even with the use of partial water-gas, which is then absolutely essential.

The best of all methods is the heating of the air of both kinds, which reduces the loss to 10 per cent., without its being necessary to use water vapour or any other auxiliary in gasification.

In the present state of construction and working, with a temperature of 500° on the grate, the new furnace appears to be inferior to the old one by about 8 or 10 per cent., a quantity which is about equal to the useless losses in the latter, apart from those of the regeneration. The two furnaces may, therefore, be considered as of about the same value as regards utilisation of heat, and the only advantages remaining to the new one will be those arising from simplified construction and working. Its superiority would, however, be assured if the producers could be modified so as to resist air at a high temperature, as in that case the best possible furnace, where the total regeneration is effected by air alone, would be realised.

The Mixing and Stratification of Gases. W. Leybold. J. für Gasbeleuchtung, 1893, 261. Proc. Inst. Civil Eng. **113**, 111.

The mixing, or rather non-mixing, relations of a heavy gas, with a high illuminating power, can be best observed in a gasworks, as small variations may there be noted. It might be supposed that the gas in a gasholder would soon become fairly homogeneous, but circumstances arise which frequently retard the mixing; these are most noticeable when there is a considerable difference between the temperatures of the gas and of the atmosphere. With severe cold in winter, say 5° F., the gas made during the morning deposits the heavy hydrocarbons, and loses in illuminating power; to compensate for this, more than the usual quantity of enriching material is used; but it may still be found that the quality of the gas passing out into the district has not improved; the richer gas seems to have disappeared, because the gases in the holder have become stratified, on account of the difference in their specific gravity. The newly-made gas reaches the holder at a temperature of, say 54° to 59° F., and, in consequence of this temperature, it is specifically lighter than the gas already in the holder, and it therefore ascends to the top. If the holder is supplying the district the old, low-lying gas goes out first, until a time comes when the poor gas gives place to a bright, high illuminating-power gas, exceeding the required quality. The gas produced the previous day has first gone out, and the newly-produced gas then follows at a difference of temperature of nearly 55° F., and is therefore considerably lighter than the old gas, even although the latter has a considerably higher illuminating power, and, if reduced to the same temperature, would have a higher specific gravity than the gas at the bottom of the holder. Under these conditions, the mixture of the gases does not take place until the newly-made gas has cooled considerably, and they may remain unmixed for many hours.

In summer, when the external temperature is considerably higher than that of the gas, the latter, on account of condensation, is about 59° to 68° F. at the gasholder inlet. From the heat of the sun the crown of a gasholder becomes so hot that it cannot be touched with the hand, being at least from 113° to 122° F. This temperature is also taken up by the gas in the holder, and, if freshly-made gas is passing in, cooler and therefore of higher specific gravity, this newly-made gas remains below, and under these conditions the mixture does not take place for many hours.

The conditions of temperature in summer act exactly contrary to those of winter. In the first case, the newly-made gas remains below, and in the latter at the upper part of the holder. When the atmospheric and gas temperatures are nearly equal, stratification of the gases does not occur, as they mix more freely, and the illuminating power remains more uniform.

The foregoing arguments are opposed to the generally accepted law that gases mix with facility, and prove that a considerable time is frequently required, and that the difference of temperature may considerably affect the mixing. The best means to prevent stratification is to avoid great variations of temperature in the holder by enclosing it in a building heated, when necessary, by steam.

Peat as Fuel. From Note in Brit. Foreign Office "Reports on Subjects of Commercial Interest."

In Denmark the peat bogs extend over 90 square miles (English measure), or about 4 per cent of the entire area. It is either cut and dried in the air without further treatment, or is kneaded into a more or less homogeneous mass and then cut into blocks. In neither case does it pay to transport it to any distance. Some time ago an attempt was made to heat railway carriages with peat, but without avail, and steam was substituted.

In France a small quantity of peat is cut in the districts of Brest, Cherbourg, and Marseilles, but nothing to speak of, although it is sold in Lyons for domestic purposes. There are peat bogs in the south-western part of France, as in the district of Bordeaux, but only a local demand is supplied. Even in Charente, where formerly the industry was of some importance, the annual production is now only about 7,000 tons. There is a company at No. 8, Rue St.-Martin, Paris, founded by M. Beraud, for making articles from peat fibre. It is stated that briquettes can be made for 50 per cent. of the cost of coal-dust briquettes.

The peat industry of Germany maintains about the same position from year to year, but the consumption is for the most part local. Very little is transported by rail even for 20 miles, as the rate is prohibitive. In the Grand Duchy of Oldenburg about 150,000 tons yearly are used in brick kilns, bakeries, &c. The method of peat-cutting used at Carolinenhorst is as follows:—The peat is cut by three men, the first cutting from the top with a sharp square-ended spade, the second from the side with a round-ended spade, dividing the turf into lengths also. This second man sometimes uses a three-sided square-ended spade, shaped like a parallelogram with one of the long sides lacking. The third man lifts out the sods with a four-pronged fork having the tines turned up at an angle of 45°. The depth to which the peat is cut varies from 9 to 15 ft., the whole of it being used except some 3 or 4 in. of the top. Machine cutting has been tried, but was not found to be any cheaper than hand labour. The best peat is in the undermost layers, the first 3 or 4 ft. being used for moss litter. The cutting takes place in the spring, and the drying goes on until August. All of the peat is air-dried. For air-drying the peat is stacked by women, in piles 6 ft. long, 3 ft. wide, and 6 ft. high, the sods not being laid close together, but overlapping, so as to give free access of air. Each pile holds 3 cubic metres of peat, or 1,200 sods. The dried peat is divided into three classes. 1st. The dark peat coming from the lowermost layers, being heavier than the other kinds, and affording so little ash that 15 sods, measuring when fresh 13 × 10 × 10 in., yield only a large wineglassful. 2nd. The peat lighter in colour and of less weight. 3rd. The peat from the top layers, less valuable than the other two sorts.

The peat exported from Germany during the last few years was as follows:—1888, 11,184 tons to foreign countries; 1889, 12,056 tons; 1890, 11,819 tons; 1891, 11,457 tons, all to foreign countries.

Switzerland takes most of the foreign exports. The imports into Germany are slightly in excess of the foreign exports, being 13,073 tons in 1891.

Peat fuel has found its greatest development in the Netherlands, where about 280,000 tons are annually used in the brick-kilns, and have a value of about 149,625*l*. It is estimated that the value of an acre of good black peat, well situated, is about 90*l*. Along the rivers Maas, Waal, Linge, Lek, and Yssel black peat is almost exclusively used in the brick-kilns. The peat has to be cut and stacked and dried before it gets frozen, as when once it has been frozen it loses a great deal of its heating power. In Holland peat is made into charcoal, which has about the same heating effect as wood charcoal, but being more porous and leaving more ash it is not so much in demand. The sods are air-dried, and then converted into charcoal either in piles or ovens.

Of all the European countries Russia has by far the greatest extent of peat bogs, as they cover an area of some 67,000 square miles, and are capable of yielding 14 milliards of tons. The peat bogs of the crown lands in the provinces of Petersburg, Moscow, Orel, Riazan, Vladimir, Tamboff, and along the Kursk-Kieff line are said to contain 100,000,000 cub. ft. of excellent peat. In Norway and Sweden the utilisation of peat is progressing faster than in any other country. It is employed as a fuel by glassworks, brick-kilns, wood-pulp factories, under steam boilers, and by metallurgical establishments. For the last-named purpose alone the annual consumption is about 30,000 tons. The peat bogs of Sweden cover an immense area in Dalecarlia, Vermland, Smaland, Halland, and North Scania. In Upper Noorland also and in Lapland there are large areas of peat deposits. The waste gases from certain ironworks are used for drying the peat, locally, and by this treatment there is a gain in heating power of 20 to 30 per cent. The cost of making good peat fuel in Sweden may vary from 4*s*. 10*d*. to 6*s*. per ton. It is expected to contain from 30 to 40 per cent. of combustible matter, with from 7 to 10 per cent. of water.

PATENTS.

Improvements in the Decomposition of Mineral Oils for the Production of Illuminating Gas. W. Young and A. Bell, both of Peebles, North Britain. Eng. Pat. 12,421, July 5, 1892.

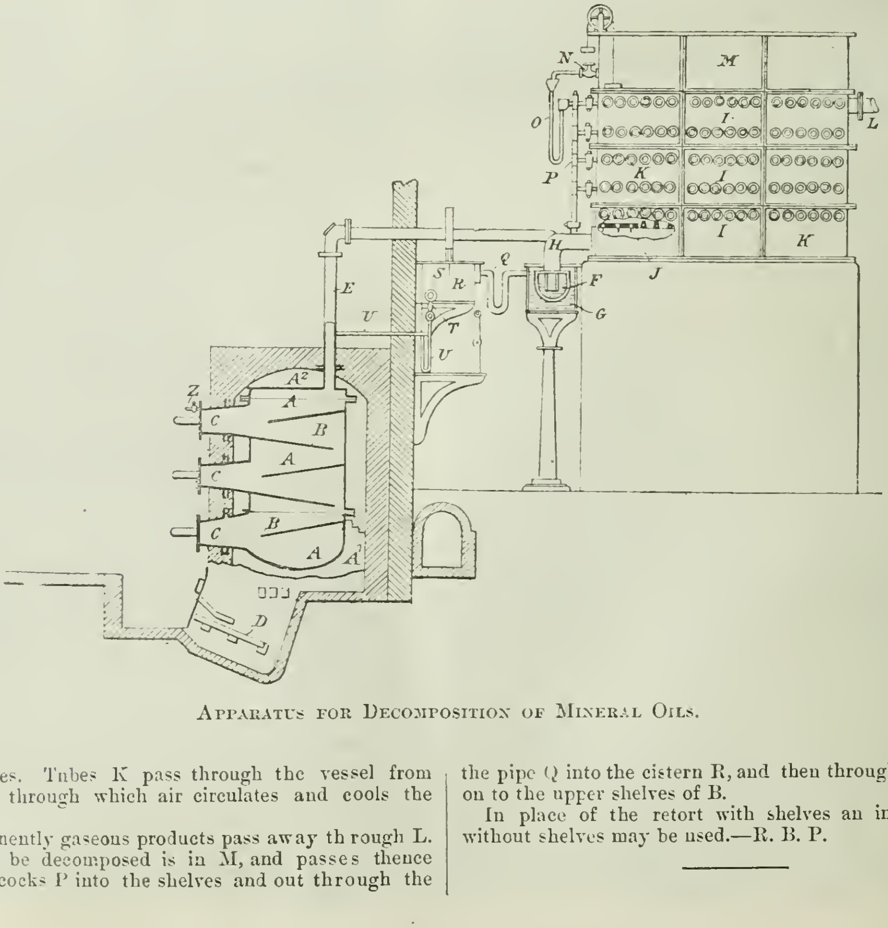
In order to obtain an increased amount of light from a given quantity of oil and to prevent the depositing of sooty carbon, the oil is subjected to the repeated and fractional decomposing action of heat at a lower temperature than is at present employed for decomposing oil at one operation, and in such a manner that the heat shall act as radiant heat. The fractional decomposition is effected by causing the oil to pass alternately through the decomposing retort and the condenser and washer or scrubber. The oil to be decomposed is used for washing out of the products from the retort all that are not sufficiently gasified, and to convey them back to the retort to undergo further decomposition, the operations of decomposition, condensation, and washing being continued until the oil is split up into gaseous compounds and solid carbon.

The figure shows a suitable apparatus.

The retorts A are provided with shelves B and openings C. The retort may be heated by a separate furnace as shown, or if it is being used for enriching water-gas the producer gas may be used to heat it.

The stand-pipe E conveys the products of decomposition to the hydraulic main F, which is cooled externally by the water in tank G.

From F the volatile and gaseous products pass to the combined condenser and washer I. This consists of a rectangular vessel containing a series of shelves provided with short nozzles covered with light sheet-iron caps, which cause the products to bubble through the liquid contained in the shelves. Tubes K pass through the vessel from side to side, through which air circulates and cools the products.



Apparatus for Decomposition of Mineral Oils.

The permanently gaseous products pass away through L.

The oil to be decomposed is in M, and passes thence through the cocks P into the shelves and out through the pipe Q into the cistern R, and then through O, down E, on to the upper shelves of B.

In place of the retort with shelves an inclined retort without shelves may be used.—R. B. P.

Improvements in Means or Apparatus for Effecting the Turning or Stirring of Oxide of Iron, Lime, or other Matters. F. D. Marshall, Copenhagen, Denmark. E. Bluhm, Martinikenfelde, Germany. Eng. Pat. 12,798, July 12, 1892.

This apparatus is for mechanically effecting the revivifying and turning of oxide of iron in gas work, or for turning or mixing pulverised or granulated material in other industries. It consists of two standards with toothed gearing at each end of the platform. An endless chain passes round the gearing and traverses a carriage carrying a hollow shaft, to which are attached shovels and an internal shaft; the chain also rotates this gear and that for reversing the motion of the carriage.—R. B. P.

Improvements in the Manufacture of Gas for Illuminating and other Purposes. B. Parkin, Golcar, Yorkshire. Eng. Pat. 14,490, August 11, 1892.

This invention relates to the manufacture of gas from "petroleum, benzoline, or other spirits of a like character."

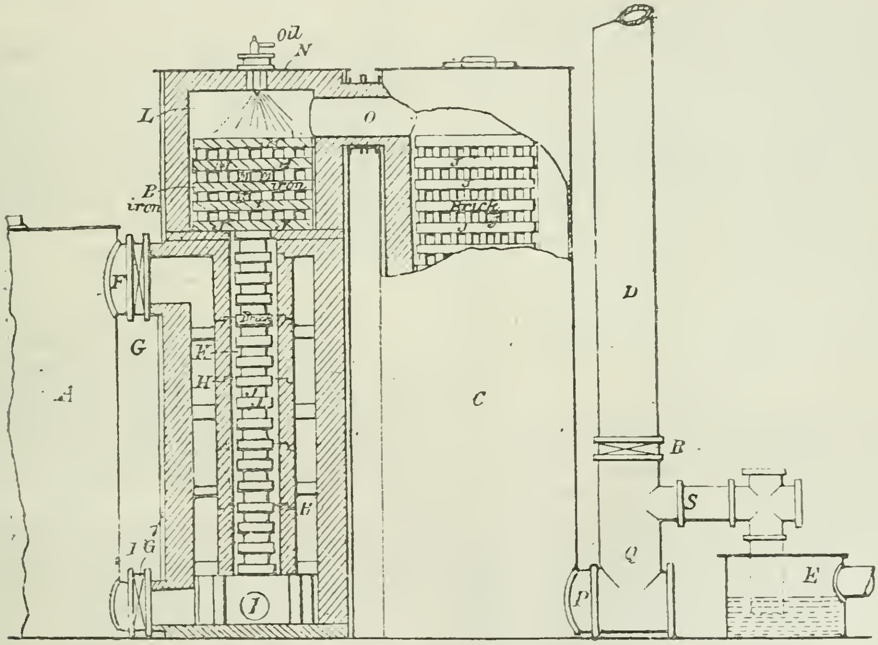
The apparatus employed consists of a vertical cylindrical retort surrounded by a furnace built of brickwork. The retort is about half filled with asbestos, or broken bricks, to prevent its being cracked by the cold spirit falling on to it whilst hot. The furnace and retort being sufficiently heated, the spirit is fed in through an inlet near the top, and, falling on the heated asbestos or brick filling, is burnt; the vapour arising therefrom passes out through a branch pipe near the top of the retort into a gasometer. Doors for filling and cleaning out the furnace are provided. —R. B. P.

Improvements in Apparatus for Producing Currents of Inflammable Gases and Air. T. Bletcher, London. Eng. Pat. 14,985, August 19, 1892.

This apparatus consists of a rotary fan blower and a burner formed so as to produce a flame by means of a current of air mixed with the vapour of oil or spirit, or with any suitable gas, as in a Bunsen burner. It is intended to be used for lighting fires, brazing, soldering, melting metals, scorching paint, &c. The fan is either driven by hand, or by a spring motor, through suitable gearing. When oil or spirit is used a vaporiser is fitted.—R. B. P.

Improvements in Carburettors. C. R. Collins, Philadelphia, U.S.A. Eng. Pat. 10,227, May 23, 1893.

This invention relates to carburettors for enriching water-gas.



Improved Carburettor.

A represents the gas generator, B the carburettor, C a fixing chamber, D the stack, and E the "washer"; all these except B are of the usual construction.

The conduit F, fitted with a valve G, leads the gas from A, into an annular chamber H, which surrounds the interior chamber K. K is open at the top and bottom as shown, and is fitted with checker work. I is a conduit leading from A into B. The conduit F is used for producer-gas formed in blowing up, and either I or F for water-gas at will. G and G¹ are valves. At the top of K is an enlarged chamber L partly fitted with brick checker work and partly with iron checker work M, of such depth as to prevent any fluid oil passing it. N is an oil injector, O a conduit leading to the fixing chamber C. The gases from A pass through F into H and heat the walls of chamber K, and being mixed with air from I¹ ignite and pass along K, L, O, C, P, and Q to the atmosphere. When water-gas is being made C is closed and G¹ opened, or *vice versâ*, and the gas enters B through I or F and passes up through the heated checker work in K and L; the injector at the same time throws a spray of oil down on the iron checker work, which, together with the hot gas, vaporises it; the gas and vapour then pass into the fixing chamber C and on to the washer, the valve R being closed.—R. B. P.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Present State of the Naphtha Industry in the Apsheron Peninsula. A. Leproux. Annales des Mines, 1892, **2**, 117; Proc. Inst. Civil Eng. **113**, 112.

The author traces the development of the Caucasian petroleum industry, and gives a table showing the gradual increase of the output since 1860, together with the American production during the same period. The amount of petroleum produced in Russia is now nearly equal to that extracted in the United States. Until 1872 petroleum was a State monopoly in Russia, and when the monopoly ceased in that year a certain number of parcels of land of 50 hectares (123·5 acres) each, were sold to private individuals. At the present time about one-half of the petroleum ground belongs to private owners; the State land is reserved for future use. In Turkestan and Bokhara numerous deposits of petroleum are known to exist, but in most instances the oil which they yield is of high specific gravity, and consequently not very remunerative. The Apsheron Peninsula consists of two tertiary deposits. The upper one, the so-called Aralo-caspian formation, is composed of hard limestones and clays, and is about 600 metres (1,968·5 feet) thick in the vicinity of Balakhany, increasing in thickness towards the south. The lower oil-bearing strata consist chiefly of soft sandy layers with some sandstone; they have been proved to a depth of 700 metres (2,296·6 feet). The difficulties encountered in boring in this district arise chiefly from the soft and pliable nature of the strata pierced. Some of the wells are artesian the oil spouting upwards with great force. This is attributed to the expansion of the gas dissolved in the oil, and the author considers that it is only in cases where a cavity exists immediately above the lower end of the tube that the pressure of the gas becomes sufficient to raise the oil to the surface. Where the layers are much fissured the yield is smaller than when they have been compressed *in situ*.

The wells are invariably bored with rods, the formation being too soft to admit of the use of the American system of boring with ropes. The diameter of the tubes varies from 8 inches to 2 feet, the boring being started with the latter diameter and the tubes reduced as required. The depth of the bore-holes rarely exceeds 300 metres (984 feet), and the average rate of sinking is 1·50 metre (4·92 feet) in twenty-four hours. An engine of about 10 h.p. is usually employed. In some instances the gas exercises great pressure in the bore-holes, which may attain as much as 20 atmospheres, and cases have occurred where the boring tools have been ejected from the bore-hole and the lining-tubes have collapsed, bringing about the destruction of the well. The quantity of oil ejected from some of the wells is sometimes so enormous as to be a source of loss instead of profit on account of the damage caused to the neighbourhood. Where the oil does not rise naturally to the surface it is extracted by means of cylindrical vessels, which are lowered into the well by a steel-wire rope and then drawn up again full of oil. The yield of oil varies extremely in the different wells; but, taking the average, it amounts to about 50 tons in twenty-four hours in the Balakhany district. At present an output of about 6 tons in twenty-four hours is the minimum which proves remunerative where the oil has to be pumped.

Once extracted, the oil is conveyed to the factories at Baku either by pipe-lines or by boat when the wells are near the coast. The pipes are all of wrought-iron it having been found that cast-iron offers too much resistance to the flow of the oil, especially in winter. Each line has a tank at both ends constructed of sheet-iron, and the oil is forced through the pipes by a pump of the Worthington type. The chief products obtained from the crude oil are lamp-oil and lubricating-oils. The latter are extracted from the residues remaining after the distillation of the former; but only a small portion of these residues is thus utilised, the remainder being used as fuel. Before distillation the oil is purified from sand and water by allowing it to remain for some time in tall cylindrical vessels of a capacity of about 500 tons. These are slightly warmed by means of pipes through which the residue, termed mazout, from the stills is allowed to flow. The stills usually take the form of large boilers of a capacity of 20 to 25 tons, which quantity is dealt with in twelve to eighteen hours. The fuel used is mazout, and the contents of the still are kept in a state of constant ebullition by means of superheated steam. After distillation the oil has to undergo a series of chemical operations in order to remove impurities. It is first agitated with from 0·6 to 1·5 per cent. of sulphuric acid, which removes chiefly water and tarry products. Then about 0·31 per cent. of carbonate of soda is added; this combines with phenols and similar bodies, and neutralises any trace of sulphuric acid that might remain. After being subjected to the heat test in an Abel-Pensky apparatus, the oil is sent in bulk to Batoum, where a large proportion is packed in tin cans, two of which are enclosed in a wooden case. The residue, or mazout, is utilised to some extent for the manufacture of lubricating oils, for which purpose it is distilled by superheated steam in small boilers which can treat 6 to 8 tons in twenty-four hours. The vapours given off are condensed in upright pipes, a different quality of oil being collected at the bottom of each pipe. In refining, a larger proportion of sulphuric acid and carbonate of soda is required for lubricating than for burning oils. In testing the finished product some makers use Thurston's frictional apparatus, others Engler's viscosimeter. Another apparatus has been introduced by General Petroff, which is based on the time required for a certain volume of oil to traverse a narrow tube about 1 metre in length. See also this Journal, 1893, pages 709—710.

Particulars are given of the use of mazout for heating fixed and locomotive boilers, the latter information being chiefly derived from papers read by Mr. Urquhart before the Inst. Mech. Eng. in 1884, 1889, and 1890.

A number of details are given of the prices of materials, cost of transport and manufacture, and the author discusses in some detail the present position and future prospects of the Russian petroleum trade. The opinion is expressed that, owing chiefly to the high cost of transport, Russian petroleum cannot compete favourably in Europe with that from the United States.

Treating Turpentine Still Waste. C. B. Warrand. Chem. Trade J. 1893, **13**, 96—97.

Mr. C. B. Warrand has called the attention of the turpentine operators to the waste of the turpentine distilleries, which is commonly called turpentine dross. He says (according to the *Oil, Paint, and Drug Reporter*) that this dross consists of about 80 per cent. of resin; the rest is cotton chips and pipe straw, all heavily impregnated with resin.

One ton of resin will easily yield 1,000 to 1,200 pounds of lampblack, with a good furnace and properly constructed house. If the arrangements of the lampblack house are not properly constructed, not more than half of this yield will be obtained, and the quality of the lampblack will be inferior, as the slower the resin or dross is burned the better the quality of the lampblack and the larger the yield. There is nothing in resin to give the lampblack a taint or injure its black colour; hence with proper care, an excellent article of great purity ought to be the result.

Lampblack is used in large quantities by paint manufacturers. One house alone stated that it used from 3,000 to 4,000 barrels a year. Manufacturers of printers' ink use enormous quantities; manufacturers of shoe blacking also use large quantities. A considerable amount of lampblack is used by rubber manufacturers. Fertiliser works, and many other industries, also use it in limited quantities.

It would appear that all the lampblack that can be produced by the turpentine operators can be sold at fair and remunerative prices. The prices paid here will depend on the quality. Much depends also on the admixture of sand, dirt, and other foreign matter, which is liable to get mixed with the lampblack in being gathered and packed for shipment. The usual mode of shipment is in barrels, each barrel holding from thirty to forty pounds.

However, the best and cheapest plan is to pack the lampblack in large burlap sacks, five or six bushels in a sack.

The prices that lampblack will bring will range from 6*l.* to 12*l.* per ton, if shipped in bags. If the lampblack is shipped in barrels it will bring from $2\frac{1}{2}$ to 6 cents per pound, according to quality and purity; the freight on lampblack in barrels is, however, much higher.

The cost of producing lampblack is very small. The still man and his assistants could easily attend to the lampblack house at odd times without any additional expense to the operator. The only expense would be the gathering, packing in bags, hauling to the depôt, and loading on rail, all of which will not exceed 13*s.* Every still can easily produce from eight to ten car loads a year, out of material now utterly wasted or burned.

The expense of erecting a good lampblack house is not large. From 20*l.* to 40*l.* would be ample.

IV.—COLOURING MATTERS AND DYES.

The Preparation of Benzidine. E. Erdmann. Zeits. ang. Chem. 1893, 163—164.

THE author describes a simpler method for preparing benzidine than Teichmann's method, which is at present in vogue.

3·4 kilos. zinc-dust is added to the following mixture:—2 kilos. of nitrobenzene, 6 litres of caustic soda of 40° B., 2 litres of water, and 1 litre of alcohol. This mixture is contained in an earthenware vessel, which is well shaken during the introduction of the zinc-dust. The alcohol and the nitrobenzene distilling off through the heat of reaction are condensed and returned by a reflux-cooler. Great care must be taken when adding the zinc-dust, explosions having occurred through the zinc having been added too quickly. The reduction takes about $2\frac{1}{2}$ hours. When the whole has cooled down the crystals of hydrazobenzene are separated from the zinc oxide by dilution with water and filtering through fine wire gauze. The crystals, after washing with dilute hydrochloric acid, followed by washing with water, may be further purified by treatment with alcohol. With care the zinc oxide can also be separated from the hydrazobenzene by treatment with hydrochloric acid, avoiding any excess of acid and keeping the solution at about 10° C.

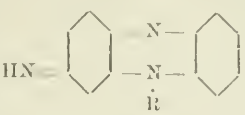
The yield of hydrazobenzene was 1,170 grms. (theory, 1,496 grms.). 1·8 to 4·1 per cent. of nitrobenzene are converted into aniline in presence of alcohol (12·5—14 per cent. in absence of alcohol, and 33 per cent. if the reduction was carried out in an iron vessel). The reaction of converting hydrazobenzene into benzidine by boiling with hydrochloric acid is not so complete, on account of the formation of more aniline and of diphenyline. The azo colours of this latter substance have no commercial value. The yield of benzidine by this reaction only amounts to about 50 per cent. of the nitrobenzene used.

1 litre of boiling water dissolves 11 grms. benzidine, whilst 1 litre of cold water only dissolves 0·4 to 0·5 grms.

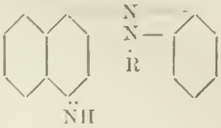
Benzidine is easily determined quantitatively by titrating with sodium-nitrite solution (1 per cent.), using potassium iodide starch paper as indicator.—K. E. M.

Studies in the Induline Group. IV. O. Fischer and E. Hepp. Annalen, **272**, 306—354.

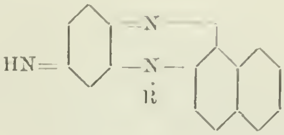
AN investigation of the indulines, extending over several years, has led the authors to the conclusion that these bodies are *p*-quinone-imides rendered stable by the presence of an azine ring in the molecule (see also this Journal, 1892, 156, and 1891, 457). They distinguish between four types of indulines according to the following general formulæ:—



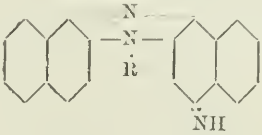
I. Benzene induline.



II. Rosinduline.

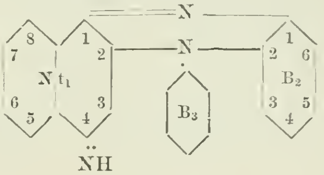


III. Isorosinduline.



IV. Naphthinduline.

There are, in addition to these, three other types possible, one being an isorosinduline and the other two naphthindulines. To avoid confusion, so-called iso-*p*-tolylrosinduline is to be known as *p*-methylphenylrosinduline, and so-called iso-naphthylrosinduline is now termed sym. α-β-anilidophenylnaphthinduline. In order to fix the position of the various substituents in the indulines the benzene rings are designated B_1, B_2, B_3, &c., the nitrogens in the azine ring Nr, the naphthalene rings Nt_1, Nt_2, &c., and the positions in the various rings as follows:—

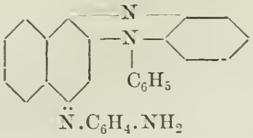


The ring containing the quinoneimide group is always B_1 or Nt_1, as the case may be. Under the four different types mentioned above, a number of indulines are then described in the paper.

I. *Benzene indulines.*—The induline $C_{18}H_{13}N_3$, a by-product of the amido-azo benzene melt, is also obtained in small quantity by boiling an aqueous solution of amido-azo benzene hydrochloride and aniline hydrochloride, *p*-phenylene diamine and di-*p*-diamidodiphenylamine, melting at 158° C. being formed at the same time. The substance melts at 215° C. and not at 135°, and dissolves in benzene or ether with a brownish-yellow colour and in sulphuric acid with a reddish-violet colour. The base rapidly absorbs carbonic acid, and as the salt so formed is very sparingly soluble in water the dyestuff can be completely precipitated by means of carbon dioxide.

Casella's *Indazine*, prepared by the action of nitroso-dimethylaniline on diphenyl-*m*-phenylene diamine, is $B_2$4-dimethylamidophenylinduline or dimethylphenomauveïn. By heating diphenylphenylene diamine and nitrosoaniline in alcohol with hydrochloric acid the compound $B_2$4-anilido-induline $C_{24}H_{18}N_4$ is formed. This body forms bronzy crystals melting at 246° and has lately been shown to be identical with phenomauveïn (Ber. **26**, 1195). A substance of the formula $C_{30}H_{23}N_5HCl$ is formed as a by-product.

II. *Rosindulines.*—By the action of *p*-phenylene diamine on phenylrosinduline B_4-*p*-amidophenylrosinduline of melting point 247° is obtained. Its constitution was determined by heating with hydrochloric acid, when it decomposes into rosindone, melting at 259°, and *p*-phenylene diamine. Its formula is therefore :—

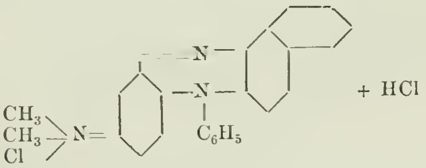


In a similar manner *p*-tolylrosinduline, melting at 213°, is obtained by heating phenylrosinduline with *p*-toluidine to 170° under pressure, and *o*-tolylrosinduline by the action of *o*-toluidine on phenylrosinduline. This compound forms bronzy prisms or needles melting at 197°, and is decomposed by heating with hydrochloric acid into rosindone and *o*-toluidine and hence is B_4-*o*-methylphenylrosinduline. By oxidising tetranilidonaphthalene the authors obtain Nt-3-anilidophenylrosinduline (Annalen, **256**, 254 ; this Journal, 1892, 156).

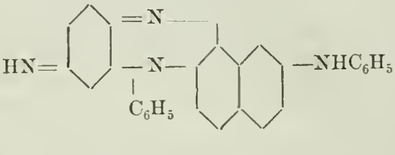
B_2-amidophenylrosinduline, which forms bronzy plates melting at 147°, is obtained by heating together nitroso-β-naphthylamine, *p*-phenylene diamine hydrochloride, and aniline to 150°. It dissolves in concentrated sulphuric acid with a characteristic green colour, which becomes reddish-violet on dilution. It contains a free amido group, and, after diazotisation and boiling with alcohol, yields phenylrosinduline, which was characterised by conversion into rosindone. By heating the substance with hydrochloric acid in acetic acid solution to 190°—200° it gives Nt_2-hydroxyisorosinduline (greenish prisms melting at 270° C.), and on further heating to 220°—225° it forms hydroxyrosindone, $C_{32}H_{14}N_2O_2$, crystallising in reddish-brown acicular crystals.

III. *Isorosindulines.*—These compounds are best prepared from nitroso bases, and several indulines prepared by this means are described.

B_1-dimethylisorosinduline hydrochloride is obtained by heating together nitrosodimethylaniline, aniline, and α-naphthylamine hydrochloride—

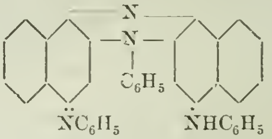


The base, which forms almost black plates, only exists as an anhydride $(C_{24}H_{20}N_3)_2O$, melting at about 270°. The nitrate, $C_{24}H_{20}N_3.NO_3.HNO_3$, separates from an alcoholic solution of the base on the addition of nitric acid, in characteristic green plates. Several isorosindulines have been obtained from 2·7-diphenylnaphthylene diamine and nitroso compounds, the simplest being that formed by condensing it with nitroso-aniline, which yields the compound, $C_{28}H_{20}N_4$—

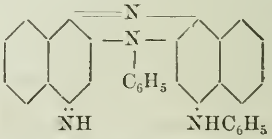


and hence is anilido-α-β-isorosinduline, which forms shining bronzy crystals. It dissolves in concentrated sulphuric acid with a yellowish-brown colour, which on dilution passes through green to violet. It forms the salts $C_{28}H_{20}N_4.2HCl$ and $C_{28}H_{20}N_4.H_2PtCl_6$. Anilido-phenyl-α-β-isorosinduline is obtained by substituting *p*-nitrosodiphenylamine for the nitrosoaniline employed above. It gives the salts $C_{34}H_{23}N_4HCl$ and $(C_{34}H_{23}N_4HCl)_2PtCl_4$, and on heating with hydrochloric and acetic acids to 180° decomposes, yielding aniline and Nt_2-7-hydroxyisorosindone, $C_{22}H_{14}N_2O_2$. From nitrosodimethylaniline and 2·7-diphenylnaphthylene diamine an induline, $C_{20}H_{24}N_4O$, is produced, which has the character of an ammonium base. Its hydrochloride, $C_{30}H_{25}N_4Cl_2$, crystallises from alcohol and is moderately soluble in water.

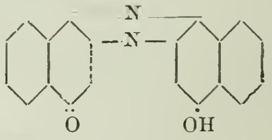
IV. *Naphthindulines.*—Some of the derivatives of this class of indulines which contain the symmetrical α-β-naphthazine ring have already been described, but are now re-named according to the scheme referred to at the commencement of the paper. Thus, isonaphthylrosinduline, obtained from α-amido-azo-naphthalene hydrochloride and aniline, is now known as symmetrical α-β-phenylnaphthinduline, whilst its anilide, a by-product of the phenylrosinduline melt from benzene-azo-α-naphthylamine, is now called α-β-phenyl-Nt_2.4.anilidonaphthinduline, or, for brevity, naphthyl-blue, as the sulphonic acids of this product are in commerce, under this name. Both these naphthindulines are obtained, together with α-β-Nt_2.4.anilidonaphthinduline, which is known as naphthyl-violet, by heating a mixture of benzene-azo-α-naphthylamine hydrochloride, α-naphthylamine hydrochloride, and aniline. If the quantity of α-naphthylamine hydrochloride be reduced, in addition to the above-mentioned indulines, a fourth substance is obtained, symmetrical α-β-naphthinduline, which forms black needles, melting at 248°—250°, and decomposing, on heating with hydrochloric and acetic acids to 200°, into naphthindone, melting at 295°, a substance which was previously known as naphthorosindone (Annalen, **256**, 249; **262**, 242). This indone, on distillation with zinc-dust, gives symmetrical α-β-naphthazine, melting at 243°, and characterised by the blue fluorescence of its alcoholic solution, which is turned green by acetic acid. The authors have further investigated the conditions for the formation of naphthyl-violet and naphthyl-blue. By heating nitroso-β-naphthylamine, α-naphthylamine, and aniline quickly to 100°, naphthyl-blue is the chief product, together with a little naphthyl-violet and also two by-products. On heating with a mixture of hydrochloric and acetic acids, both naphthyl-blue and naphthyl-violet yield the same Nt_2.4.hydroxynaphthindone, $C_{26}H_{16}N_2O_2$.



Naphthyl-blue.
Nt_2.4.Anilidophenylnaphthinduline.

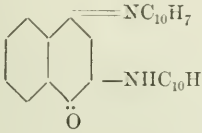


Naphthyl-violet.

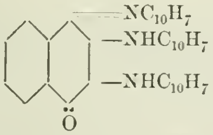


Nt_2.4.Hydroxynaphthindone.

This decomposition product (Annalen, **262**, 239) forms rectangular plates, melting at about 300°. By heating naphthyl-violet with acetic acid only, the imido group alone is substituted by oxygen, forming an anilidonaphthindone. On treating naphthyl-blue in this way the same compound is formed, aniline being split off. In addition to the method given above, naphthyl-blue is also formed when benzene-azo-phenyl-α-naphthylamine hydrochloride is condensed by heating it with phenol to 120°—150°. This method of formation leads to conclusions as to the probable course of the reaction in obtaining naphthyl-violet and blue, naphthinduline and phenylnaphthinduline being formed as intermediate products. The presence of rosinduline and of phenylrosinduline in the melt is explained by the interaction of intermediate quinone imides with aniline. The following derivatives of hydroxy-α-β-naphthindone are described :—Acetyl derivative, $C_{28}H_{18}N_2O_3$, red needles, melting at 290—295° ; benzoyl derivative, $C_{33}H_{22}N_2O_3$, reddish-brown needles ; ethyl ether, red crystals, melting above 340° ; methyl ether, melting above 300° ; bromo derivative, $C_{26}H_{13}N_2O_2Br_3$, reddish metallic plates. The by-products of the naphthyl-blue melt referred to above consist of phenylrosinduline and anilidonaphthoquinonedianil. The latter, when crystallised from benzene-petroleum ether, melts at 159°, but separates from alcohol with $\frac{1}{2}C_2H_6O$, and then melts at 143°. By further continuing their investigation as to the formation of naphthyl-blue, the authors found, by heating α-naphthylamine hydrochloride and aniline to 90°—100°, and then slowly adding nitroso-β-naphthylamine, that little violet is formed, and no blue, but that anilidonaphthazine, $C_{26}H_{17}N_3$, crystallising in yellowish-brown needles melting at 280°, is obtained, together with a not inconsiderable amount of sal ammoniac. The anilidonaphthazine, on heating with hydrochloric and acetic acids to 200°, yields hydroxynaphthazine, $C_{20}H_{12}N_2O$, which, on distillation with zinc-dust, gives symmetrical naphthazine, melting at 243°. If in the above melt, α-naphthylamine be substituted for the aniline, and the three substances be heated in an alcoholic solution, a symmetrical α-β-naphthazine, melting at 283°, is obtained. Naphthyl-violet and naphthyl-blue are formed if α-nitroso-β-naphthol and α-naphthylamine are heated in a solution of aniline but if these components are boiled in an alcoholic solution, scarcely any naphthindulines are obtained. Under these conditions the chief product formed is naphthalidonaphthoquinonenaphthalide—



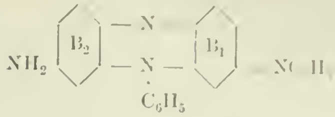
which crystallises in dark brown needles or plates, melting at 237°. A second product, which separates from the mother-liquors on concentration in the above melt, is a substance crystallising in brownish-red needles, melting at 212°. It is probably dinaphthalidonaphthoquinonenaphthalide—



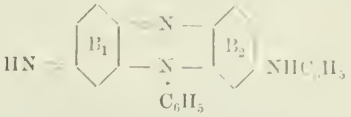
This compound dissolves in concentrated sulphuric acid with a blue colour, which on dilution turns violet and then dirty red.—T. A. L.

Constitution of Mauveïnes. O. Fischer and E. Hepp. Ber. 1893, **26**, 1194—1196.

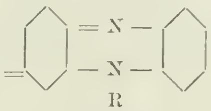
In the year 1888 the authors obtained phenomauveïne (Perkin's pseudomauveïne) by the action of nitrosodiphenylamine on aniline hydrochloride, together with a soluble induline, which now turns out to be likewise identical with phenomauveïne. The base, $C_{24}H_{18}N_4$, separates from benzene in small crystals, having a bronzy lustre, and melts at 246°. It is thus, like the induline bases, anhydrous, but corresponds in its properties to the safrinines. The mauveïnes are generally classed with the safrinine group of dyes, and phenomauveïne is usually regarded as phenylphenosafrinine. This is, however, incorrect, as hydrated mauveïnes are unknown ; these bases seem only to exist in the anhydrous induline (paraquinonoïd) form, whereas the phenylsafrinines are, according to Witt and Nietzki, to be regarded as ammonium bases. $B_2$4-anilidoinduline (see preceding abstract)—



or



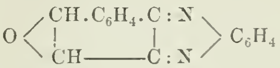
is also identical with phenomauveïne. Of the above two formulæ, which are probably tautomeric, the second is the more probable, as an amido-group cannot be recognised in the indulines. The indazine obtained from nitrosodimethylaniline and diphenyl-*m*-phenylenediamine (*loc. cit.*) is the corresponding dimethylphenomauveïne. The difference between the colouring matters hitherto known as indulines and the mauveïnes is that the former are asymmetrical and the latter symmetrical derivatives. Both contain the nucleus—



The great similarity of the mauveïnes with the safrinines indicates that the amido groups are symmetrically distributed in the latter ; the synthesis of phenosafrinine and mauveïne from nitrosoaniline or nitrosodiphenylamine stands in harmony with this view. Körner and Schraube's work (Chem. Zeit. 1893 [13]) has refuted the hitherto accepted view as to the asymmetry of the amido groups in the safrinines. Respecting the constitution of the safrinine bases, they are soluble in water, and when dried in a vacuum still contain oxygen ; moreover, these bases are more or less unstable and resemble the so-called quinoline ammonium bases. When extracted with ether, benzene, or other neutral solvents—methylal is specially suitable for the preparation of safranine bases—and dried in a vacuum at the ordinary temperature, they contain more carbon than the ammonium base. The authors hope to succeed in preparing the induline form (free from oxygen) of these bases.—A. R. L.

Azines and Eurhodoles obtained from Dihydroxydiketotetrahydronaphthalene. T. Zincke. Ber. **26**, 1893, 613—623.

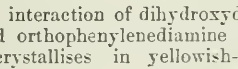
Naphthaphenazine oxide—



$$O\left\langle\begin{array}{l} CH.C_6H_4.C:N \\ \mid \qquad\qquad\quad \mid \\ CH\text{———}C:N \end{array}\right\rangle C_6H_4$$

is formed by the interaction of dihydroxydiketotetrahydronaphthalene and orthophenylenediamine in hot alcoholic solution. It crystallises in yellowish-white spherical aggregates of small needles, and melts at 186°—187° with previous softening.

β-*Hydroxynaphthaphenazine* or β-*naphtheurhodole*—



$$\left.\begin{array}{l} CH.C_6H_4.C:N \\ \qquad\qquad\quad\ \mid \\ C(OH)-C:N \end{array}\right\rangle C_6H_4$$

is prepared by heating naphthaphenazine oxide with alcoholic hydrochloric acid, diluting the solution with water, and adding ammonia until feebly alkaline. It crystallises in intensely yellow slender needles, melts at 197°—198°, and possesses both acid and basic properties.
—A. K. M.

Substantive Cotton Dyes from Diamidophenanthraquinone. S. Litthauer. Ber. 26, 1893, 848—851.

It is known that there are certain exceptions to the rule that meta-substituted derivatives of benzidine yield azo-dyes which possess little or no affinity for cotton, and a consideration of these exceptions has shown that in all cases the meta-substituting groups form a ring. The view that the property of directly dyeing cotton which such dyes possess is due to this ring-formation is further confirmed by the formation of substantive tetrazo-dyes from diamidophenanthraquinone.

For these dye-tests, the soluble dyes obtained by the combination of the sulphonic acids of α-naphthylamine and β-naphthol with diazotised diamidophenanthraquinone were employed, and for analytical purposes the following insoluble dyes were prepared, *phenanthraquinonedisazoresorcinol, phenanthraquinonedisazo-β-naphthol, phenanthraquinonedisazo-α-naphthol,* and *phenanthraquinonedisazo-β-naphthylamine.*—A. K. M.

Native Dyes in India. Mr. Thurston. Calcutta Englishman, May 23, 1893.

Regret is constantly being expressed at the gradual disappearance from Indian workmanship of permanent vegetable dyes in favour of "the cheap and fugitive productions of modern science." Mr. Thurston gives an account of *kamala* dye, which produces a gorgeous flame colour of varying shade, according to the process employed. The work is illustrated by pieces of dyed silk, which are pasted into the book and give an excellent idea of the rich colours to be obtained from *kamala.* The dye itself is merely the powder which coats the berries of the *Mallotus philippinensis* tree, which grows wild in many parts of India. The powder is brushed off into baskets made for the purpose, and requires no further preparation; but the method of collection is very wasteful, as the trees are often felled in order to facilitate the gathering of the berries, and confidence is destroyed by the frequent adulteration of the article. The red powder requires to be mixed with alkali, which in Bengal is obtained by burning plants, after which it is allowed to stand in water, which extracts the colour. The silk to be dyed has only to be soaked in the mixture to make it take up the colour, which is afterwards fixed with alum.

Constituents of the Indian Dyestuff Kamala. A. G. Perkin. J. Chem. Soc. Trans. 1893, 63, 975—990.

Besides the five substances described below, kamala contains a minute amount of essential oil or similar substance, which imparts to it a peculiar odour when warmed, but from which it can be readily freed by distillation with steam. In order to isolate the constituents the dye was first extracted with carbon bisulphide.

Rottlerin, $C_{11}H_{10}O_3$, the principal constituent, is obtained by concentrating the carbon bisulphide solution in the form of salmon-coloured plates melting at 191°—191·5°. When heated with caustic potash at 150° it yields benzoic acid and an amorphous substance; the same products are formed together with benzaldehyde when it is oxidised by alkaline hydrogen peroxide. Oxalic acid and other products are obtained by the action of nitric acid. *Diacetylrottlerin,* $C_{11}H_8O_3(C_2H_3O)_2$, melts at 130°—135°.

The *resin of low melting point* (below 100°), $C_{12}H_{12}O_3$, is apparently closely related to rottlerin; it betrays no signs of the presence of methyl groups when tested in Zeisel's apparatus, and when boiled with dilute alkali the odour of benzaldehyde is noticeable.

The *yellow crystalline colouring matter* obtained in the first extractions of kamala with carbon bisulphide is closely allied to rottlerin; it melts at 192°—193°.

The *wax* present in kamala gave numbers on analysis agreeing with the formula $C_{28}H_{54}O_2$; Anderson assigned to it the formula $C_{20}H_{34}O_4$, and it is therefore probable that its nature may vary according to the locality from which the kamala is procured. It is a crystalline mass melting at 82°, the melting point of cetyl cerotinate, with which it may be identical, the two substances having many properties in common.

Isorottlerin crystallises in minute plates and melts at 198°—199°; it differs from rottlerin in being insoluble in carbon bisulphide.

The *resin of high melting point* (about 150°) is a yellow amorphous substance of the formula $C_{13}H_{12}O_4$, closely allied to rottlerin in many of its properties.

Kamala contains a cupric reducing sugar in small small amount, but all attempts to obtain it in a state of purity were unsuccessful.—A. R. L.

PATENTS.

Improvements in the Manufacture of Alpha-naphthol and of Alpha-naphthol-sulphonic Acids from the corresponding Amido Compounds. C. D. Abel, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 14,301, August 8, 1892.

Commercial α-naphthol contains about 10 to 15 per cent. of β-naphthol, as the naphthalene α-sulphonic acid cannot be obtained free from the β-isomeride. According to the present invention pure α-naphthol can be obtained by heating the salts of α-naphthylamine with water to a high temperature. In a similar manner sulphonic acids of α-naphthylamine can be converted into the corresponding α-naphthol sulphonic acids. For the preparation of α-naphthol, α-naphthylamine sulphate is mixed with five times its weight of water and heated in an autoclave to 200° C. for 1 to 4 hours. The α-naphthol deposits as a solid cake and may be purified by distillation. Instead of employing the sulphate, the hydrochloride may be used, the temperature being 170°—220° C. As an example of the formation of an α-naphthol sulphonic acid, 10 kilos. of 1·8-α-naphthylamine-sulphonic acid S of Ger. Pat. 40,571 are heated with 40 litres of water for 5 to 8 hours at 180°—220°. After cooling and filtering, the 1·8-α-naphthol-sulphonic acid is precipitated by means of salt or obtained by evaporation. Di- and tri-sulphonic acids of α-naphthol may be obtained in a similar manner from the corresponding di- and tri-sulphonic acids of α-naphthylamine.

—T. A. L.

New Blue and Bluish-green Colouring Matters and the Process for their Manufacture. Brooke, Simpson, and Spiller, Lim., and A. G. Green, London. Eng. Pat. 14,398, August 9, 1892.

The starting point for these new colouring matters is benzyl-*o*-toluidine obtained by the action of benzyl chloride on *o*-toluidine in presence of caustic soda. This substance, which does not appear to have been hitherto described, is a white crystalline solid melting at 60° C. and boiling under atmospheric pressure at 313° C. On condensation with benzaldehyde it forms dibenzyl-diamido-ditolyl-phenylmethane, and the sulphonic acids of the corresponding carbinol yield blue to bluish-green colouring matters for wool and silk. The dyestuffs can be obtained in various ways, such as sulphonation of the methane derivative above mentioned and subsequent oxidation; or the order of these operations may be reversed; or else benzyl-*o*-toluidine is converted into its monosulphonic acid and this condensed with benzaldehyde and the resulting leuco-sulphonic acid then oxidised. In order to obtain higher sulphonation products this leuco-sulphonic acid may be further sulphonated and then oxidised or the finished colouring matter may be treated with sulphonating agents. The following examples give the quantities for carrying out this invention:—

(1.) A mixture of 10·5 lb. of benzaldehyde, 39·5 lb. of benzyl-*o*-toluidine, and 10 lb. of concentrated sulphuric acid are heated to 100—120° C. for three to four hours. The product, after washing and basifying with caustic soda is dried, ground, and dissolved in 100 lb. of concentrated sulphuric acid and sulphonated by gradually adding fuming sulphuric acid containing 70 per cent. of SO_3 until the melt is soluble in warm water. After pouring into water, the excess of sulphuric acid is removed by lime, the calcium salt converted into the sodium salt, and the solution of this oxidised by adding 24 lb. of finely-divided lead peroxide and 12 lb. of sulphuric acid in the cold. After filtering from lead sulphate the solution of the colouring matter is evaporated to dryness. It dyes wool and silk bluish-green from an acid-bath.

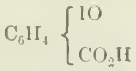
(2.) About 39·5 lb. of benzyl-*o*-toluidine are dissolved in 80 lb. of concentrated sulphuric acid and carefully sulphonated by the addition of fuming sulphuric acid at 40—50 C. until a drop dissolves in alkalis. The melt is then poured into water, when the sulphonic acid crystallises out on standing. A mixture of 47·5 lb. of this acid and 10·5 lb. of benzaldehyde in 50 gallons of water is boiled for several hours under an inverted condenser. The leuco-sulphonic acid separates out on cooling. It is dissolved in 200 gallons of water together with sufficient sodium carbonate to make a slightly alkaline solution and is then oxidised by adding 10 lb. of potassium bichromate and sulphuric acid until acid under constant agitation until the formation of the colouring matter is complete. It separates as a bronzy precipitate and is purified by dissolving in sodium carbonate, filtering, and precipitating by salt. In place of the sulphuric acid used in the first example as a condensing agent other substances, such as zinc chloride, hydrochloric acid, or oxalic acid, may be employed and other oxidising agents than lead peroxide and potassium bichromate may also be used.—T. A. L.

The Manufacture or Production of New Colouring Matters. H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 14,478, August 10, 1892.

This is an extension of Eng. Pat. 3397 of 1890, Eng. Pat. 13,443 of 1890 (this Journal, 1891, 760), and Eng. Pat. 5984 of 1891 (this Journal, 1892, 345), in which are described the products obtained by combining various diazo and tetrazo compounds, with the mono- and di-sulphonic acids of 1·8-dihydroxynaphthalene. Colouring matters isomeric but not identical with these are obtained by combining various diazo compounds with 1·8-dihydroxy-naphthalene, and subsequently sulphonating these azo compounds. By sulphonating to the right extent, products are obtained which are said to be fast to alkalis. The most valuable colouring matters are obtained by sulphonating the azo-compounds from 1·8-dihydroxynaphthalene and diazotised aniline, *m*- or *p*-amido-benzene sulphonic acid. The solution of diazo benzene chloride from 13 kilos. of aniline hydrochloride and 7 kilos. of sodium nitrite is added to a mixture of 16 kilos. of 1·8-dihydroxynaphthalene and 30 kilos. of sodium acetate in a large quantity of water and some acetic acid. After several hours the combination is complete, and the dyestuff is filtered off, washed, pressed, and dried. After having been finely sifted it is added to 5 to 10 times its weight of sulphuric acid monohydrate and heated to 40°—50° C. until a sample dissolves easily in water with a magenta-red colour which is not turned yellow by alkalis. The melt is then poured into water, when the non-sulphonated portion precipitates and can be filtered off whilst the sulphonated dyestuff is salted out, filter-pressed, and dried. It dyes unmordanted wool magenta-red from an acid-bath, and wool mordanted with chromium salts a violet-black. The colouring matter from *m*-amidobenzene sulphonic acid produces a yellowish-red shade on unmordanted wool, whilst that from sulphanilic acid gives a bluish-red shade, the shades on wool mordanted with chromium salts being in both cases violet-black.—T. A. L.

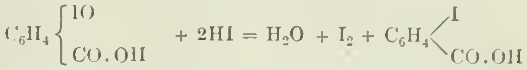
Improvement in the Production of a New Iodo-oxygen Derivative of Benzoic Acid. O. Imray, London. From the Farbwerke, vormals Meister, Lucius, and Brüning, Höchst-on-Maine, Germany. Eng. Pat. 14,715, August 15, 1892.

Ortho-iodo-benzoic acid is dissolved in fuming nitric acid, the solution boiled, and diluted after cooling, "Iodosobenzoic acid"—



$$C_6H_4 \left\{ \begin{array}{l} IO \\ CO_2H \end{array} \right.$$

separates out as small, slightly yellow leaflets. It is with difficulty soluble in water, and melts with decomposition at 209° C. When heated with acidulated potassium iodide solution the following reaction takes place :—



$$C_6H_4 \left\{ \begin{array}{l} IO \\ CO.OH \end{array} \right. + 2HI = H_2O + I_2 + C_6H_4 \begin{array}{l} \diagup I \\ \diagdown CO.OH \end{array}$$

—J. G. W.

Improvements in the Production of Alpha-nitro-alpha-amido and Alpha-quinoline-compounds of Alizarin and the Anthra- and Flavo-purpurines. O. Imray, London. From "The Farbwerke, vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 14,717, August 15, 1892.

The nitro compounds alluded to are obtained by nitrating the di- or tri-benzoyl compounds of the alizarins and anthra- and flavo-purpurins, and, after saponification and reduction, converting the amido products into quinolines by heating them with glycerol, sulphuric acid, and nitrobenzene. Alpha-nitro-alizarin is obtained by mixing 6 kilos. of dibenzoylalizarin with 11 kilos. of nitric acid of 43° B., and 16 kilos. of sulphuric acid of 66° B., the temperature being kept below 45°. The mixture is then agitated at 20°—25° until a sample dissolved in alcohol no longer shows an alizarin spectrum. The melt is then poured into iced water, filtered off, and washed till neutral. In order to isolate the free nitro compound the product thus obtained, dibenzoyl-α-nitro-alizarin, is dissolved in hot soda-lye, precipitated by an acid, filtered, and the benzoic acid removed by washing. On reduction, preferably by hot alkaline reducing agents such as stannous chloride, sodium sulphide, or glucose, the nitro compound is converted into the corresponding amido compound, which gives a yellow hydrochloride nearly insoluble in concentrated hydrochloric acid and decomposed by water. This amido compound is converted into the quinoline by dissolving 1 kilo. in 7—8 kilos. of sulphuric acid of 66° B. and mixed with 0·5 kilo. of glycerol and 0·5 kilo. of nitrobenzene. The mixture is heated to 110° C., kept at this temperature for three hours, and poured into water. The crude product after filtration is purified by dissolving it in hot dilute sulphuric acid and precipitating by adding water. The alizarin-α-quinoline so obtained is nearly insoluble in water, and forms blue salts with small quantities and green salts with large quantities of soda or potash lye. The ammonia salt is blue and the compounds with acids which are deep red are decomposed by water. The quinoline compounds of the anthra- and flavo-purpurins are obtained in a similar manner. These quinolines, which are all sparingly soluble in water, yield easily-soluble compounds with sodium bisulphite, and the products thus obtained can be used in paste or powder for dyeing and printing, and are decomposed into their components by boiling with water, or more easily by adding acids or alkalis.—T. A. L.

The Manufacture or Production of New Colouring Matters. H. E. Newton, London. From "The Farbenfabriken, vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 14,927, August 18, 1892.

This is an extension of Eng. Pat. 8229 of 1889 (this Journal, 1890, 608), Eng. Pat. 18,517 of 1889 (this Journal, 1890, 1032), and Eng. Pat. 5984 of 1891 (this Journal, 1892, 345). The colouring matters produced are azo dyestuffs containing either carboxyl or hydroxyl groups, or both, and are chiefly of value as they are capable of forming lakes with mordants. For the production of these dyestuffs the diazo compounds of the following amido-carboxyl acids are employed: *o*-, *m*-, and *p*-amido-benzoic acid, *o*- and *p*-amido-salicylic acid, amido-*p*-hydroxy-benzoic acid, amido-phthalic acid, amidosulphobenzoic acid, amidosulphosalicylic acid, amidosulpho-*p*-hydroxybenzoic acid, and amidosulphocresol carboxylic acid. These are combined with various hydroxy- or carboxy-compounds, such, for instance, as phenol, resorcinol, salicylic acid, α- and β-naphthol, and certain of their amido, hydroxyl, carboxyl, and sulphonic derivatives, and also with *m*-phenylene and *m*-tolylene diamine. One instance may be given of the method employed. A slightly acid solution containing 18·5 kilos. of the diazochloride from *m*-amido-benzoic acid is allowed to run into an aqueous solution of 22·4 kilos. of β-naphthol-δ-sulphonic acid and 10·6 kilos. of sodium carbonate at about 0° C. After about 12 hours, hydrochloric acid is added, the dyestuff salted out, filtered off, and washed with brine till free from acid. It gives yellowish-red shades when dyed or printed on wool mordanted with chromium salts. The quantities given for a printing paste are 62 kilos. of acetic starch tragacanth thickening, 30 kilos. of a 10 per cent. paste of the dyestuff, and 8 kilos. of chromium acetate of 20° B.—T. A. L.

Production of New Dyestuffs derived from Amidonaphthol-sulphonic Acids. G. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 14,993, August 19, 1892.

An extension of Eng. Pat. 16,699 of 1889, Eng. Pat. 19,330 of 1890, and Eng. Pat. 1742 of 1891 (this Journal, 1890, 935; 1891, 917 and 918), describing diazo dyestuffs obtained from *p*-phenylene diamine by diazotisation and combination with the various amidonaphtholsulphonic acids described in the previous specifications. The reaction is carried out by diazotising acetyl-*p*-phenylene diamine and combining it with one molecule of α-naphthylamine, β-ethoxy-α-naphthylamine, or amidonaphtholsulphonic acid, saponifying the product, diazotising with two molecules of sodium nitrite, and combining in an alkaline solution with γ-amidonaphtholsulphonic acid. The resulting compound dyes unmordanted cotton a deep black. In Eng. Pat. 7067 of 1889 (this Journal, 1890, 385) it was shown that in most of the secondary azo compounds obtained from α-naphthylamine that the latter may be replaced by the 1·2-α-amidonaphthol ether, and this substance can also be used for the preparation of secondary diamine blacks. The γ-amidonaphtholsulphonic acid may be replaced by the mono- or di-sulphonic acids of 1·8-amido-naphthol, and all the colouring matters obtained from any of these acids may be further diazotised and combined on the fibre.—T. A. L.

Manufacture of New Colouring Matters. C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 16,569, September 16, 1892.

The colouring matters are obtained by combining the tetrazo compounds of tolidine or dianisidine with the 1·8-amido-naphthol sulphonic acid obtained by fusing with an alkali the α-naphthylamine disulphonic acid of Ger. Pat. 40,571. The process may be varied by using one molecule of the tetrazo compound and combining it with two molecules of the 1·8-amidonaphthol sulphonic acid, or else by employing only one molecule of the acid and combining the intermediate compound thus obtained with one molecule of an amine, a diamine, phenol, amidophenol, or their sulphonic or carboxylic acids. The colouring matters are said to dye unmordanted cotton blue from an alkaline or a neutral bath, the shades from dianisidine being rather greener than those from tolidine.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From K. Oehler, Offenbach-on-the-Maine, Germany. Eng. Pat. 17,546, October 1, 1892.

Brown and orange dyestuffs for cotton are obtained by combining the tetrazo compound from one molecular proportion of tolylenediamine sulphonic acid—

$$[1.2.4.6]C_6H_2.CH_3.NH_2.SO_3H.NH_2$$

with one molecular proportion of *m*-phenylenediamine, or with two molecular proportions of β-naphthylamine.
—T. A. L.

Manufacture of Polyazo Colouring Matters, derived from Dioxydiphenylmethan and Condensation Products of Formic Aldehyde with Benzidine, Tolidine, or Dianisidine. C. D. Abel, London. From L. Durand, Huguenin, and Co., Bâle, Switzerland. Eng. Pat. 8511, April 27, 1893.

According to Eng. Pat. 9360 of 1892 (this Journal 1892, 809), condensation products are obtained by acting with formaldehyde on benzidine, tolidine, or dianisidine, and these compounds, after convertion into their tetrazo derivatives, combine with one molecule of a naphthylamine sulphonic acid, or a hydroxybenzoic acid to form an insoluble intermediate compound, which, as it still contains a free diazo group, can be further combined, and two molecules of such intermediate compounds, either the same or different, will combine with one molecule of dihydroxydiphenylmethane to form the so-called polyazo colouring matters of the present specification. A solution containing 21·8 kilos. of the condensation product of tolidine and formaldehyde is diazotised by means of 40 kilos. of hydrochloric acid (21° B.) and 7 kilos. of sodium nitrite, and poured into 300 litres of water, containing 7·5 kilos. of salicylic acid and 60 kilos. of 30 per cent. caustic soda. The intermediate compound, which forms in about 2—3 hours, is a deep brown precipitate, which is added to a solution of 5 kilos. of dihydroxydiphenylmethane and 5 kilos. of caustic soda in 200 litres of water. The colouring matter separates as a reddish brown precipitate, and is filter-pressed and dried. It dyes unmordanted cotton yellow and dissolves in sulphuric acid with a reddish-violet colour, and is partially decomposed by heating with soda lye with evolution of formaldehyde. The intermediate compound obtained as above is added to 10 kilos. of dihydroxydiphenylmethane and 10 kilos. of caustic soda in 400 litres of water, and after some time there is added the diazo solution from 4·6 kilos. of aniline, 15 kilos. of hydrochloric acid, and 3·5 kilos. of sodium nitrite. The mixture becomes lemon-yellow when the triazo colouring matter is formed. This is scarcely soluble in hot water and is used preferably as a paste, and dyes unmordanted cotton yellow.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Manufacture of Pyroxylin. W. D. Field. J. Amer. Chem. Soc. 1893, 15, 140.

See under XXI., *page* 708.

PATENTS.

The Manufacture of an Improved Composition for Waterproofing and other Purposes. W. Baker, Downham Market. Eng. Pat. 22,175, December 3, 1892.

See under IX., *page* 692.

Improvements in Steam Vulcanising Woollen Waterproof Fabrics for Garments. S. Wiener, Salford. Eng. Pat. 14,012, August 3, 1893.

This invention refers to the vulcanising of woollen waterproof fabrics with steam, in which process the cloth is liable to be affected by the steam. In order to prevent this, the cloth is inserted into a smaller cylinder or drum provided with an air-valve, and this cylinder is placed in the steam vulcanising chamber, where it is subjected to and vulcanised by the heat of the steam without the latter having access to it.—C. O. W.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

Decomposition of Alkaline Aluminates by Carbonic Acid. M. A. Ditte. Compte. rend **116**, 386—388.

When potassium carbonate is added drop by drop to a solution of an alkaline aluminate a cloudiness is produced, which at first disappears on shaking. As more potassium carbonate is added, a permanent precipitate is formed. The carbonate decomposes the aluminate, and an unstable aluminium carbonate results, which unites with potassium carbonate to form a double carbonate, represented (when potassium aluminate is used) by the formula—

$$5CO_2,\ 3K_2O,\ 2Al_2O_3$$

Potassium hydroxide is produced at the same time, and this is capable of decomposing the double salt, thus bringing about an inverse reaction whereby potassium carbonate and aluminate are regenerated.

If the aluminate, containing a slight excess of alkali, be subjected to the slow action of carbon dioxide, the free alkali present prevents precipitation of the double carbonate. After a short time the aluminate is decomposed by water and crystals of hydrated alumina, $Al_2O_3.3H_2O$ separate out.

If a *current* of carbon dioxide is passed through an aluminate solution containing a slight excess of alkali, after some time a deposit of the double carbonate mixed with hydrated alumina is formed. On stopping the current, shaking the vessel, and allowing to stand for some hours, the double carbonate is decomposed, and only the alumina crystals remain undissolved.

When there is present a *considerable* excess of alkali, only the double carbonate is precipitated, the large excess of caustic alkali preventing the formation of the alumina crystals.

The same result is obtained if potassium carbonate is first added until the precipitate just becomes permanent, and then CO_2 is passed through for some time. But if the amount of CO_2 is insufficient, the crystals also come down.

It appears then that the result of passing CO_2 into solutions of alkaline aluminates containing excess of alkali depends on the amount of this excess, the alumina crystals being formed when the amount of alkali is small, while on increasing the alkali a deposit of the double carbonate of aluminium and potassium is obtained.—R. B. B.

Dyeing Sand with Azo-Colouring Matters. R. Möhlau. Zeits. ang. Chem. 1893, 255.

For experimental purposes in hydraulic engineering it was desirable to employ sand of various colours, which colours should resist the action of water and friction fairly well. All attempts to precipitate inorganic colours, such as Prussian blue, chrome yellow, &c. in the pores (fissures) of the quarz-particles failed, probably owing to the extreme fineness of the pores. It was found, however, that the naphthol-azo-colours, which were insoluble in water, could be fixed satisfactorily on quarz. The sand was dyed for example a red-orange with benzene-azo-β-naphthol in the following way:—1 kilo. of finely-powdered β-naphthol was dissolved with rather more than its equivalent of caustic soda in 25 litres of water. 100 kilos. of sand were slowly stirred into this solution, followed by the requisite quantity of diazo-benzene chloride.—K. E. M.

PATENTS.

Improvements in Machines for Printing Fabrics. W. Pickup and W. Knowles, Pendleton. Eng. Pat. 8908, May 11, 1892.

This invention relates to machines for printing scarves, shawls, &c. with an intermittent roller. One end of the printing roller is keyed to a bush having a shoulder or flange, and upon this bush is arranged to rotate loosely, or with it through frictional contact, as may be required, a spur-wheel in gear with a driving wheel. The shoulder or flange end of this wheel bush is furnished with an adjustable projection or finger, adapted to be operated upon by another adjustable projection or finger, carried by a bracket fixed to the frame of the machine. When the printing roller is not in operation the spur-wheel runs loose in its bush, and the finger of the latter is in contact with that on the bracket, whilst on the roller being raised the fingers become disengaged so as to allow the spur wheel to take with it the bush, and thus rotate the printing roller.

—W. E. K.

An Improved Process for the Purification of Tannin, Dye, and other Vegetable Extracts. J. B. F. E. Roy, Paris. Eng. Pat. 8604, April 28, 1893.

Heretofore the purification of tannin and dyeing extracts has been effected by precipitating a portion of the valuable material by a metallic oxide or some organic precipitant, it having been found that the objectionable impurities in a tannin or dyeing bath are always removed by the first stuffs which are tanned or dyed in the bath. The researches of the patentee convince him that the prejudicial impurities are not oxidation products "as generally supposed," but "are constituted solely by oxides of iron, manganese, and sometimes copper, engaged in a combination which is singularly stable for the medium in which they are found." The removal of such impurities is effected by precipitation with potassium or sodium ferrocyanide in the proportion of from 200 to 600 grms. to the hot extract resulting from 1 ton of spent wood.—A. G. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Twenty-Ninth Annual Report on Alkali, &c. Works by the Chief Inspector. Proceedings during the Year 1892, presented to the Local Government Board and to the Secretary for Scotland. 1893. 11*d.*

The number of works registered in England and Ireland was 910, and in Scotland (for which a separate report is presented) there were 137. These numbers differ but little from those of recent years. In the report for England and Ireland a table is given showing the number of alkali works and other works registered in each of the seven divisions into which the countries are divided for the purposes of inspection, and another table showing the number of separate processes of manufacture under inspection in these works; a third table shows the number of visits paid by inspectors and the number of tests made of escaping gases. The following table shows the average of all the tests throughout the year, a separate column being given to each district.

TABLE OF THE AVERAGE AMOUNT OF ACID GASES ESCAPING FOR EACH DISTRICT.

—	Dist. I. Ireland.	Dist. II. North of England.	Dist. III. Cheshire, N. Wales, and part of Lancashire.	Sub-Dist. Widnes.	Dist. IV. East Lancashire and Yorkshire.	Dist. V. South Midland.	Dist. VI. South-West of England and South Wales.	Dist. VII. South-East of England.	Average. 1892	1891.	1890.
Hydrochloric acid in chimney gases. Grains per cubic foot.	0·070	0·121	0·060	0·099	0·065	0·116	0·103	0·110	0·093	0·081	0·090
Hydrochloric acid. Amount escaping compared with that produced. Per cent.	0·830	2·710	1·440	1·900	1·590	3·380	1·260	2·385	1·937	2·182	1·950
Acid gases escaping from sulphuric acid chambers given as SO_3. Grains per cubic foot.	1·000	1·550	1·410	1·250	1·120	1·280	1·390	1·270	1·284	1·320	1·280
Acidity of chimneys given as SO_3. Grains per cubic foot.	0·950	0·837	0·780	0·680	0·510	0·640	0·960	0·790	0·768	0·700	0·700
Acidity of gases from manure works given as SO_3. Grains per cubic foot.	0·250	0·160	0·260	0·560	0·190	0·250	0·250	0·255	0·272	0·326	0·367

The limit fixed by the Alkali Act for the quantity of hydrochloric acid allowed to escape in the chimney smoke of alkali works is 0·2 grain per cubic foot; from the first column of the above table it may be seen that the actual amount found has been 0·093 grain. The second horizontal line of the table shows the amount of hydrochloric acid found to be escaping compared with the quantity of acid produced. The legal limit for this is 5 per cent. and the actual amount found is 1·937 per cent. The legal limit for the amount of acid allowed to escape from the chambers of sulphuric acid works is fixed at 4 grains of sulphuric anhydride per cubic foot, whilst the amount actually found to have escaped is equivalent to 1·284 grain of sulphuric anhydride. The fourth horizontal line states the amount of acid from all sources found in the smoke of the chimneys of alkali works, stated in terms of sulphuric anhydride. No legal limit has been fixed for this, but the amount has been reduced to 0·768 grain. In the fifth and last line the acidity of the gases discharged from chemical manure works is given, and it will be seen that it amounts to only 0·272 grain per cubic foot. Formerly the whole of the acid gases from these works escaped into the air.

Alkali Works.—The chief inspector referring to the union of the principal alkali manufacturers into one company says—"A wholesome competition has been established among the managers and the directors, having the detailed reports before them, have been able to make exact comparison between the different systems of management and working. All that was best in the practical details of manufacture, though found in practice possibly in one of the smaller works, has been adopted in all, and those which were proved on strict comparison to be wasteful, have been abandoned. Thus a system of selection has been carried on, which has operated more rapidly and by a less painful method than nature's process of the survival of the fittest."

The gradual decrease in the manufacture of soda by the Leblanc process which has been taking place for several years owing to the competition by the ammonia-soda process still continues. The amount produced by each process is shown in the following table:—

SALT DECOMPOSED IN THE LEBLANC AND AMMONIA-SODA PROCESSES (INCLUDING SCOTLAND).

—	1892.	1891.	1890.
	Tons.	Tons.	Tons.
Leblanc process	519,593	567,863	602,769
Ammonia-soda............	304,897	278,528	252,260
Total	824,490	846,391	855,029

The vitality of the Leblanc process depends chiefly on its important by-products bleaching powder and chlorate of potash. Two new works have been built to carry on this process, one at Irvine in Scotland and the other at Felling-on-Tyne. In the meantime continued efforts are made to produce chlorine in connection with the ammonia-soda process, and Messrs. Brunner, Mond, and Co., at Winnington, are now working a large bleaching powder plant, but it is too early to report as to its commercial success. The growth of the manufacture of soda by the ammonia-soda process will be further extended, as two large works have been started during the last year and are now in full operation, and another large work is in course of erection by the United Alkali Company, near Fleetwood.

Efforts are being made in another direction to modify the present Leblanc method of making soda, and an extensive plant has been erected at Bristol for carrying out a process suggested by Mr. Gossage, by which the carbonate of soda is produced from the sulphate without the intervention of lime. The sulphate is reduced by the aid of coal in an ordinary black ash revolver, and after lixiviation, the sodium sulphide liquors are acted on with carbonic acid from a limekiln. Bicarbonate of soda as in the ammonia-soda process is thus obtained, and all the sulphur is recovered as sulphuretted hydrogen, whilst by avoiding the use of lime there is no sulphurous tank waste formed.

The Nitric Acid Chlorine Process.—Two extensive works have been this year erected for carrying out the production of chlorine by the action of nitric acid on hydrochloric acid. The processes are similar but not identical, and it would be premature to speak decidedly on the result of this enterprise. One work is at Lostock Gralam, in Cheshire, and the other at Kilwinning, in Ayrshire.

Sulphate of Ammonia Works.—As has been pointed out in previous reports special interest attaches to the production of ammonia as it is only obtained as a by-product in other industries, and has not yet been produced commer-

AMOUNT OF SULPHATE OF AMMONIA PRODUCED IN THE UNITED KINGDOM.

—	1892.	1891.	1890.
Gas works..................	Tons. 110,748	Tons. 107,950	Tons. 102,138
Iron works	11,000	6,290	5,064
Shale works	23,105	26,600	24,730
Coke and carbonising works.	4,973	2,766	2,325
Total	149,826	143,606	134,257

cially by any direct process. The increase in the manufacture of sulphate of ammonia during the present year may be seen from the following table. The diminution in that made in shale works as compared with that made in former years is due to the slackness of the paraffin trade, caused by increasing importation of foreign oil.

The Alkali, &c. Works Regulation Act, 1892.—This Act was passed in the last Session of Parliament to amend the Act of 1881, and came into force on April 1st 1893. By its provisions a further group of 13 processes is brought under supervision. The chief inspector points out that it is very difficult to describe all the various processes of manufacture which give rise to certain noxious gases, and if at any time the list can be made complete the introduction of new processes soon renders it imperfect. For this reason it was found advisable to amend the Act of 1881. In his report to the Chief Secretary of Scotland he further remarks:—"It is much to be regretted that in accordance with past legislation it has been thought necessary in this way to name specially every process of manufacture to be included under the Alkali Act, on account of some noxious gas liable to be discharged from it. It would have seemed on many grounds preferable to have named the gases themselves, and not the processes which generate them, enacting that all the processes of manufacture from which such gases were discharged should come under inspection. The number of such noxious gases as would thus be named is only seven, while the number of processes which generate them is indefinite . . . ."

The full text of the new Act is given in the report. Besides bringing certain processes under the Alkali Acts it gives exemption to certain small salt works in Scotland and Ireland, where salt is refined from rock salt, and upon which the annual registration fee is felt to be a heavy tax. The first of the processes named in the schedule of the new Act is the recovery of sulphur from tank waste. The rapid adoption of Chance's method following its introduction in the year 1888 did not give time for manufacturers to observe and avoid each others mistakes, and at first much nuisance was felt near works owing to the escape of sulphuretted hydrogen. The points of danger are now well understood and carefully watched, and the presence of sulphuretted hydrogen is no longer perceived. The four processes next named in the schedule are for the production of barium and strontium compounds, antimony sulphide and bi-sulphide of carbon. In all these processes there is danger of the escape of sulphuretted hydrogen. The next on the list are Venetian red works. In such works the practice has been to allow the acid gases driven off by the roasting of sulphate of iron to pass freely away with the chimney gases, but in some cases they have been led to wash-towers where a large proportion of the acid dissolving in the water is condensed. At one work the gases pass into a sulphuric acid chamber and are thus utilised. It may be expected that now a much larger proportion of the acids discharged from Venetian red works will be kept from poluting the atmosphere. The works next mentioned in the schedule are those for the smelting of sulphate of lead deposited in the sulphuric acid chambers of alkali and other works. Frequently this sulphate of lead, still moist with sulphuric acid, has been thrown on to the bed of an open reverbatory furnace, the smoke from which passing into a low chimney has deluged the neighbourhood with acid gases. It is not too much to require that either by washing the sulphate of lead the free acid shall be removed before it is thrown into the furnace, or that by passing the gases through a wash-tower they shall be cleansed from acid before reaching the chimney.

Next in order are the arsenic works. These are of two kinds, those for the preparation of arsenious acid, and those in which arsenic acid is made by oxidising arsenious acid with nitric acid or a nitrate. About 5,000 tons of arsenious acid, the white arsenic of commerce, are manufactured yearly. It is obtained by roasting arsenical ores commonly containing also sulphur, iron, tin, and copper. A mineral of this kind called mundic is largely worked in Cornwall, and is roasted in reverberatory, revolving, or rotating furnaces. The arsenic and sulphur are oxidised and driven off as arsenious acid and sulphurous acid, and the arsenious acid, commercially called arsenic or white arsenic, is collected in the flues and settling chambers provided for the purpose. The sulphurous acid passes up the chimney. The arsenic thus collected is discoloured by the dust and smoke of the fire, and is called "arsenic soot." It contains about 90 per cent. of arsenic, and is purified by re-subliming in a refining furnace where only coke or anthracite is burnt. The vapour from this condenses in brick chambers and long flues. In some cases a wash-tower is added, but these are not general. The condensation in the chambers and flues is large, but never complete, and the remainder passes out by the chimney, and is dispersed over the adjoining land so as often to injure herbage and poison cattle that browse on it. This has frequently been a source of litigation for alleged damage. The proposal to include arsenic works under the Act has given general satisfaction. As some of the works had been voluntarily placed under inspection before the passing of the new Act, the chief inspector is able to give some figures illustrative of the present condition of the works, and the result of some of the attempts made to arrest the last traces of arsenic. The flues for collecting the arsenic are, in many of the works, very extensive; several are over 500 ft. in length, and in one work the length is 1,163 ft., and there are also chambers with a capacity of 16,000 cubic ft., whilst another work has chambers of 14,160 cubic ft. capacity. The following table gives the result of tests made in the chimneys of 12 of the works:—

Arsenious Acid in the Air of Chimney.	Arsenious Acid in the Air of Chimney.
Grains per Cubic Foot.	Grains per Cubic Foot.
1·50	0·10
0·22	0·11
0·40	7·40
0·10	0·50
3·00	1·45
0·11	0·10

The chief inspector adds that in the case of the chimney showing 7·40 grains of arsenious acid per cubic foot of air, the amount has been reduced recently to 0·20 grain by the erection of a condenser. Another table is given showing a great reduction of arsenic escaping by the chimney, at works where very long flues and large chambers, or condensers, filters, or washers, have been introduced.

Amount of Arsenious Acid found escaping where Condensers are employed.	Amount of Arsenious Acid found escaping where Condensers are employed.
Grains per Cubic Foot.	Grains per Cubic Foot.
0·025	0·050
0·015	0·020
0·020	0·035
0·590	0·040
0·015	0·085
0·035	Average... 0·073
0·050	
0·055	

The condensers that have as yet been tried are various forms of water-towers. The report points out that the use of water for this purpose is not very suitable, as its power to remove finely-divided solid matter is not great; and further, that it leads to a poisoning of the streams into which the water discharges. Fortunately a dry condenser is more effective and much cheaper than a wet one. The form of chamber that will probably be found to be most suitable will be a small one of about 6 to 10 ft. square by 10 ft. high, filled with common broom, furze, brushwood, straw, &c. This would rest on horizontal bars. As the smoke rises through the broom, &c. the arsenic would be caught and deposited upon it chiefly at the bottom of the stack. Besides the arsenic, however, a nuisance is caused in the roasting of mundic by the sulphurous acid that escapes by the chimneys. Some of the tests quoted in the report are very high, in one case as much as 7·92 grains of SO_3 per cubic foot of chimney gas. This, to a great extent, may be removed by means of a wash-tower. In the case of the work showing 7·9 grains of SO_3 per cubic foot, the introduction of a wash-tower has reduced the acidity to 2·98 grains.

Referring to the works in which arsenic acid is made by the oxidising action of nitric acid or nitrates, the cause of air-pollution in this case is not due to arsenical fumes, but to the escape of the mixed vapours of nitric and nitrous acids that are generated. These may be arrested by reconversion into nitric acid and collected for further use. To this end air with steam is admitted and the mixed gases caused to traverse columns packed with hard coke or pumice. Nitric acid of sp. gr. 1·310 is collected at the bottom. Clause 9 of the schedule refers to a similar use of nitric acid in the manufacture of salts of iron, and the same means may be taken to arrest the nitrous fumes.

Clause 10 of the schedule refers to various processes in which muriatic acid is produced otherwise than by the action of sulphuric acid upon the chlorides of potash or soda, and which therefore did not come within the scope of the Act of 1881. An important instance of this kind is the process of Turner, described in the report for 1891 (this Journal, 1892, 683), for the recovery of the muriatic acid from galvanisers' dippings. Clause 11 relates to works where muriatic acid gas is used for the separation of silk or woollen fibre from vegetable fibre. In these works, in order to separate cotton threads from woollen rags, the mixed articles are placed in chambers and there exposed for some hours to the action of dry hydrochloric acid gas. The cotton becomes carbonised whilst the wool remains unattacked. By beating and shaking the carbonised cotton dust is removed. The nuisance liable to arise in this process is the escape of hydrochloric acid on opening the chambers. The evil is easily combated by drawing the residual gases from the chambers through wash-towers.

Clause 12 of the schedule refers to works for the distillation of gas-tar, or where, for other purposes, it is highly heated; and the last clause of the schedule brings zinc works under the supervision of the Act. In the last-mentioned class of works nuisance is caused by the sulphurous acid thrown into the air in the roasting of blende, and by the escape of oxide of zinc as an impalpable powder, caused by the oxidation of an uncondensed portion of the metallic zinc vapours that escape into the air.

Dangerous or Injurious Trades.—In cases where occupations are known to be dangerous or injurious to the workers a provision is made in the Factory and Workshop Act 1891, whereby such occupations can be brought under its provisions. Accordingly, by a notice issued from the Home Office on the 27th December last, henceforth alkali and other chemical works will be under the provisions of that Act. Under it "special powers are given on behalf of the safety and comfort of the workpeople, extending to the fencing of machinery, the protecting of dangerous places, as tanks, furnaces, &c., and that which is the most difficult of all—the protecting of the workman against himself. In many factories it has been customary to provide respirators and special clothing for the men, but it is difficult to persuade them to use them."

The bleaching-powder packers prefer to use a home-made respirator consisting of several folds of damp flannel rather than any other that has been offered. "I have often spoken to the packers on their coming out of a chamber where they had been working. They complained only of temporary irritations such as passed off on breathing fresh air again, and rather boasted of the number of years during which they have been employed at the work." It is with difficulty that the salt-cake men when drawing the hot charge from the furnace and wheeling it away in an open barrow can be brought to prevent the escape of hydrochloric acid from the charge by sprinkling over it some cold salt-cake, and thus protect themselves from inhaling the gas.

The chief inspector points out that already much has been done under the inspection provided by the Alkali Act to protect the workers, and instances the removal of free chlorine from the bleach chambers before the packers enter them, and also the marked improvement brought about in chemical manure works, where in old time the mixture of sulphuric acid with ground mineral phosphate was made in open shallow tanks, and the men working at the mixture with long rakes were exposed to torrents of acid steam charged with fluorine compounds. This is now all changed. The mixing is done in closed boxes, the stirring is by machinery, and the gases are drawn away and passed to a wash-tower.

Next in the report follows a series of tables, which the chief inspector is able to give through the courtesy of the United Alkali Co., showing the number of operatives in the alkali works of Widnes, the number of men employed in the various departments, the number of hours of labour, the rates of wages paid, and the relative mortality; and, through the kindness of Mr. Alexander Chance, tables of the vital statistics of those employed in the works of the Oldbury Alkali Company. So far as these statistics go, they support the statements of those most familiar with alkali works,—that the health and longevity of the operatives in them compare favourably with those of the general population elsewhere.

Black Coal Smoke.—Although this source of air-pollution does not come within the scope of the Alkali Act, yet its effects are so constantly pressed upon the attention of the inspectors that they cannot ignore it. There are two factors of evil in the smoke, *firstly*, the sulphurous acid arising from the burning of the sulphur in the coal, and *secondly*, the black unburnt carbonaceous matter. No practical remedy has yet been devised for the former evil, but the second one may be more easily attacked. In the chief inspector's report for 1888 (this Journal, 1889, 664—667) an account was given of experiments undertaken in this cause, and tests of the smoke from 52 furnaces taken in different parts of the country where various kinds of coal were burnt, and in different forms of furnaces, were detailed. The analyses of the gases of combustion showed great differences in the proportions of air admitted, and in all cases, even when the smoke was blackest, there was an excess of air. The imperfect combustion therefore arose not from want of air, but from failure to use it properly. As has been often pointed out, there must be, firstly, a sufficient supply of air; secondly, that air must be brought in contact with the fuel, both solid and gaseous; and thirdly, the mixture of air and gases must be kept for a sufficient length of time at a temperature of incandescence in order to produce complete combustion. In hand-fed furnaces the supply of fuel is intermittent, whilst that of air is constant, and the due proportion between the two cannot be maintained. This points to the necessity of using mechanical stoking, and of late years such machines have been simplified and their general construction modified, so that they stand the wear and tear of constant use better than the first machines of the kind, and "it may with confidence be asserted that consumers of coal in almost all kinds of furnaces have it now in their power to conform with the requirements of the Public Health Act, and prevent the discharge of black smoke from their chimneys." An instance is quoted of a row of 50 large Lancashire boilers each with two furnaces, and an equal number of furnaces applied to other purposes, making in all 200 fires, the smoke from which was poured until recently in black clouds from four chimneys. The introduction of mechanical stokers has now rendered the smoke colourless and only fully burnt gases are sent into the air. As regards economy it is estimated that a saving of about 10 per cent. has been effected in the cost of the fuel used, probably not through the quantity of fuel consumed being lessened but through a cheaper kind of fuel being used efficiently in mechanical stoking. During the past year the chief inspector has devoted much time to a continuation of the smoke tests, applying them to some of the various systems of firing commonly met with. The results are given in a tabulated form. It is hoped that the publication of these analyses will induce coal consumers to undertake similar tests with a view to ascertain the conditions of their furnaces as regards due admission of air and the method of its application. Often such an analysis has pointed out defects, that when thus known were easily remedied.

Black Smoke from Salt Works.—This problem presents a difficulty from the fact that the deposition of the salt upon the bottoms of the pans interferes much with conduction of heat, and therefore a large hot fire cannot be maintained under the pans, as they would thereby be rapidly destroyed. But without a bright heat, the whole of the carbonaceous matter of the coal cannot be burnt. A plan of a furnace devised by Mr. William Blagg, of Winsford, is given, which is said to be very effective in diminishing the smoke. The furnace is so arranged that the gases from the fuel become mixed with heated air in a hot corner of the furnace.

Scotch Works.—A separate report for these works is made to the Chief Secretary for Scotland. Reference is again made in this report to the new Act of 1892, and a list of the works that will come under it is given. Of these the most important for Scotland are the tar distilling works. The tar as received from the gasworks usually carries with it a quantity of ammoniacal liquor, and therefore at the beginning of the distillation much sulphuretted hydrogen and sulphide of ammonium are given off, causing a nuisance. Throughout the process also, and especially at the end of it, uncondensable gases escape, which are a cause of nuisance to the neighbourhood. In some works means have been taken to prevent the escape of these noxious gases, and it may be expected that now other works will do the same. The chief inspector points out that already a difficulty in the interpretation of the Act has arisen. In clause 12 of the new schedule the words "gas tar" are used, meaning the tar produced by the distillation of coal in gasworks. Does this include tar produced in shale distillation works? This tar does not give off the noxious compounds of sulphur when distilled, but in some works it is usual to mix it with sulphuric acid to separate some of its basic ingredients, and after this treatment when distilled it gives off similar offensive compounds. Had the Act specified those processes in which sulphuretted hydrogen was generated instead of mentioning individually certain processes, this difficulty of interpretation would not have occurred.

The detailed report of the inspector of Scotland is appended. From it, it will be seen that the amount of salt used in the manufacture of alkali has declined about 2½ per cent.—from 46,240 tons in 1891 to 44,361 tons in 1892 (these figures include 4,637 tons used in copper works in 1892). This is owing to the advance of the ammonia-soda process in England. In Scotland there are no works of the kind. There has also been from the same cause a decrease in the amount of pyrites and sulphur burnt, and the decrease in the amount of sulphuric acid made is also partially due to the slackness in the manure trade. There has been a continued increase in the production of sulphate of ammonia.

The tests of the chimney gases in alkali works, &c., show that the average acidity of the gases is well within the limits of the Act.—H. S. P.

Description of Distilling Apparatus, Machinery, and also Consumption of Steam, in the Ammonia Soda Process. H. P. Fassbender. Zeits. ang. Chem. 1893, 165—174. (See this Journal, 1893, 600—601.)

The loss of ammonia in the different phases of the Ammonia Soda process is shown in the diagram on page 680, which must be studied in connection with the first part of this paper, abstract of which appears in this Journal, 1893, 601.

Before calculating the quantity of brine required for a daily make of 10 tons of soda ash, the author accepts the following data:—

(1.) The loss of soda, as dust, &c., amounts to 10 per cent. on the soda ash.

(2.) If anhydrous ammonia be passed through brine till the resulting liquor contains 7 per cent. of ammonia, the original volume of brine will have increased by 9 per cent.

(3.) On adding ammoniacal brine to fresh brine, or mother-liquor to water, the resulting volume is equal to the sum of the volumes before addition.

(4.) When using the apparatus described further on, the gases from the distiller, after condensation in the ammonia-absorber, will occupy about 4 cbm. per diem.

(5). The moist bicarbonate passing daily through the calcining apparatus contains 5 cbm. of water.

(6.) 9 cbm. of wash-water are required daily in the process of filtration.

(7.) The purified brine contains in 1 cbm. 307 kilos. of sodium chloride, 890 litres of water, 2·3 kilos. of ammonia as ammonium carbonate, and 0·57 kilo. of ammonia as ammonium sulphate.

(8.) 1 cbm. of mother-liquor, after dilution with the water of filtration, contains 850 litres of water.

For a daily make of 10 tons of soda ash, 11 tons of soda must be precipitated as bicarbonate of soda, or $\frac{11.000}{53} \times 17 = 3{,}528·3$ kilos. of ammonia must be converted into ammonium chloride. Of the 6 per cent. of ammonia contained in ammoniacal brine, 4·6 per cent. is converted into ammonium chloride, therefore, 3,528·3 kilos. of ammonia correspond to $\frac{3{,}528·3}{46} = 76·7$ cbm. of ammoniacal brine,

	Kilos.
containing 6 per cent. of ammonia = 60 × 76·7 kilos. of ammonia	= 4,602
The ammoniacal brine is obtained by mixing brine of 7 per cent. of ammonia with about 11·3 cbm. of fresh brine of 0·23 per cent. of ammonia = 11·3 × 2·3 kilos. of ammonia	= 26
Ammonia contained in the 7 per cent. ammoniacal brine, therefore	= 4,576

corresponding to $\frac{4{,}576}{70} = 65·3$ cbm.

Total 6 per cent. ammoniacal brine used, therefore 11·3 + 65·3 = 76·7 cbm.

The 65·4 cbm. of ammoniacal brine (7 per cent.) are derived from:—

	Cbm.		Kilos.
(1.)	56·3	fresh brine containing 56·3 × 307 kilos. salt	= 17,284·1
(2.)	5·1	increase of volume = 9 per cent.	..
(3.)	4·0	condensation of gases from distillation.	..
Total	65·4	at $\frac{17{,}284·1}{65·4}$ kilos. salt = 264·2 kilos.	..
Add	11·3	fresh brine containing 307 × 11·3 kilos. salt	= 3,469·1
Yields	76·7	of 6 per cent. ammoniacal brine containing salt	= 20,753·2

or 1 cbm. of 6 per cent. ammoniacal brine contains $\frac{20{,}753·2}{76·6} = 270·6$ kilos. salt.

For 10 tons soda-ash are required therefore, say 210 tons of rock salt.

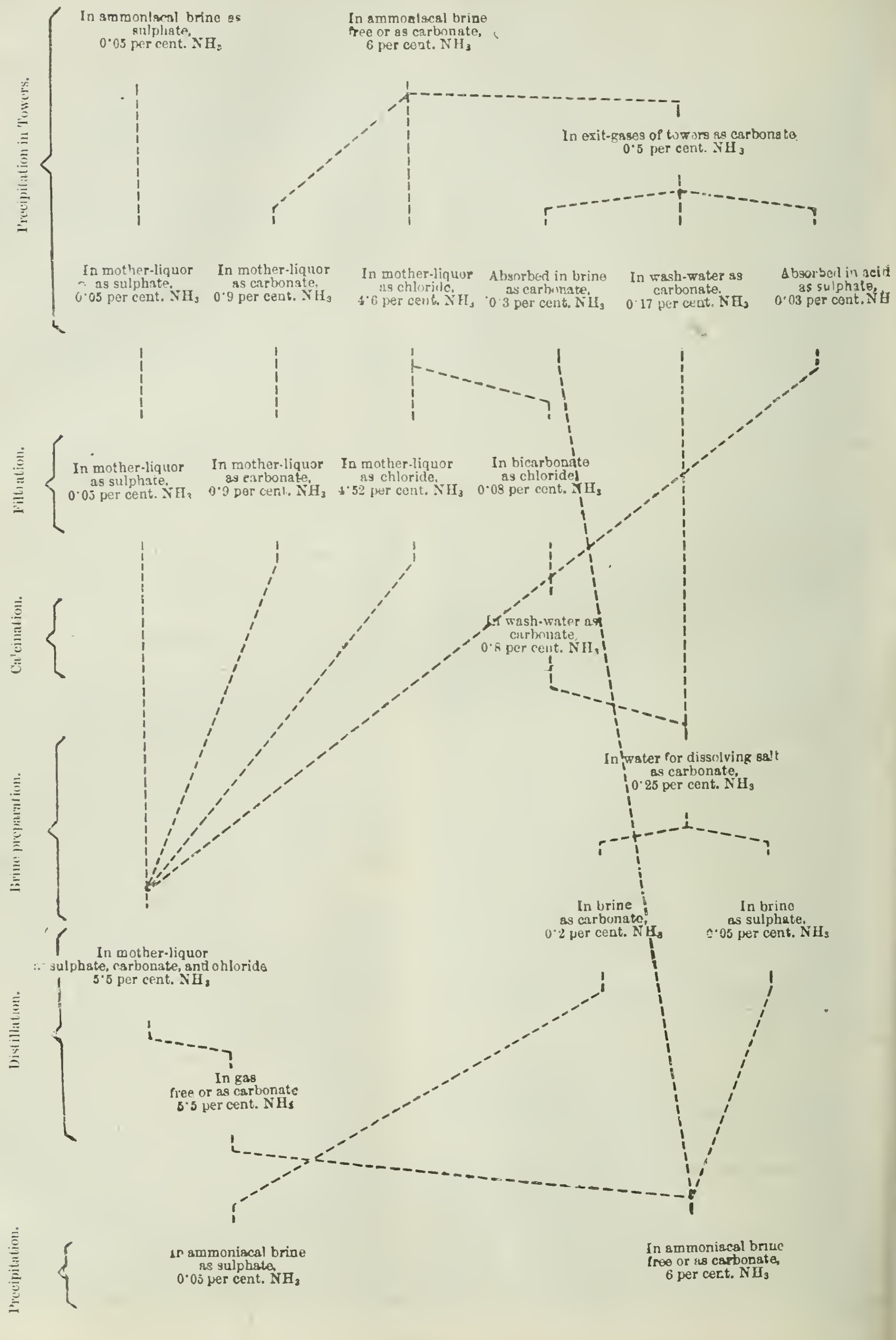
Of fresh brine is daily required:—

	Cbm.
(1.) For the 7 per cent. ammoniacal brine from ammonia absorber	56·3
(2.) For dilution	11·3
Total	67·6

		Litres of Water.
67·6 cbm. contain 890 × 67·6	=	60,164
To this has to be added water of condensation	=	4,000
And wash water from filters	=	9,000
		73,164
From this has to be deducted water contained in bicarbonate	=	5,000
Therefore water in mother-liquor	=	68,164

In 1 cbm. of mother liquor are contained 850 litres of water.

Loss of Ammonia.


Precipitation in Towers.
In ammoniacal brine as sulphate, 0·05 per cent. NH₃
In ammoniacal brine free or as carbonate, 6 per cent. NH₃
In exit-gases of towers as carbonate 0·5 per cent. NH₃
In mother-liquor as sulphate, 0·05 per cent. NH₃
In mother-liquor as carbonate, 0·9 per cent. NH₃
In mother-liquor as chloride, 4·6 per cent. NH₃
Absorbed in brine as carbonate, 0·3 per cent. NH₃
In wash-water as carbonate, 0·17 per cent. NH₃
Absorbed in acid as sulphate, 0·03 per cent. NH
Filtration.
In mother-liquor as sulphate, 0·05 per cent. NH₃
In mother-liquor as carbonate, 0·9 per cent. NH₃
In mother-liquor as chloride, 4·52 per cent. NH₃
In bicarbonate as chloride, 0·08 per cent. NH₃
Calcination.
In wash-water as carbonate, 0·8 per cent. NH₃
Brine preparation.
In water for dissolving salt as carbonate, 0·25 per cent. NH₃
In brine as carbonate, 0·2 per cent. NH₃
In brine as sulphate, 0·05 per cent. NH₃
Distillation.
In mother-liquor as sulphate, carbonate, and chloride 5·5 per cent. NH₃
In gas free or as carbonate 5·5 per cent. NH₃
Precipitation.
In ammoniacal brine as sulphate, 0·05 per cent. NH₃
In ammoniacal brine free or as carbonate, 6 per cent. NH₃

68,164 litres of water, therefore, correspond to $\frac{68,164}{850}$ = 80·2, or say, 81 cbm. of mother-liquor, containing ammonia as sulphate :—

		Kilos.
(0·05 × 0·03) × 76·7 × 10	=	. 61·36
Ammonia as bicarbonate 0·9 × 76·7 × 10 .	=	690·3
Ammonia as chloride 4·52 × 76·7 × 10 ...	=	3,466·84
		4,218·50

4,218·5 kilos. of ammonia have, therefore, daily to be distilled from 81 cbm. of mother-liquor.

In calculating the quantity of lime required for distilling this quantity, the author assumes that $\frac{4}{5}$ of the ammonium bicarbonate contained in the liquor is distilled off by steam in the distilling column, and that only $\frac{1}{5}$ reaches the distiller as monocarbonate. About 25 kilos. of ammonia are held back during distillation by the liquor and are lost.

The quantity of lime used for distilling must be equivalent to the following quantity of ammonia :—

	Kilos.
Ammonia as sulphate	61·36
„ „ carbonate $\frac{1}{5}$ 690·3	138·06
„ „ chloride	3,466·84
Loss in distiller, say	25·74
Total	3,692·00

This requires $\frac{3,692}{17}$ × 28 = 6,081 kilos. of CaO as an excess, of about 25 per cent. of lime should be used = 7,600 kilos. of pure lime, or 8,085 kilos. of 94 per cent. lime, or say 15,000 kilos. of 94 per cent. limestone, are required.

8,085 kilos. of lime (94 per cent.) are slaked and diluted to about a volume of 30 cbm. Although this is used hot it will condense sufficient steam to be diluted to 33 cbm., and this is the daily quantity of milk of lime which has to pass through the distiller.—K. E. M.

Description of the Distilling Apparatus and Steam Engines, with Consumption of Steam, in Ammonia Soda Works. H. P. Fassbender. Zeits. ang. Chem. 1893, 224—229.

The chief endothermic and exothermic processes occurring in the distilling of the mother liquors for recovery of ammonia have been investigated by the author and their numerical values may be stated approximately in the following table. Of course, some assumptions have to be made (which have been detailed in the original paper), but these assumed conditions agree pretty closely with those obtaining in the works.

Table No. 1.

No.	Are Required for	Calories per Hour.	
		Winter.	Summer.
1	3,375 litres of mother-liquor heated from 16° to 116°: 3,375 × 100 × 0·95.	320,625	..
	3,375 litres of mother-liquor heated from 25° to 116°: 3,375 × 91 × 0·95.	..	291,769
2	1,375 litres of milk of lime heated from 90° to 116°: 1,375 × 26 × 0·95.	33,963	33,963
3	345 litres of condensed water heated from 60° to 116°: 345 × 56 × 1.	19,320	19,320
4	17,577 kilos. of ammonia distilled off..	87,885	87,885
5	In the liquor (see 4) there are contained $\frac{690 \cdot 3}{24}$ = 28·8 kilos. NH_3 in the form of monoammonium carbonate, which equals 28·8 × $\frac{44}{17}$ = 74·5 kilos. CO_2; $\frac{1}{5}$ of the NH_3 enters the stills as normal carbonate, therefore, $\frac{9}{10}$ × 74·5 = 67 kilos. CO_2 have to be volatilised : 67 × 127	8,509	8,509
		470,302	441,446
	To be deducted are— Calories set free on mixing the mother-liquor with milk of lime 4* × 0·95 (3,375 + 1,375).	18,050	18,050
	Calories required	452,252	423,396

* The temperature rises 4° C.

The minimum quantity of steam required to effect the distillation has been calculated in the following table on the assumption that 1 kilo. of steam of 1·5 atmospheric pressure, the condensed water of which is supposed to have a temperature of 116°, gives off 524 calories, and on the further assumption that the stills, having a cooling surface of about 600 square metres, condense in winter 1 kilo. and in summer 0·9 kilo. of steam.

Table No. 2.

Are Required for	Kilos. Steam per Hour.	
	Winter.	Summer.
452,252 calories : $\frac{452,252}{524}$	864	..
423,396 „ $\frac{423,396}{524}$	..	808
600 sq. m. cooling surface	600	..
„ „	..	540
	1,464	1,348

On comparing this theoretical consumption of steam with the amount of steam actually supplied for the process, it was found that a plant consisting of four stills, distilling column, and rectifier, working with exhaust steam and *in vacuô* gave off 2·2 kilos. of NH_3 per hour for every kilo. of steam (in spring). (For five stills the consumption of steam may be a little smaller, but this may be neglected here). The daily production of 4128·5 of NH_3 requires therefore, $\frac{4218 \cdot 5}{2 \cdot 2}$ = 1917 kilos. of steam per hour. Having regard to the difference noticed in winter and summer it may be said that in winter 1976 and in summer 1860 kilos. of steam are required per hour.

The difference between the last mentioned quantities and those represented by Table No. 2, viz., 512 kilos. corresponds to the quantity of steam condensed in the cooling vessel, of which by far the greatest part, say 345 kilos., runs back into the distilling column, whilst the smaller quantity passes into the absorber.

Dimensions of the Distilling Apparatus.

a. Stills.—We assume two sets of distilling apparatus consisting of 5 stills each. Each set has to work 78·7 cubic metres of mother-liquor in winter, and 12 hours are quite sufficient to expel the ammonia completely for practical purposes. Thus every still requires for charging 2·4 hours and works 9 hours; the whole distillery working 10 charges daily, each charge yielding 7·87 cubic metres on blowing off.

The consumption of steam for the whole system is detailed in the following table.

Table No. 4.

Are Required for	Calories.	Steam Kilos.
3,375 litres mother-liquor heated up 18°: 3,375 × 18 × 0·95.	57,713	..
345 litres condensed water of the coolers heated up 18°.	..	..
$\frac{630}{975}$ litres condensed water of the columns heated up 18°: 975 × 18.	17,550	..
1,375 litres milk of lime heated from 90° to 116°: 1,375 × 26 × 0·95.	33,963	..
17,575 − $\frac{4}{5}$ × 28·8 = 15,271 kilos. NH_3 expelled : 15,271 × 500.	76,355	..
	185,581	..
Deduct calories becoming free on mixing liquor with milk of lime cpr. Table No. 1.	18,050	..
	167,531	..
167,531 calories require $\frac{167,531}{524}$	..	320
The 10 stills and the additional apparatus having a condensing surface of 514 sq. m.	..	514
	..	834

The two distilling columns condense therefore per hour 1464 – 834 = 630 kilos. of steam; 512 kilos. leave the column uncondensed, and have to be condensed by the cooling worm.

(*b.*) *The Distilling Column.*—The inside diameter of the distilling column is assumed to be 1,500 mm. From the work to be performed in the column, viz., to heat up 1,687·5 litres of mother-liquor, entering at 16°, to 60°, it is calculated that the coil has to be 18·7 m. long for an inside diameter of 40 mm. The hydraulic resistance of one compartment equals, for a specific gravity of 1·1 of the mother-liquor, 70 mm. of water pressure, for the five compartments, therefore, 350 mm., which is brought up to 420 mm. by an additional resistance of 70 mm. in the bottom compartment. In consequence of the resistance the vapours experience in rising from plate to plate, &c., &c., the total resistance may be safely assumed to equal 1 m. of water. The steam entering the apparatus at a pressure of 0·8 atmosphere, consequently passes into the cooler with a pressure of 0·7 m. only.

(*c.*) *The Condensers.*—The work of the condensers should be to condense the steam nearly completely, and to cool the gases so efficiently that they may escape with a temperature of 60° C. only. It is impossible, in consequence of the manifold complications, to calculate theoretically the cooling surface required, and one is forced to adopt a value furnished by practical work on a manufacturing scale. Experience has demonstrated that per 100 kilos. soda made in 24 hours, 1 sq. m. inner cooling surface is required. Therefore, every cooler has to be made so as to possess 50 square metres of cooling surface.

(*d.*) *The Ammonia Absorber.*—Into each of the two absorbers there enter per hour 87·9 kilos. of NH_3 as vapour, 33·5 kilos. of CO_2, both having a temperature of 60° C., and 83 kilos. of water, to which has to be added 1,173 litres of brine. The ammonia absorber has a diameter of 2·2 m., and is 1 m. high, its cooling surface is, therefore, 6·9 sq. m. The hydraulic resistance the gases suffer may be assumed as 1 m. of water pressure.

(*e.*) *The Vacuum Pump.*—The resistance met with by the steam and gases in the different apparatus of the distilling plant is 10 mm., and the partial resistances are composed as indicated in the following table:—

Resistance.	M. of Water.
In the four stills and pipes................	7·0
In the distilling column	1·0
In the cooler	0·2
In the ammonia absorber................	1·0
Various smaller resistances	0·8
	10·0

There is required for both sets of distilling apparatus of five stills each, a vacuum pump capable of raising 11 cubic metres per minute, whereby the pressure in the suction pipe reaches half an atmosphere.—J. L.

Description of the Distilling Apparatus, Steam Engines with Consumption of Steam in Ammonia Soda Works. H. P. Fassbender. Zeit. ang. Chem. 1893, 256—264.

The apparatus employed for the distillation of the mother-liquor and the preparation of the ammoniacal brine consists of four or five stills (Figs. 1 and 2), the reversing valve B, the column C, the condenser D, the ammonia absorber E the vacuum pump F, and the mother-liquor tank G. The stills A are provided with conical bottoms and serve for the distillation of the mother-liquor with milk of lime. Fig. 3 represents one of these stills with its fittings and pipe connections. There are two pipes to each still (*n* and *o*) communicating with the reversing-valve B. The pipe *o* attached to the top of the still serving for the exit, the pipe *n* descending to within a distance of about 10 cm. of the lowest point of the bottom for the entrance of the gas. A sieve of about 1·5 m. diameter is fixed at a distance of 50 cm. off the orifice of the pipe *n*, while a pipe *p* forms a connection between the latter and the blow-off pipe *r*; *x* is a bell valve which, when open, allows steam to pass from *p* into *r*, thus preserving a clear passage through the blow-off pipe. The blow-off tap is provided with a blank flange in order to prevent any possible loss of liquor or steam. The exhausted liquor, which is conducted away by a pipe not shown in the figure, is used for warming the boiler-feed water. Between the charge valve *s* for the mother-liquor and the still another blank flange is placed. This arrangement prevents the entrance of steam into the main pipe from which the set of stills is being charged, thus excluding disturbances in the working, in case of the valve being leaky. A front view of this blank flange is given at *s*. By releasing the pressure screw the blank flange is set free

Fig. 1.

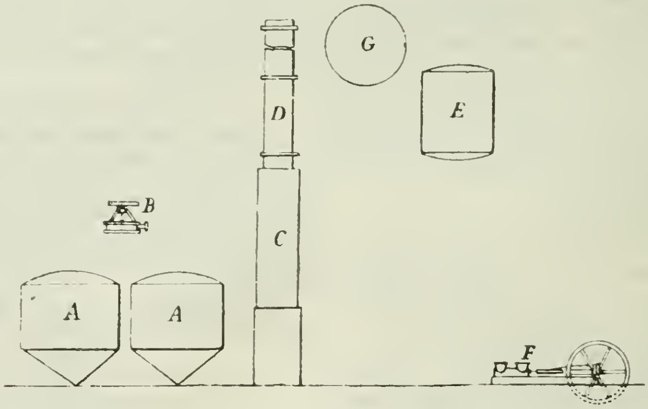
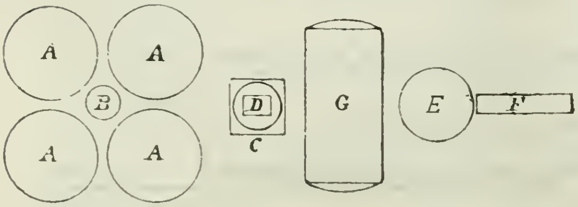


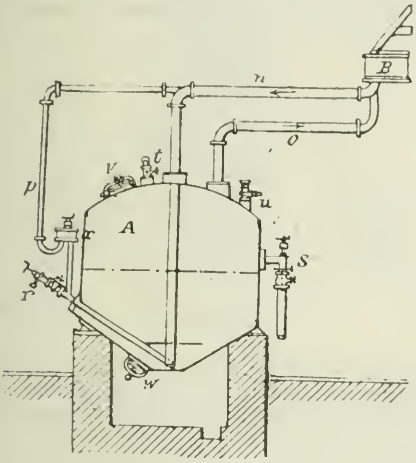
Fig. 2.



and can be reset. No condensed liquor can accumulate above it. By the use of the blank flange a vacuum is maintained in the still, while in the mother-liquor pipe a constant vacuum exists, owing to its being connected with the distilling column. Hence, even in case of the tap being very defective, neither mother-liquor nor gases can escape when the blank flange is being reset, and the employment of the latter also conduces to ease and cleanliness of working.

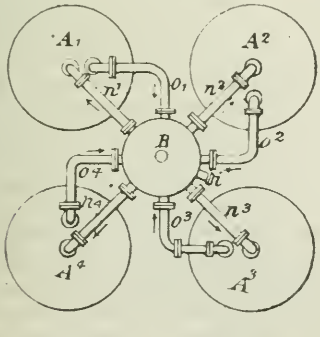
In order to compensate the pressure during the charging of the still the boiling spaces of the still and column are connected by a pipe furnished with the valve tap t. Although less necessary than in case of the taps by r and s, a blank flange may also here be used with advantage. The stop-cock u serves for introducing the milk of lime, which is conducted to the still by means of a short spiral hose-pipe. This pipe has to supply all the stills of a set and is removed when the charge is completed, a cap being screwed over the orifice of the stop-cock. The still is provided with the manholes V and W of 40 cm. and 2·5 cm. internal diameter respectively. There are also a pressure gauge and several small openings for the taking of samples and the observation of the height of the liquor. Eight steps are riveted to the conical portion of the still by which it is kept in position upon the brickwork supporting it, remaining at the same time accessible from below.

Fig. 3.



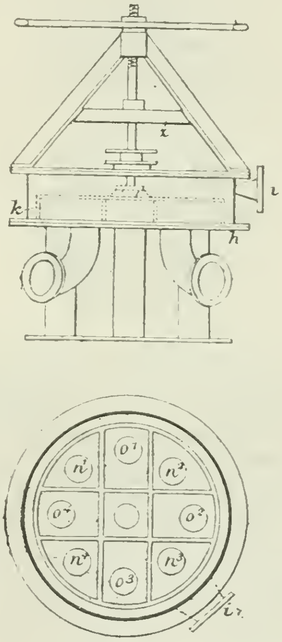
The object of the reversing-valve B consists in disconnecting or setting at rest one of the stills and keeping the others connected, while the current of steam for driving off the ammonia is passing through the apparatus. Fig. 4 explains the working of the reversing-valve for a set of four stills. Assuming the still A^2 to be disconnected and being charged with mother-liquor and milk of lime, the steam would enter the reversing-valve through i, passing through n^3 first into A^3, the contents of which are nearly exhausted. From A^3 it returns through o^3 into the reversing-valve and through n^1 goes into the still A^1, from which it again returns to the reversing-valve through o^1. Then it is conducted by n into A^1, which, being the last of the stills started, contains strong mother-liquor. The steam, saturated with ammonia, now passes for the last time into the reversing-valve, and then goes on to the column. In regular working the still A^3 is exhausted, and the residual liquor blown off while the charging of A^2 has been completed. By resetting the reversing-valve the steam is now first made to enter A^1, travelling through A^1 and A^2 to the column, while A^3 is disconnected and being recharged. The valves originally employed in the arrangement for this systematic distillation were found to be subject to rapid corrosion by the ammoniacal vapour, and to cause, moreover, too great a reduction of the pressure when waste steam was being used for working the apparatus. They were therefore discarded and replaced by the reversing-valve now to be described, the construction of which is founded upon that of Clegg's well-known reversing-valve, which is or used to be in extensive use in gasworks.

Fig. 4.



The description of this apparatus refers to a set of four stills, but only some slight modifications would be necessary in case of any other number of stills. Fig. 5 represents an elevation and section of the apparatus. The nozzle i, attached to a short cast-iron cylinder gives access to the steam. A plate h carrying 9 flanged nozzles is screwed to the bottom of this cylinder. One of these nozzles is placed in the centre and is coupled up with a pipe leading to the column, whereas the remaining eight, half of which are for the sake of economy of space of bent form, are arranged at equal distance from each other in a circle around the central nozzle.

Fig. 5.



The bent nozzles n are connected with the entrance pipes of the stills, the straight ones o with the exit pipes. A circular groove of dove-tail section (Fig. 6) is cut into the bottom of the cylinder and the space circumscribed by this groove has nine divisions produced by four grooves at right angles to each other (Fig. 5). Each of these divisions contains one of the openings of the nozzles. India rubber cords of square section and 25 mm. thick, are placed into the grooves mentioned. These cords, by the influence of the heat and the pressure of the bell k, accurately fill up the grooves and remain firmly bedded when the bell is being raised. The latter fits upon the circular groove and is provided with four division-webs corresponding to the straight grooves referred to. By a turn of 90° the bell can again be set upon the grooves, any inaccuracy in the movement being rendered harmless by the thinness of the webs (12 mm. thick), and the ball and cotter joint (Fig. 7) by means of which the bell is connected with the spindle. The cotter being fixed in the spindle whilst the slot in the boss of the bell is of dove-tail shape section, only two edges of the former are in contact with the sides of the latter, thus securing freedom of motion and fixity of the bell at the same time. In the plan of the bell (Fig. 7), the nozzle openings are indicated by the letters *n* and *o*. The top of the bell has a perforation at *l*, corresponding to the entrance of the steam through n^3 into the still No. 3 (Fig. 4). The webs between o^3 and n^4, o^4 and n^1 and o^1 and the central compartment are pierced in such a manner as to just leave a rib for forming a joint with the india-rubber in the grooves of the bottom plate. Two such openings are shown in the sectional diagram A., B. (Fig. 7). It now becomes apparent that the steam entering the reversing valve by *i* (Fig. 5), can find no other way out than through the opening *l* (Fig. 7), and must hence consecutively travel through the stills 3, 4, and 1, passing through the openings in the webs of the bell. From the still 1 the steam has to go through the reversing valve into the central pipe and is then conducted to the column. The still 2 is at rest. It is also plain that by a turn of the bell of 90° in the direction of the motion of the hands of a watch the opening *l* is brought just opposite n^4, thus allowing the steam to pass through the stills 4, 1, and 2 to the column, while still 3 is at rest. The greatest steam pressure is in the cylinder surrounding the bell, hence this is being firmly pressed against the joints. The latter do not come into contact with the current of steam and ammonia, and the india-rubber filling being compressed, any condensed liquid, collecting in the upper part of the groove, tends to preserve the packing.

Fig. 6.

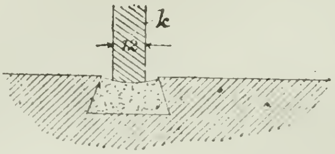


Fig. 7.

Section A B.

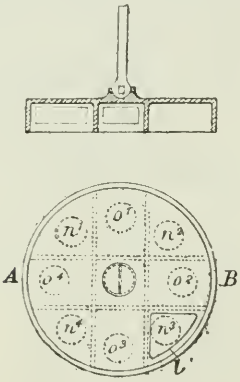


Fig. 8.

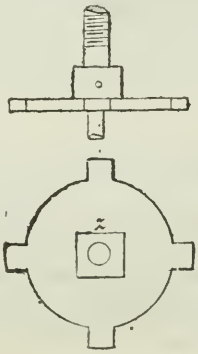
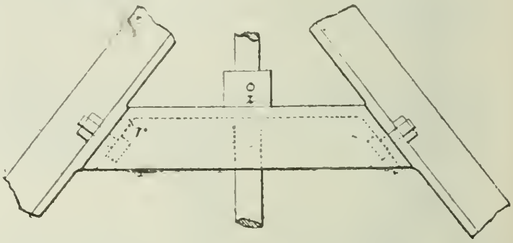


Fig. 9.

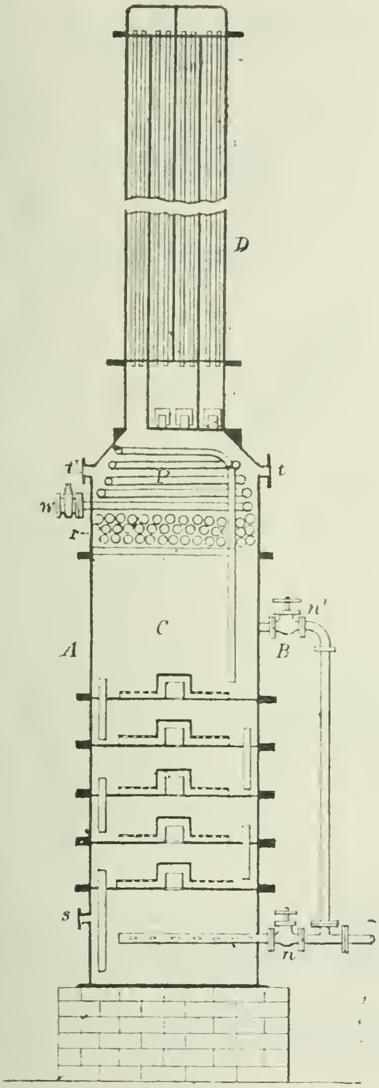


In order to facilitate the setting of the bell the following arrangement was resorted to. The end of the spindle attached to the bell is provided with a screw thread as may be seen from Fig. 5. There is a hand-wheel for raising and lowering the spindle. The correct setting of the bell is ensured by the employment of a tooth-disc *z* shown in Fig. 8. This disc is fixed on the bell-spindle and has four teeth which fit into corresponding recesses of a ring *r*, bolted to the bracket attached to the lid of the apparatus (Fig. 9).

It will be readily seen that the bell cannot be moved until the tooth-disc *z* (Fig. 8) has been raised above the ring *r*, at which point the bell is completely out of the joint-grooves and can then be moved by means of a key fitting to the square boss of the disc. The teeth indicate the right advance of 90° and secure the bell in its proper position when the spindle is being lowered.

The distilling column C (Fig. 10) serves for heating the mother-liquor and for expelling the ammonium bicarbonate dissolved therein. The heat necessary for this purpose is furnished by the steam and ammonia from the stills. A great deal of this steam being condensed during its passage through the column, the latter acts also as a concentrator of the ammoniacal vapour. The column is of the well-known construction represented in Fig. 10. Six divisions are provided for expelling the bi-carbonate. The lowest compartment is furnished with the flange-pipes *s* and *n* for the drawing-off of the liquor and the entrance of the gas respectively. The uppermost compartment has three pipe attachments *w*, *t*, and t^1. By *t* the difference of the pressure in the column and that still, which by *s* is being charged with liquor, is equalised, while t^1 does the same with regard to the column and the mother-liquor tank. A coil P for heating the mother-liquid is also placed in this compartment. Below the coil rest a number of stone-ware balls *r*, over which the condensed liquid has to flow, thus being deprived of the ammonia it contains by the vapour rising through it. (This system having to our knowledge first being employed by Ilges in the distillation of alcohol.) The mother-liquor enters the coil by the tap *w*. The condenser D forms the continuation of the column. Its construction differs slightly from that of the ordinary tube condensers. The tubes are arranged in eight groups, the gases going from one to the other, hence the speed with which they travel is eight times as great as in a condenser of the same number and width of tubes. The current of the cooling water is opposed to that of the gases and its speed is likewise eight times as great as in an ordinary condenser of the same size. The quick motion of the water combined with its seven-fold deflection, brings all the water into thorough contact with the condensing surfaces, and the speed of the current of the gases together with the upright position of the tubes, serve to keep the latter clear of condensed liquid. By the constant reversal of the current, the liquid carried away by the gases is separated, causing them to become dry. All the peculiarities mentioned enhance the effectiveness of the condenser. Fig. 11 shows the longitudinal section and plan of the condenser D (Fig. 10). The tubes *a* fixed in the plates *b* are packed with india-rubber rings in the usual manner. By the division walls *c* the tubes are divided into eight bundles. Openings *e* are provided alternately at the top and bottom of the division walls for circulation of the cooling water, which enters at *f* and leaves at *g*. *h*, *h*¹, are stop-cocks for letting out the air. The vapours take their course through the passage *i* and the eight sets of tubes, escaping ultimately through the pipe *a*. The chambers *k* have divisions arranged in such a manner as to make the vapours pass through one set of tubes after the other. There being no variation of pressure in the sub-divisions of the chambers, the tight fitting of the division walls is readily attained. The bottom of the lower chamber is provided with siphon-traps for the outflow of the condensed liquor. The apertures *l* in the side walls of the chambers serve for examining the tubes.

Fig. 10.



Section A B

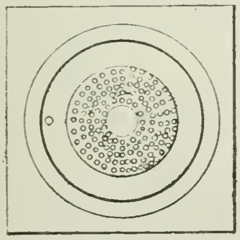
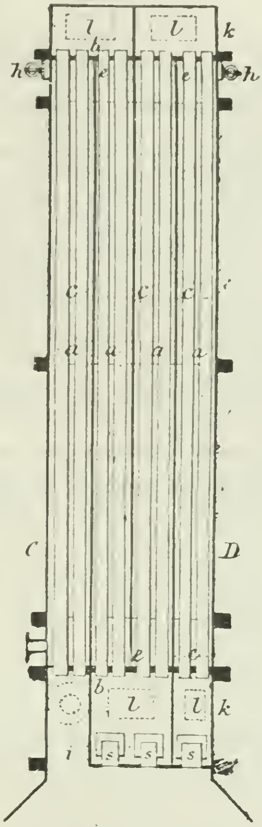
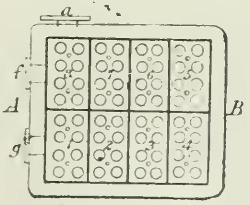


Fig. 11.

Section A B

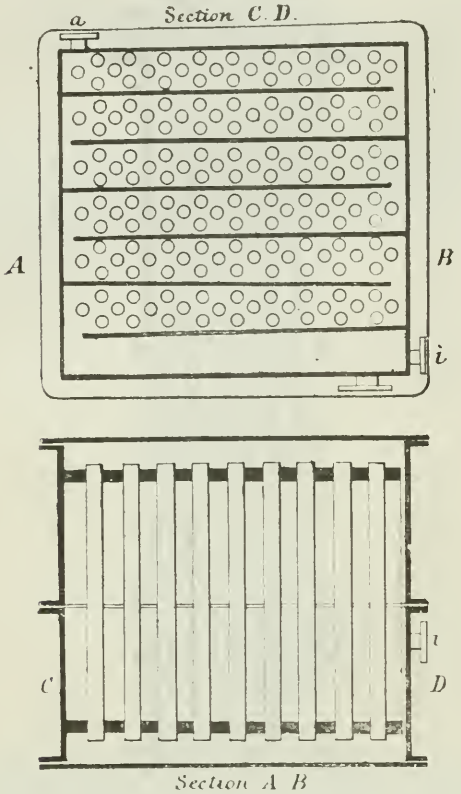




Section C D

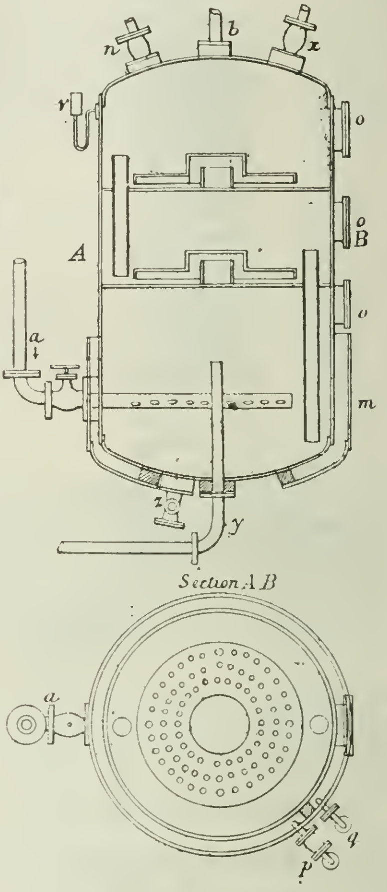
Another kind of condenser, which at the same time acts as a dephlegmator of the condensed liquid, is shown in Fig. 12. The cooling water flows in a downward direction through the different systems of tubes, with exception of the lowest one. The vapours enter at *i* and are by the partitions forced to travel through the apparatus in zigzag line, thus coming into constant contact with the tubes. The strong ammonia leaves at *a*, whereas the condensed liquor runs downward over the slightly inclined partitions. The latter being heated from below by the vapours, whose temperature is higher than that of those in the division above it (the temperature of the vapours naturally decreases as they rise from one compartment to the one above it), the condensed liquor running from the partition is readily deprived of its ammonia by the vapours passing over it. The lowest system of tubes serves for heating the mother-liquor, and therefore takes the place of the coil in the apparatus previously described. Owing to the necessity of having the tubes in this form of condenser shorter than in the one represented by Fig. 11, their number, and consequently the number of joints, is larger. This drawback, however, is compensated by the greater ease of examination and renewal in case any of the tubes should become defective. It may be mentioned that other forms of columns and condensers, such as those used for rectifying alcohol and benzene (see Märker, Spiritus fabrikation, and Lunge, Coal-tar) can be successfully employed, provided the right proportions be observed. By a suitable construction of the distilling apparatus and careful working, the gaseous ammonia can be obtained so dry that it becomes needless to enrich the ammoniacal brine by means of solid salt later on.

Fig. 12.



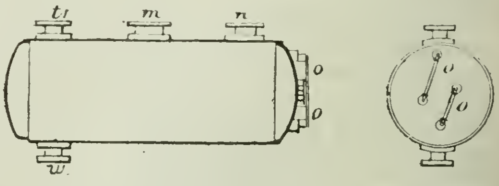
The ammonia-absorber (Fig. 13), in which the ammoniacal brine is produced, is a wrought-iron vessel, constructed internally after the manner of a rectifying column. To counteract to some extent the rise of the temperature, which is caused by the absorption of the ammonia, the lower part of the apparatus is surrounded by a water-jacket *m*, the pipes *p* and *q* shown in the horizontal section being the inlet and outlet for the water. The gaseous ammonia enters by *a* and the unabsorbed gases leave the apparatus by *b*. *x* is the inlet, *y* the outlet for the brine, while *z* serves for emptying the lower part. Every compartment of the apparatus is provided with a manhole *o* and three small taps (not shown in figure) for drawing samples and for ascertaining the height of liquor. The uppermost compartment is furnished with pressure and vacuum gauges *u* and *v* and a water inlet *w*. The apparatus is supported by cast-iron brackets not indicated in the diagram.

Fig. 13.



The air-pump F (Fig. 1) removes the unabsorbed gases escaping through the pipe *b* (Fig. 13) and sends them through a washing apparatus, which also washes the gases from the precipitation process. They then have yet to pass through a vessel containing acid, whereupon they are allowed to escape into the atmosphere. The vacuum pump is described in Part 4 (The Engines).

Fig. 14.



The mother-liquor tank G (Fig. 14) consists of an elevated cylindrical vessel, into which the mother-liquor resulting from the filtration is forced by compressed lime-kiln gases. The mother-liquor enters through *n*. The flange t^1 is connected by a pipe with the flange t^1 of the column (Fig. 10, the pressure in both these apparatus being thereby kept equal. From the outlet *w* a pipe leads to the tap attached to the coil of the column (Fig. 10, *w*). *o* are gauges and *m* is a manhole. The mother-liquor tank must be raised at least 4 metres above the inlet *w* of the column. An alteration in the level of the liquor in the tank of 2·5 metres diameter does not affect to any considerable extent the speed of the flow of the liquor to the column when the condition stated is complied with. A satisfactory working of the column is ensured by its being fed regularly.

The position of the various apparatus to each other in a distilling plant is shown in Fig. 2, and the former having been described and their manner of working explained, the working of the entire system will be readily understood. The mother-liquor flows from the tank in a continuous and even stream through the pipe *w* into the coil of the distilling column, from which at a temperature of about 60° it passes into the boiling space of the column. Here it is quickly brought to the boil by the current of steam, and descending from shelf to shelf parts with most of the ammonium carbonate. From the column it travels through the pipe *s* to the still which is just being charged. Hot milk of lime is introduced into the still at the same time. The ammonia set free is partially retained by the liquor, but a large portion of it is set free, owing to rise of the temperature of the mixture to the boiling point, and escapes through the pipe *t* into the boiling space of the column. As soon as the charging of the still is completed steam is allowed to pass through it (as pointed out in the description of the reversing valve) and the distillation completed. The exhausted liquor is used for heating the boiler feed-water and is then run off. The waste steam from the engines enters the reversing valve and travels from one still to the other. The mixture of steam and ammonia is by the reversing valve conducted to the column, in which it expels the ammonium carbonate from the descending stream of mother-liquor. Rising higher it has to pass through the layer of stoneware balls, and in doing so expels the ammonia from the liquid condensed by the coil and the tube condenser, warming at the same time the contents of the coil. Most of the steam is condensed. What remains rises, charged with the ammonia separated, to the condenser, where the aqueous vapour is almost completely condensed. The ammonia mixed only with a little air and carbonic acid passes through the pipe *a* on to the absorber. Ammonia, carbonic acid, and the small quantity of aqueous vapour accompanying them are almost completely retained by the brine in this apparatus. The unabsorbed gases are by means of the air-pump driven through the washing apparatus and acid vessel, and then escape into the air.

The brine enters the absorber through *x* in a constant flow, and deprives the rising gases of their ammonia in the two upper chambers. In the lower one the amount of ammonia to be contained in it is being adjusted by regulating the inflow of the brine. The ammoniacal brine leaves the apparatus through *y* ready for further treatment.

4. *The Engines.*

Elaborate details are given in this part of the paper of the amount of work to be performed by each engine, of the power required for performing this work, of the dimensions of the various parts of the engines, and the quantity of steam needed for working them. The paper concludes with a *résumé* containing a statement of the total consumption of steam for the production of a certain quantity of soda, and some remarks on the respective advantages and disadvantages of working the distillation apparatus by waste steam from the engines or by steam fresh from the boilers. In order to arrive at correct figures regarding the dimensions of the engines and the steam required by them, due attention has been paid to the resistances that have to be overcome, the losses resulting from condensation and leakage, and to other factors influencing the working capacity and the effect produced. Thus in case of—

The Carbonic Acid Compressor, the following facts have to be taken into account. For a daily production of a quantity of bicarbonate corresponding to 11,000 kilos. of 100 per cent. soda 380·5 kilos. of carbonic acid per hour would have to be forced into the towers. In consequence, however, of the loss of carbonic acid owing to its remaining partially combined with the ammonia (see Part 1 of the paper, this Journal, 1893, 600—601), and its incomplete recovery in the process of distillation, 400·5 kilos. of carbonic acid are in reality required. The calcining apparatus produces 190·25 kilos. carbonic acid per hour. About one-half of this is sucked up by a pump and passed into the tower, in which 10 per cent. of the gas remains uncombined. Hence the quantity of carbonic acid resulting from the calcination process is to be set down at 80·5 kilos. per hour, leaving 400·5 − 80·5 = 320 kilos. to be supplied by the limekilns. The gases from the limekilns contain about 30 per cent. by volume of pure carbonic acid, 27 per cent. of which are absorbed by the liquor. The gases being drawn in at a pressure of 740 millimetres and a temperature of about 25° in summer, 676·5 cubic metres per hour are required to furnish the 320 kilos. of carbonic acid. The compressed limekiln gases being further used for raising 150 cubic metres of mother-liquor and ammoniacal brine, for which purpose about 25 cubic metres per hour are necessary, and there being a loss of carbonic acid by mechanical absorption in the liquor (the carbonic acid escapes when the contents of the saturators are filtered unless a special arrangement is provided for collecting it) to be set down at about 10·5 cubic metres per hour, the quantity of gas to be pumped sums up to 712 cubic metres per hour or 197·8 litres per second. Accepting for the wet compressor a volumetric effect of 0·85, the piston would have to displace a volume of 232·6 litres per second. At 40 revolutions per minute and a speed of the piston of 1·2 metres the stroke must be 0·9 metres. The net sectional area of the piston would therefore have to be 232·6 : 12 × 100 = 0·193833 square metres. This area is obtained at a diameter of the cylinder of 0·5 metre and a diameter of the piston-rod (on one side of piston only) of 0·075 metre (0·196350 square metre of piston means 0·002209 square metre of piston-rod, equal 0·194141 sq. metre net). For the purpose of calculating the dimensions of the steam engine and the quantity of steam required, the tension of the gases in the pressure pipe must first be ascertained. The total resistance to be overcome in the tower, the brine and water washing apparatus, and acid tower amounts to 2·04 atmospheres. Allowing for resistance in the valves and pipes the highest tension of the compressed gases in the pump-cylinder may be taken at 2·5 atmospheres. The tension of the gases sucked in being 740 millimetres (mercury column) the net tension is found to be 1·46 atmospheres. This corresponds to 45·3 indicated horse-power. Fully 80 per cent. of work performed by the steam being utilised by the pump, the number of actual horse-power required is 45·3 : 0·8 = 56·6. Bearing in mind that the waste steam from the engine must have a pressure of 1·5 atmospheres in order to be suitable for working the distilling plant, it must, instead of the usual escape-pressure of 1·13 atmospheres, possess a pressure of 1·63, or, in case of no vacuum-pump being employed, 2·33 atmospheres. An engine which, with steam of 6 atmospheres pressure at the inlet valve, would fulfil these conditions and produce 56·6 horse-power at a speed of the piston of 1·2 metres, would require a net sectional area of the cylinder of 0·147396 square metre, or a diameter of the cylinder of 0·440 metre, and of the piston-rod of 0·075 metre. The quantity of steam used per hour was ascertained by means of Hrabák's formulæ, and amounts to 1,244 kilos., of which about 853 kilos. are used in the distilling process. For each indicated horse-power 1244 : 56·6 = 22 kilos. of steam are required per hour. If the distillation is carried on without the help of a vacuum the pressure of the steam at the end of the period of expansion would, inclusive of 0·46 atmosphere for work wasted in friction, have to be at least 2·33 + 0·46 = 2·79 atmospheres. Retaining the same speed (1·2 metres) to have 56·6 horse-power available, would now require a cylinder of 0·153805 square metre sectional area or a diameter of 0·499 metre. The steam required amounts to 1,538 kilos., 1,096 kilos. being utilised in the distilling process. For every indicated horse-power 27·2 kilos. of steam are used. Absolute reliability of working being indispensable in case of the compressor the transmission of the power of the engine to the pump should always take place direct and without the intervention of shafts and pulleys driven by a large central engine. The advantages accruing from the employment of a compound engine cannot be displayed where the exhaust steam is still to possess a comparatively high tension, hence an ordinary engine with variable expansion is the most suitable in this case. If dry compressors are used the gases must be cooled, a water spray injector fed with condensed water (to avoid corrosion) being the best arrangement for the purpose. Wet compressors if well constructed are very safe, convenient, and efficient, and can be run at speed little behind that of the dry compressors. The apprehension of a possible diminution of the effect by the absorption of the carbonic acid and subsequent disengagement is in actual working found to be ungrounded. There is, moreover, no difficulty in reducing the absorption by allowing the temperature of the water in the cylinder to rise to about 25°, should the amount of carbonic acid in the limekiln gases exceed 25 or 30 per cent. With regard to the necessity for occasional renewals of valves and packings, &c., and the possibility of a breakdown, a second engine should be kept, or, as is the case in some works, the work of compression may be divided between two engines, a third one being kept in reserve. Great safety in the working may also be attained by the simple means of applying the pump for the removal of the gas from the calcining process to the work of sending the lime-furnace gases to the precipitating column. The current of gas from this engine is strong enough to prevent the settling down of the bicarbonate in the column, which otherwise might be the cause of objectionable disturbances in the process.

The Vacuum Pump for the Distilling Process.—The dimensions of this pump, the piston of which has to displace 11 cubic metres per minute or 183·333 litres per second, are ascertained in the same manner as those of the compressor. The amount of steam required is also calculated upon the same lines as in case of the last-mentioned engine. The various data are as follows:—(1.) The pump cylinder at a speed of the piston of 1 metre must have a sectional area of 0·183333 square metre, or a diameter of 0·488 metre, that of the piston-rod being 0·063 metre. With a stroke of 0·7 metre 42·8 revolutions per minute are necessary. The power required is 13·5 indicated horse-power, but as 25 per cent. are lost, 18 h.p. must be taken. (2.) The steam cylinder, allowing for a mean absolute tension of the exhaust of 1·63 atmospheres, must be (at a pressure of the steam at the inlet-valve of 6 atmospheres) of a diameter of 0·275 metre, the piston-rod being 0·063 metre. The total quantity of steam used per hour is 500 kilos., 322 of which are utilised in the distilling process. For every indicated horse-power 27·7 kilos. of steam are used per hour.

The Vacuum Pump for the Filtration.—The volume to be displaced by the piston of this pump is about 210 cubic metres per hour, for a production of 10,000 kilos. per day. At a speed of 50 revolutions per minute and a stroke of 0·500 metre, the net sectional area of the cylinder would have to be 0·070108 square metre, corresponding to a diameter of 0·302 metre (piston-rod = 0·044 metre). This pump is driven by means of a pulley and requires 5 h.p. (3·9 h.p. indicated by the piston).

The Vacuum-Pump for the Calcining Process serves for drawing the gases (carbonic acid, ammonia, and aqueous vapour) from the closed pans in which the bicarbonate is heated. The carbonic acid expelled by the calcining process amounts to 190·25 kilos. per hour. It has been assumed (see compressor) that 80·5 kilos. of this carbonic acid are sent to the tower. As, however, air is drawn in along with the carbonic acid through the joints, &c., the 67·1 cubic metres, corresponding to the 80·5 kilos. of gas at 0·666 atmosphere pressure in the suction pipe, are in reality increased to double this amount. The tension of the gases in the pressure pipe should be 3·5 atmospheres, and the speed of the engine (worked by pulley) 50 revolutions per minute, with a stroke of 0·5 metre. This necessitates a net sectional area of the cylinder of 0·052941 square metre, and a power at the shaft of about 10 h.p. (8·33 indicated by piston + 16 per cent. for loss). The three pumps last mentioned are preferably double-acting pumps on the wet principle. Plunger-pumps possess the disadvantage of air finding ready access through the large stuffing-boxes.

The Brine-Pump has to raise 67·6 cubic metres of brine per day. Taking the total height (inclusive of equivalent for resistance) at 25 metres, about 0·5 h.p. would be required for doing this work.

Various Machines.—The power required for driving a mill for grinding the soda and a hydro-extractor for drying the bicarbonate, inclusive of the power necessary for overcoming the friction in the transmitting system, is set down at 16 h.p.

The Driving Engine.—For the engines and machines mentioned under the last four headings, this engine has to furnish 31·5 effective h.p. or 40 h.p. indicated. The quantity of steam (6 atmospheres) used is 814 kilos. per hour, or 20·4 kilos. for 1 h.p. 610 kilos. of exhaust steam are utilised in the distillation process. If the latter is carried on without the use of a vacuum, 1,013 kilos. steam per hour would be necessary, or 25·3 kilos. for 1 h.p.

The Water-Pump.—The total quantity of water used per hour is composed of the following items:—

		Cubic metres.
1. Amount required for two ammonia absorbers and two distilling columns		16·0
Of this water there are utilised—	Cubic metres.	
(*a.*) For feeding the boilers	3·2	
(*b.*) For the filtration	0·4	
(*c.*) For preparing the milk of lime	1·6	
(*d.*) In the first washing apparatus for the lime-kiln gases	10·0	
	15·2	
2. Cooling water for the precipitating column		6·0
3. Water for washing the gases from the precipitation and calcination process (used afterwards for preparing the brine)		2·6
4. Cooling water for the washing apparatus serving for the gases resulting from the calcination		7·0
5. Water for the second washing apparatus for the lime-kiln gases		1·5
6. For the wet compressors and various purposes		2·9
Total		36·0

or 10 litres per second.

The total resistance to be overcome may be assumed to correspond to a height of the water column of 28 metres. The power required at the shaft of the pump is 4·66 h.p. effective, equal to about 6·4 h.p. indicated at the steam piston. The transmission of the power from the steam engine to the pump is obtained by means of tooth-wheel gearing, engine and pump being fixed on the same frame. 192 kilos. of steam are used per hour, of which 138 kilos. are utilised in the distilling apparatus. Hence each indicated horse-power requires 30 kilos. of steam per hour. In case of the distilling process being carried on without the use of a vacuum, 236 kilos. of steam would be needed (171 kilos. being utilised in the distillation process), which corresponds to 36·9 kilos. for 1 h.p. per hour.

The Limestone Elevator, the Milk of Lime Pump, and the Air-Jet Agitator.—The consumption of steam for working the elevator is taken at 10 kilos. per hour. The exhaust escapes into the air. The freshly-prepared milk of lime has a temperature of from 50° to 60°. It is lifted by a steam-jet pump into a well-covered tank, into which sufficient steam has to be blown to raise the temperature to 90°. This steam is made to work an air-jet agitator, which draws its air from the upper part of the closed tank. For the raiser and agitator, 160 kilos. steam per hour are put down, bringing the total consumption of steam by the machines under this heading up to 170 kilos. per hour.

5. *Summary.*

The following table shows the total consumption of steam by the engines and the amount of exhaust steam available for the distillation, both in case of its being worked with or without the employment of a vacuum:—

Table V.

Number.	——	Indicated Horse Power.	Distillation. With Vacuum. Kilos. of Steam Consumed.	Exhaust.	Without Vacuum. Kilos. of Steam Consumed.	Exhaust.
1	Carbonic acid compressor	56·6	1,244	853	1,538	1,096
2	Vacuum-pump for distillation	18·0	500	322	..	..
3	Steam engine	40·0	814	610	1,013	783
4	Water-pump	6·4	192	138	236	171
5	Stone elevator, milk of lime pump, and air-jet agitator.	..	170	..	170	..
6	Condensation in the pipes and water carried over from boiler.	..	250	..	250	..
	Total	121·0	3,170	1,923	3,207	2.050

In working the process with a vacuum, the engines Nos. 1 and 4 deliver their exhaust steam together into the first set of stills (991 kilos.), while Nos. 2 and 3 supply the second set (932 kilos.). Two sets at 4 stills each requiring 1,860 kilos. exhaust steam per hour in summer and 1,976 in winter (or 930 and 980 kilos. per set respectively), and less steam being necessary for a 5-still set, the winter consumption of the 5-still set is, for the sake of a safe calculation, assumed to be equal to the summer consumption of the 4-still set, namely 930 kilos. Hence it is evident that not only the quantity of steam needed is always available, but that in case of the engines 1 and 4 there is a moderate surplus. This, if not used for heating the boiler feed-water, may without any detriment, be employed for accelerating the distilling process. In working the distillation without a vacuum, the exhausted liquor is run off at a higher pressure and consequently higher temperature, as in the previous case. This loss of heat would necessitate an increase in the quantity of steam of fully 100 kilos. per hour, *i.e.*, 1,088 kilos. steam per set in winter. The 1,096 kilos. exhaust steam from the compressor alone are more than sufficient for one set of stills, whilst the steam-engine and water-pump combined scarcely supply the amount needed for the second set. Besides this, the boilers have to produce about 37 kilos. more steam per hour. These disadvantages are, however, compensated by greater simplicity and cheapness of the plant. Judged in respect of the quantity of steam consumed only, both methods of working would therefore appear to be of equal value, nevertheless that employing a vacuum deserves the preference on account of its greater expediency and its tendency to diminish the loss of ammonia.

By the use of a *large central steam engine* a further economy in the steam consumption might be obtained, but owing to the increased danger of disturbances resulting from a breakdown, such engines are never employed.

When steam direct from the boilers is used for working the distilling plant, the vacuum-pump is usually dispensed with, as in this case the resistance in the various apparatus is readily overcome. The total consumption of steam is, however, considerably larger than that of a plant worked with a vacuum. In calculating the quantity of steam required, the following facts must be taken into account:—The exhaust, being allowed to go into the air, escapes at a less pressure, and therefore the consumption of steam of the engines Nos. 1, 3, and 4 of Table V. is lessened, amounting now to only 20 kilos. per hour and indicated horse-power. No. 5 remains unchanged, and the vacuum-pump No. 2 is left out, but the winter consumption of steam has to be put into account specially. This is taken at 1,860 kilos., the same as for exhaust, for the absence of the vacuum entails the blowing off of the exhausted liquor at a higher pressure and temperature, whereby an increase in the consumption of steam of fully 100 kilos. per hour is caused. It is assumed that this increase is compensated by the greater effectiveness of the direct steam in the stills. The hourly consumption of steam would now be as follows:—

	Kilos.
1. 103 h.p., at 20 kilos. steam	2,060
2. Limestone elevator, milk of lime raiser, and air-jet agitator	170
3. Distillation in winter	1,860
4. Condensation, &c.	350
Total	4,440

This shows an excess of 4,440 − 3,170 = 1,270 kilos. of steam per hour, as compared with a plant in which use is made of exhaust steam and vacuum. Although this consumption might be reduced by employing condensing engines, the verdict must, in consequence of the greater liability of these to become the cause of interruptions in the working of the process, still be given in favour of the use of exhaust steam and vacuum.—K. E. M.

Decomposition of Alkaline Aluminates by Carbonic Acid. M. A. Ditte. Comptes rend. **116**, 386.

See under VI., *page* 675.

Soda Mortars. C. Rabut. Le Génie Civil, **22**, 1893, 178; Proc. Inst. Civil Eng. **113**, 7.

See under IX., *page* 691.

PATENTS.

Improvements in Apparatus and Means for the Electrolysis of Alkaline Chlorides. D. G. FitzGerald, London. Eng. Pat. 9799, May 24, 1892.

See under XI., *page* 697.

Improvements in the Electrolytic Production of Caustic Soda or Caustic Potash. C. A. Burghardt, Manchester. Eng. Pat. 12,977, July 15, 1892.

See under XI., *page* 698.

An Improved Process for the Extraction of Alumina from Bauxite and other Substances. Dr. A. Hand, Nieder Schönweide, and Dr. H. Kunheim, Berlin. Eng. Pat. 14,657, August 13, 1892.

A suitable source of alumina, such as bauxite, is "smelted" with alkalis or alkaline earths, with addition of phosphoric acid or an alkaline phosphate, in order to render the silicic acid present insoluble. Or the aluminous material and alkali may be furnaced in the usual way, and the phosphoric acid or phosphate be added to the alkali aluminate solution obtained by lixiviating the fused product. One and a half equivalent of phosphoric acid, free or combined, is added for one equivalent of silicic acid present in the liquor. The silica precipitates, and the phosphoric acid is thrown down by a suitable agent, as, for instance, calcium hydroxide. The calcium phosphate formed carries down with it any remaining silica. Alumina is separated from the filtered liquid by carbon dioxide in the ordinary manner.—E. S.

Improvements in the Manufacture of Proto-sulphate and Per-sulphate of Iron. C. Dreyfus, Clayton, Manchester. Eng. Pat. 14,665, August 13, 1892.

Acid tar, resulting from the treatment of mineral oils with sulphuric acid, is diluted with water, and separated from an upper layer of tarry matter that forms. A proper proportion of this "diluted waste acid" is stirred up in a suitable capacious vessel with waste iron resulting from the manufacture of aniline or other amido compounds. When the acid is neutralised, the upper portion is run into settling tanks, and the clear hot liquor into cooling tanks, in which ferrous sulphate crystallises out.

To produce ferric sulphate, the diluted waste acid of the preceding process is mixed with the waste acid resulting from the treatment of benzene, glycerin, cotton, and the like, with a mixture of strong sulphuric and nitric acids. To the iron residues acted upon, an oxidising agent, such as sodium nitrate, potassium chlorate, or manganic oxide, may, if necessary, be added. A solid basic ferric sulphate is obtained by using more concentrated acids with an excess of the iron waste.—E. S.

Improvements relating to the Manufacture of Aluminium Fluoride. L. Grabau, Trotha, Germany. Eng. Pat. 15,083, August 20, 1892.

Clay or kaolin is calcined at a carefully regulated temperature, and the product is digested with hydrofluoric acid of about 12 per cent., until a neutral solution is obtained, giving with tropaeolin a yellow colour. Hydrofluosilicic acid may replace hydrofluoric acid; but in this case the digestion is aided by gentle heating. It is important that the solution should be obtained in a neutral or slightly basic state, as otherwise it will retain silicic acid. The solution is filtered, and saturated with hydrogen sulphide, not only to throw down lead, arsenic, and the like, but also to reduce any ferric salt to the ferrous state. The solution is then filtered, slightly acidulated, say by hydrochloric acid, and is well cooled, preferably in an aluminium vessel. Crystals of aluminium fluoride ($Al_2Fl_6 . 18H_2O$) separate, free from iron, owing to the iron being present in the liquor as a ferrous salt. The crystallisation may be initiated by addition of crystals of the aluminium fluoride. The temperature is brought down to about 0° C. during crystallisation. The crystals are washed, and it is stated that "the water may be readily removed" from them.—E. S.

Improvements in the Production of Chlorine, Soda, and other Products by Electrolysis, and in Apparatus employed therein. H. Blackman, New York, U.S.A. Eng. Pat. 19,170, October 25, 1892.

See under XI., *page* 699.

Improvements in Salt Purifiers. T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 9294, May 9, 1893.

The object of the invention is to purify common salt, both from soluble impurities, such as calcium chloride and magnesium chloride, and from earthy or colouring matters, by a process of washing accompanied by mechanical agitation and separation by gravity. The salt to be purified is taken up an inclined trunk or carrier flue by an endless bucket-chain arrangement to the top of an inlet pipe in a stand pipe, in which a shaft carrying radial arms is rotated, such arms working between corresponding stationary arms projecting from vertical ribs in the sides of the iron pipe towards the centre. This pipe communicates with a vertical trunk of less diameter, having outlet to an inclined conveyor pipe, the top of which is higher than the level of the stand pipe. Brine, or other washing fluid, is run into the conveyor pipe, at a height about level with an outflow tube from the stand pipe, and flows downwards while a bucket-chain arrangement conveys the washed salt from the lower prolongation of the stand pipe, upwards for delivery. The brine thus flows in a contrary way to the progress of the salt, and flows upwards through the salt that is being agitated in the stand pipe, until it reaches the exit tube, whence it passes to a receiver, carrying with it mechanical and dissolved impurities. The washing liquid may be suitably treated to fit it to be used over again.—E. S.

Improvements in Evaporating and Concentrating Apparatus, particularly applicable for Concentrating Sulphuric Acid. G. Siebert, Hanau-on-the-Maine, Germany. Eng. Pat. 9514, May 12, 1893.

The apparatus consists of a flat closed vessel, in an inclined position, the bottom of which is terraced or stepped, with each step inclined backward, so as to form a shallow trough. The upper part of the vessel has a dome for carrying off steam or vapours, and the lower end, an outlet for the concentrated acid or liquid. An inlet opening is arranged at the upper face of the vessel, surrounded at the outside with a basin, and protected internally by a screen, so that the liquid in the basin forms a hydraulic joint. In one form of the apparatus, each step or terrace has a metal ridge or rib, but shorter than the entire length of the step, so as at one end to leave a gap for passage of the liquid; and the gaps being on alternate sides in successive steps, the liquid traverses at each step the whole length, to and fro, as it flows downwards, step after step. The under part of the vessel—that is, the stepped bottom—is heated. In the first-described form of apparatus, the liquid flows down along the whole width of each step.—E. S.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

A Study of the New Siemens Furnace, and of the Utilisation of Heat in Regenerative Furnaces. E. Damour. Ann. des Mines, 3, 1893, 84; Proc. Inst. Civil Eng. **113**, 64.

See under II., *page* 662.

PATENTS.

Improvements in the Manufacture of Pottery and in Plastic Compositions therefor. E. J. Tompkinson, Hanley. Eng. Pat. 13,067, July 16, 1892.

Hitherto telegraphic insulators, match pots, strikers, and the like have been made by hand. According to this invention, plastic clay is forced from a pug mill through an outlet of suitable form, or, if dust clay is used, the material is put in dies or iron frames and pressed to the required shape.

The invention also relates to the composition used for match strikers, which consists of a mixture of grey marl clay, red marl clay, and sand. The ingredients may be mixed in equal parts, which gives a material very similar to ordinary sandstone.—V. C.

Improvements in Means for Producing Objects of Glass, or for Ornamenting Sheets of Glass. P. Sievert, Döhlen, Saxony. Eng. Pat. 9466, May 11, 1893.

This process relates to the use of rollers provided on their face with projections by means of which objects are stamped out of sheets of glass when in a heated and plastic condition. The improvement on former practice consists chiefly in the employment of a roller of gridiron form, and in mounting the dies or projections on the skeleton or gridiron roller in such a manner as to facilitate their removal at pleasure, and the construction of the dies, or projections, of pieces so mounted that by varying the arrangement of the pieces different decorative designs can be produced.

The advantages of the skeleton or gridiron roller are—(1) that on account of its smaller mass the glass is not chilled to the same extent as by a solid roller, and (2) that the air escapes freely through the grids, whereas with a solid roller the air is imprisoned under the dies or projections and acts prejudicially on the surface of the glass. —V. C.

Improvements in Glazing Pottery. H. L. Doulton and R. Meldrum, Lambeth. Eng. Pat. 13,416, July 22, 1893.

In the ordinary process of salt-glazing the common salt is thrown into the kiln at its highest temperature, when the sodium unites with the clay, forming sodium silicate, and the chlorine is evolved as hydrochloric acid gas in dense noxious fumes from the shaft of the kilns. According to the present invention the oxide, hydroxide, or carbonate of soda is substituted for the chloride, whereby the same glaze is obtained without the evolution of any noxious fumes. More commonly salt and soda-ash are used together, about $\frac{1}{3}$ salt to $\frac{2}{3}$ soda-ash. By using this mixture the amount of hydrochloric acid evolved is much less than in the old process.—V. C.

Improvements in the Production of Corrugated or like Roughened Surface Sheet Glass. W. L. Pilkington, St. Helens. Eng. Pat. August 23, 1893.

The molten glass is gathered upon a blow-pipe in the usual way and blown in a mould having corrugated walls so as to form a corrugated or fluted cylinder. The cylinder is withdrawn, split longitudinally in the usual manner, and then is laid upon a corrugated or fluted table in a hot chamber, and by this means is brought to the form of a sheet, which is subsequently removed and annealed. These sheets are specially suited for use with corrugated iron. —V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Beechwood as a Flooring Material. G. Stephan. Annalen für Gew. und Bauwesen, May 15, 1893, 201; Proc. Inst. Civil Eng. **113** [3], 7.

Attention is directed to the value of beechwood as a material for parquetry floors. The author states that practical experiments with this timber were undertaken mainly at the instigation of the State Department of Forests some 25 years ago, and that he has been surprised to find that in many cases which have come under his notice, the wood lasts better than oak used for a similar purpose. In fact, he has found that oak floors laid several years later than those of beech show much greater signs of wear, the oak being much deteriorated, while the beech put down 20 years ago was still sound in texture, and the fibre of the wood was as firm and fresh as if it had been laid only for a few years. The reason that many experts have rejected this useful and inexpensive material is, that the trees vary greatly in quality, in accordance with the soil in which they are grown, and their position in the forest. It is necessary to select the close-grained narrow-ringed wood, grown in special positions, which ensure freedom from sap and tough compact fibre. There is no other timber which depends so much for its quality upon the site and the soil upon which it is grown as the beech. Though employed at times without previous steaming, the wood is greatly improved by this process, which tears open the cell-walls and liberates the sap. It is advisable to carry out this treatment as speedily as possible after the timber is felled. Hints are given, based upon practical experience, as to the best methods of seasoning, and also as to the utilisation of the material in the manufacture of parquetry.

Soda-Mortars. C. Rabut. Le Génie Civil, **22**, 1893, 178; Proc. Inst. Civil Eng. **113**, 7.

The author gives the results of experiments undertaken with soda-mortars, and of masonry work carried out therewith during the winter of 1891—92, on the Carenton-Cantaret and Vire-Saint Lô and Caen railway lines, which it was desired to push forward in spite of the rigorous weather.

Mortar made both with and without the addition of cement was used, and has been exposed without injurious results to 10° to 15° C. of frost, either during the course of the work or immediately afterwards.

Anhydrous carbonate obtained by the Solvay process was employed. This carbonate, supplied in the form of powder, cost less for transport and labour than the hydrated carbonate. It was dissolved in boilers containing a solution of 2 lb. of carbonate to each gallon of water, the temperature being maintained at 30°. An equal quantity of water is afterwards added to this solution by the workmen, and, so reduced, it is used at a temperature of 10° to 12° C. In making mortar, 25 per cent. more of the solution is added than would be the case with plain water. The masons should be provided with india-rubber gloves.

The extra cost due to the employment of soda is estimated by the author at 1*s.* 6*d.* per cubic yard of masonry.

The addition of the soda not only permitted work to be carried on at a low temperature, but accelerated the setting of the mortar. Thus mortar mixed therewith set at 5° of frost twice as quickly as mortar mixed with plain water at 10° above freezing point.

Work executed with this mortar showed for some time white patches which finally disappeared, but this fact, and also the long continued dampness of the inner portion of the work, would prevent its use for the front elevation of buildings, but for all other purposes it may be used without fear.

The use of Quebracho Wood for Railway Sleepers. Georges Poulet. Rev. Gén. des Chemins de Fer, **16**, 1893, 75. Proc. Inst. Civil Eng. **113**, 49.

The Quebracho colorado wood is described by the author as being of a blood-red colour, very bright when freshly cut. It is found in great abundance in large forests in North Argentina. The wood so far has only been appreciated in Europe by tanners, as it contains a large proportion (said to vary from 15 to 20 per cent.) of its weight in tannin, to the presence of which the author ascribes its extraordinary durability. It is stated that when, for the purpose of extending railways in the province of Santa Fé, posts which had surrounded grazing enclosures were taken up, the wood, though having been for 150 years, and sometimes longer, in ground alternately parched by great heat or sodden by tropical rains, appeared to be in as good condition as though recently cut. The wood is specially suitable for railway sleepers, on account of the stability it gives, from its durability and weight, and by its freedom from attack by insects.

It weighs about 78 lb. per cubic foot, does not decay, and is not compressible, so that holes must be bored clear through the wood, and equal to the diameter of the bolts, &c. used.

It is calculated by the author that a sawn sleeper, f.o.b. at the port of shipment, would cost about 3*s.* 8*d.*, and freight to Europe (reckoning eight sleepers to the ton) about 2*s.* 6*d.*, giving a total of 6*s.* 2*d.*

PATENT.

The Manufacture of an Improved Composition for Waterproofing and other Purposes. W. Baker, Downham Market. Eng. Pat. 22,175, December 3, 1892.

This invention refers to a waterproof preparation for coating walls, paper, and other fabrics, and water-supply pipes. The composition is manufactured by dissolving shellac or resin in methylated spirit with application of heat. To the partially-cooled solution lead carbonate and carbolic acid are added.—C. O. W.

X.—METALLURGY.

A Supplementary Paper on a New Process for Desulphurising Iron and Steel. E. H. Saniter. Iron and Steel Institute, Spring Meeting, 1893.

This paper contains a number of practical results obtained by the author since the appearance of his previous paper on the subject (this Journal, 1892, 911), and brought forward to show the effectual working of the same as carried on at Wigan. Following these there is a report on the process by G. J. Snelus, who describes two days' personal experience with its practical working and quotes further results. He states that fluorspar may be mixed with lime, &c. in the ladle, and is efficient, but not so much so as when calcium chloride is used.—A. W.

The Elimination of Sulphur from Iron. Part II. J. E. Stead. Iron and Steel Institute, Spring Meeting, 1893.

The changes which take place when fluid oxides of iron act on molten iron containing sulphur are first examined. By experiment it is shown that when sulphurous white iron and basic ferrous silicate are heated together no sulphurous acid is formed, but that the sulphur existing as sulphide in the iron is removed, and is found in that state in the cinder. Most probably the basic slag dissolves out the sulphide of iron from the metal. The author then attacks the criticisms of Hilgenstock in *Stahl und Eisen* on the deductions in his previous paper (this Journal, 1892, 911—912; 1891, 704). He finds that some of Hilgenstock's experiments give in his own hands exactly opposite results, and states that "Herr Hilgenstock's statement that liquid iron is capable of dissolving out sulphur from the lime basic slags is not only negatived by all my experiments, but is constantly shown to be incorrect in the basic Bessemer converter whenever sulphurous iron is converted into steel, for, as will be shown presently, such lime basic slags become charged with sulphur during the after-blow, and yet, no matter how long they are kept in contact with the metal afterwards, there is no re-absorption of sulphur."

By practical tests in the basic Bessemer process and analyses, it is shown that it is only during the after-blow that any more than traces of sulphur is eliminated, but there is no indication of any sulphur being volatilised, as all that leaves the metal is accounted for in the slag.

The explanation of how it passes into the slag is that it is believed to be due to the excess of oxide of iron in the metal dissolving out the sulphide of iron and carrying it upwards into the calcareous slag, by which the sulphide is converted into oxide of iron with the formation of calcium sulphide. Hilgenstock maintains that the sulphur remains as sulphide of iron in the slag, but the fact that there is no tendency for it to return to the bath shows that either no sulphide of iron is present, or that, if it is present, the lime basic slag has a greater affinity for it than has the liquid iron.

The author gives two reasons in explanation of the fact that no sulphur is eliminated during the first stages of the blow, viz.:—"1st. Because the lime, although present in sufficient quantity, is solid and is only fluxed by the silicates, which rise to the surface and never become really very basic till near the end of the blow. 2nd. Because the mass of actual fluid cinder is very small compared with metal."

Further results obtained with the lime and calcium chloride process are then given, and it is believed that the sulphide of iron is dissolved out of the metal by these substances, and is converted into calcium sulphide and oxide of iron, and that the oxide so formed then reacts on some of the phosphorus, producing phosphoric acid, which with the lime basic slag forms phosphate, the oxide at the same time being reduced to iron, which returns to the bath. The fact that two analyses of slags show an insufficient quantity of iron and manganese to combine with all the sulphur proves that calcium sulphide must be present.

The irregular distribution of sulphur in iron and steel is next considered. In a basic pig containing about 2·5 per cent. of manganese, analyses by Ridsdale show that the sulphur at the top of the pig averaged 0·123 per cent. as compared with 0·049 per cent. at the lower part, this separation being probably due to the manganese carrying the sulphur to the surface as manganese sulphide in accordance with the law of the Hoerde process when the pig solidified. In a hematite pig the segregation of the sulphur was in the centre, and to the extent of about 45 per cent. over and above the average amount in the whole pig, the smallest percentage being found in the lowest portion. The importance of these facts cannot be overlooked in taking samples for analyses.—A. W.

Arsenic Works on the Tamar. Graphic, 1893, Rev. S. Baring Gould.

The great source of arsenic in England is the famous mine known as the Devon Great Consols. Early in the present century a spur of hills on the Tamar had attracted the attention of mining speculators. Money had been spent there without result other than that of exhausting the pockets of the shareholders, when, with great difficulty, a fresh company was formed in 1844 to make another attempt; and only 9 ft. below the point at which the mine had been abandoned one of the finest lodes of copper ore ever discovered was struck. It was 30 ft. wide and a mile in length. At the end of 10 months the company divided 70,000*l.* The lode was worked for 28 years and then gave out. It would have been abandoned before this had not the waste thrown out as worthless when copper was sought proved rich in arsenic. The Devon Great Consols is now resolved into arsenic works. Copper is still raised, but in comparatively small amount, and is despatched to South Wales, there to be smelted. As it takes 4 tons of coal to smelt 1 ton of copper, it is obviously advisable to carry the ore to the coals, and not bring the coals to the ore. Besides copper ore, the mine had yielded vast quantities of mundic. Mundic is iron pyrites; and the arsenical pyrites consists of 25 to 30 per cent. of iron, 12½ to 14 per cent. of arsenic, and the rest earthy matter. This goes through several crushing and sorting operations, the latter being carried on by girls from 13 to 16 years of age. After washing and "jigging"—that is, sifting—the arsenical pyrites is conveyed to the first calciner, where it is burnt with low-class coal and produces "arsenic-soot"—that is, arsenic so mixed with smoke-soot from the coal as to be of a grey colour. The arsenic and soot are deposited together in the chimney or condenser. This deposit is subsequently scraped out and taken to the second calciners to be purified.

These calciners consist of revolving iron drums, through which a fire of anthracite coal is carried, or rotating iron furnaces kept red-hot, to which the arsenical soot is fed, the arsenic being sublimed and condensed in a white condition.

The calcining of the arsenic is let out to the workmen. Three men in four weeks will make 100 tons of arsenic; if they make more they receive extra premium; if they burn the arsenic badly, so that it is wasted, they are fined, and the fine has been known to amount to 30*s*. Some years ago arsenic-soot fetched from 2*s*. 6*d*. to 15*s*. a ton; it is now worth from 7*l*. to 7*l*. 10*s*.

The chimney in which the arsenic is condensed is a mile long, carried on an incline up the hill, with iron doors in the side. As the hot blast passes up the chimney it deposits a crust of arsenic crystals on the brickwork all round to the depth of from 2 to 3 in., and it deposits minute dust of crystals on the floor. Before the smoke passes into the upright chimney, the height of which is 125 ft., it has to traverse a shower of water, which catches what remains of the arsenic, after which what passes forth is little else than sulphurous acid.

The crystals of arsenic are scraped out of the flue or condenser whilst still warm, and are ground in a mill to flour of arsenic, after which it is packed in small barrels containing a little over 3 cwt.

The men who work the arsenic, either raking up the arsenic-soot, or scraping out the condensers, or grinding it in the mill, are obliged to wear mufflers over their mouths and noses to prevent them inhaling the dust. The arsenic workers are obliged to wash themselves thoroughly every day on returning from the works, as the arsenic is liable to produce sores wherever it lodges in wrinkles and folds of the flesh, especially about the mouth and nostrils, the wrists and ankles, and under the arms—in fact, wherever perspiration lodges. As a rule, it only does this when the worker is careless as to his personal cleanliness. Otherwise the work is healthy; it prevents all eczema; and the fumes of sulphurous acid, as well as the arsenical dust, are fatal to the germs of disease—such as scarlet fever. Eventually the workmen may come to suffer from the chronic arsenical symptoms, which are—loss of appetite, silvery coating to the tongue, nausea, frontal headache, languor, sleeplessness, and anæmia. When that is the case they have to give up the work entirely, but many remain at the works for a great many years without suffering; but these are men who have been scrupulous about their personal cleanliness, and have not been careless concerning their mufflers.

The Determination of Chromium in Ferro-chromium. W. Galbraith. Iron and Steel Institute, Spring Meeting, 1893.

See under XXIII., *page* 713.

Methods of Determining Chromium, with Notes on the Distribution of Chromium in British Irons. J. E. Stead. Iron and Steel Institute, Spring Meeting, 1893.

See under XXIII., *page* 712.

PATENTS.

Improvements in Separating or Recovering Tin from Tin-Plate, and Apparatus for the purpose. J. F. Duke, Southwark, and F. Redman, Holborn, London. Eng. Pat. 7151, April 13, 1892.

Tin-plate is compressed and immersed in a bath of molten lead, whereby much of the tin adherent to the iron is

Fig. 1.

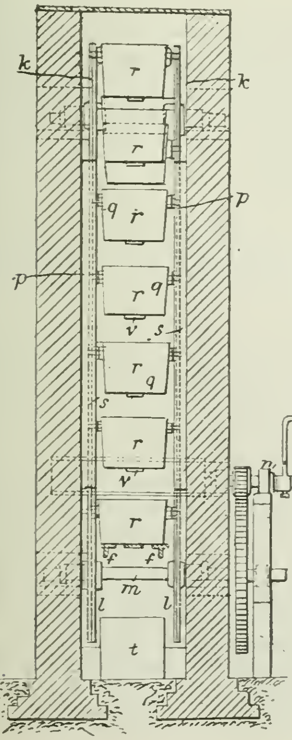
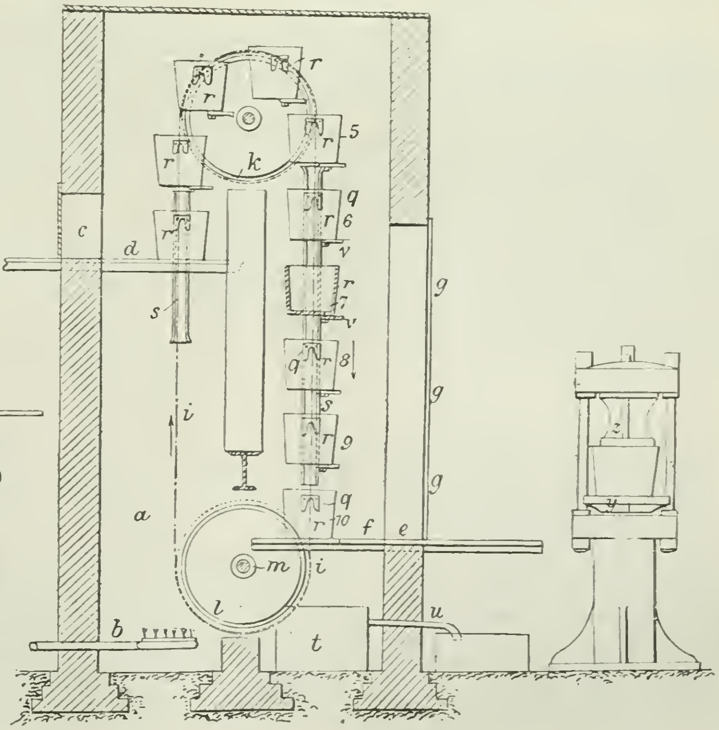


Fig. 2.



dissolved away after a short time; the lead containing tin is run off into another vessel and made to act on a further quantity of tin-plate, and so on, conveniently for six times in succession, after which the lead has taken up sufficient tin to be used as solder or for other purposes. The washed tin-plate is again treated with molten lead, a methodical system of passing the molten metal from one vessel to another being adopted. Finally, the hot residual iron coated with melted lead containing little or no tin is subjected to powerful pressure, by means of a hydraulic press or otherwise, so as to squeeze out the liquid metal. The apparatus used consists of a tower, or vertical flue, containing the vessels holding the fused lead, &c., arranged one above the other, so that the liquid metal can be run from any one to the next beneath it. By means of a furnace, gas flames, &c., the temperature inside the tower is maintained at somewhat above the melting point of lead. Figs. 1 and 2 represent the arrangement; the tin-plate and melted lead are introduced through the door *c*, into the vessels *r*, *r*, *r*, each vessel at first standing on a platform *d*. Two endless chains *i*, *i*, pass over and under two pairs of sprocket wheels *k*, *k*, *l*, *l*, so that by means of the gearing and handle *m*, *n*, the chains can be revolved as required. These chains carry at intervals projecting arms *p*, *p*, which engage with undercut lugs *q*, *q*, on the vessels *r*, *r*, *r*, thereby lifting up the vessels as the handle is turned, bringing them round the upper sprocket wheel without upsetting, and finally delivering them on the lower platform *f*. The movement is intermittent, say at intervals of 10 minutes, and is only equal to the distance between the suspension points of two consecutive vessels. By the time that a given vessel has reached the position marked 5, the solution of the tin in the lead is well in progress. Assuming that all the other five vessels (Nos. 6, 7, 8, 9, and 10) are in action, No. 10 is discharged by opening a valve, so that the molten lead tin alloy contained runs out into a receptacle *t*; the valve is then closed, and the liquid metal in 9 run into 10. In similar fashion the fluid contents of each vessel, 8, 7, 6, and 5, are successively transferred to the vessel next beneath. Vessel 10 is then withdrawn through the opening *e*, and its contents turned out into the containing box *y* of the hydraulic press (kept hot by gas or otherwise), and all fluid metal squeezed out. In similar fashion each of the vessels in the series is dealt with in turn.—C. R. A. W.

Improvements in the Extraction of Metals from Ores or Metalliferous Materials. J. Y. Johnson, London. From N. Lébédeff, St. Petersburg, Russia. Eng. Pat. 9127, May 13, 1892.

In a former patent (this Journal, 1892, 923) fused metalliferous materials are reduced by carbonic oxide, which passes through the walls of a vessel made of plumbago or similar carbonaceous material, and which floats on the surface of the bath. In this process the bath of fused oxides, sulphides, &c., is simply covered with coke or charcoal, on which flame and furnace gases impinge, producing carbonic oxide, and this is caused to pass through the fused mass by immersing a pipe or tube connected with a flue or other exhaust in the molten bath, it being stated that occluded gases will pass through fused materials in the direction of least resistance.—H. K. T.

Improvements in the Method of Treating Blue Billy or Purple Iron Ore, Iron Sand, and other Ores in a similar Condition, for the purpose of Preparing them for the Reducing Furnace. J. Bowing, Tilbury, London. Eng. Pat. 9442, May 18, 1892.

In order to render "blue billy" and similar ores suitable for reduction in furnaces they are mixed with coking coal and water, if necessary, and are coked in an ordinary coking oven, hard dense masses suitable for reduction in furnaces being the result. Good proportions are equal parts of the ore and a highly bituminous coal, but the proportions depend largely upon the quality of the coal and the kind of furnace for which it is intended. The coal may be powdered, and then plays the part of a substitute for tar or pitch in the process described in Eng. Pat. 11,083 of 1891 (this Journal, 1891, 628), which has the same object in view as the present patent.—H. K. T.

Improvements in Machinery or Apparatus used for Galvanising or Coating Sheets or Plates of Iron, Steel, or other Metals or Alloys with Zinc, or with Tin or Terne Metal or other Metallic Alloys. W. J. Walduck, Tipton. Eng. Pat. 10,354, May 31, 1892.

In this apparatus the rolls are outside the bath, the metal plate being controlled in its passage through the bath by means of curved guides. The plate as it issues from the bath presses against a moveable guide, which throws into gear a clutch or gripping apparatus, and this draws the plate from the bath.—H. K. T.

Improvements in Wet Upward Current Separators for Treating Metals, Ores, Gems, or other Minerals or Substances. W. S. Lockhart. Eng. Pat. 12,333, July 2, 1892.

The improvements are in apparatus for introducing gangue containing gems, slime containing metal particles, &c., into a stream of water of steady and adjustable flow at right angles thereto. The heavier particles, consisting of gems, particles of metal, &c., gradually sink in opposition to the stream of water, whilst the lighter particles are carried onward by it. The chief feature in the apparatus is a funnel which delivers its contents through an annular-shaped aperture into a vertical upward stream of water of annular cross-section, the channels being shaped so as to avoid eddy currents or unequal flow.—H. K. T.

Improvements in Treating Rich Argentiferous Blende and other Ores. J. David, Swansea. Eng. Pat. 12,491, July 6, 1892.

Finely-divided blende containing silver is treated with a boiling solution of "iron chloride" (a waste product from tin-plate works) "to which hydrochloric acid and oxidising agents are added," such as sodium nitrate, whereby zinc chloride is produced and sulphur precipitated. The residual ore can then be smelted for silver without the great loss which usually occurs in smelting silver ores containing zinc. The zinc may be precipitated from the zinc chloride solution by means of lime and recovered in the usual way. Good proportions are four or five times the weight of the ore of "chloride of iron" solution, 10 per cent. of the weight of the ore of hydrochloric acid, and 1 per cent. of sodium nitrate.—H. K. T.

Improvements in regulating Temperatures in Manufacturing Metals, and in Means or Apparatus employed therein. R. E. B. Crompton, London. Eng. Pat. 12,776, July 12, 1892.

The working of certain metals, &c., as regards rolling and wire-drawing, can only be carried out with advantage within certain limits of temperature, which are sometimes not very far apart; to maintain the temperature at the right point during the operation demands great care and skill on the part of the workman. The inventor employs the heat generated by a sufficiently powerful electric current as a means of ensuring that metallic sheet, strip, or wire shall be raised to the required temperature during the process of rolling or drawing. The current enters the strip or wire at a contact consisting of rollers or rubbers, and leaves at a point further on, which may be the rolls themselves or the drawplate, or a second contact just short of the rolls or drawplate. The current used is produced by a generator capable of heating the strip or wire to a temperature considerably superior to that required, and is reduced to the necessary strength by introducing resistances or otherwise; these may be actuated automatically by appropriate thermostats, or devices which diminish the current strengths when the desired temperature is exceeded. Several special arrangements for this purpose are described. In order to avoid the cooling effect of the air a casing or covering for the heated portion of the strip or wire may be conveniently used; this may, in certain cases, be made sufficiently air- or gas-tight to enable the space surrounding the wire or strip to be filled with a non-oxidising gas or vapour, so as to protect the metal from oxidation. When the temperature required is low and the thickness of the metal is small the heating up may be done wholly by means of the current; but if higher, the strip is preferably passed through a suitably arranged furnace on its way to the rollers, especially if the strip is of considerable thickness. In some cases, by means of a bath of melted metal, oil, or sand, &c., it is possible to ensure that the strip is heated to the required temperature without employing current for the purpose; but in general the combination of the direct furnace heating and the further heating by automatically regulated current answers better.—C. R. A. W.

Improvements in Treating Residues (Seconds) from Zinc Smelting, Galvanised Iron Scrap, Flux Skimmings, and Acid Residues for the purpose of obtaining Products therefrom. E. H. Cook and A. E. Petter, Bristol. Eng. Pat. 13,121, July 18, 1892.

Seconds and scrap iron are treated with spent acid from galvanising and tin-plate works and the clear liquor is set aside for the lead to separate as chloride. This chloride is subsequently purified by re-solution in hot water. The clear liquor, after the removal of the lead, is treated with ammonia obtained by heating flux skimmings with lime in a suitable furnace, and the precipitated ferric hydrate is separated and roasted for the production of red oxide of iron. The clear liquor, which now contains zinc and ammonium chlorides, is mixed with lime and heated, and the ammonia evolved, together with ammonia obtained as above, is passed into spent acid, as already described. The precipitate containing zinc is collected and dried.—H. K. T.

Improvements in Bronze Alloys. A. K. Huntington, London, and R. T. Preston, Deptford. Eng. Pat. 14,579, August 12, 1892.

Improved bronze alloys are prepared containing copper and zinc, to which various proportions of ferromanganese and nickel are added, together with small quantities of deoxidising and fluxing agents, such as sodium, potassium, or magnesium. Aluminium or silicon (siliceous iron) may also be used for this purpose, the quantity being somewhat increased if these elements are intended to form a sensible portion of the alloy. Tin in proportion usually not exceeding 1 per cent. may also be added. In preparing these alloys it is preferable first to alloy the ferromanganese and nickel, and then melt that alloy with the copper, lastly adding the zinc and deoxidising agents with the tin, if it is employed. Iron may be used instead of ferromanganese, in almost the same quantity; zinc may be diminished or omitted, the proportion of iron or ferromanganese and nickel being increased. Compositions suitable for many purposes are:—copper, 55; "zinc," 40; iron, 1; manganese, 3; nickel, 1, with or without one part of tin. Or copper, 82; iron, 8; nickel, 10.—C. R. A. W.

An Improved Method of Converting Pulverous Metallic Oxides into Solid Ores. N. Henzel, Wiesbaden. Eng. Pat. 14,739, August 15, 1892.

The powder to be treated is well moistened and stirred with a suitable proportion of aluminium silicate, such as ordinary clay; the mass is then made into irregular lumps and heated by the top flame of a furnace, when it becomes hard-burnt to a substance still sufficiently porous to be susceptible to the action of reducing gases. When iron oxide, such as roasted pyrites dust, or purple ore from copper extraction is thus smelted, silicon is contained in the reduced metal; thus 5 per cent. of aluminium silicate suffices in the case of the smelting of iron required to be poor in silicon; 10 per cent., with hæmatite free from phosphorus, so as to produce first quality hæmatite pig; 30 per cent., when ferro-silicon is required, containing 14 per cent. and upwards of silicon.—C. R. A. W.

A New Method of Dealing with Blast Furnace and other Slag, and Apparatus therefor. D. Rock, London. Eng. Pat. 14,982, August 19, 1892.

The molten slag is run in a stream between a pair of crushing rolls, the lowest portions of which are immersed in water, whilst water is simultaneously run on to it, so that the cooling and solidification take place simultaneously with the crushing. The pulverised mass falls into a water tank, whence it is raised by means of a power driven mechanical elevator. Instead of rolls, a revolving shaft may be used, carrying strong arms which strike the slag and break it up as it comes in contact with the water.
—C. R. A. W.

Improvement relating to the Coating of Articles with Zinc. E. H. L. Stürzel, Hamburg. Eng. Pat. 15,491, August 29, 1892.

According to the patentee metallic aluminium only enters into combination with zinc in the proportion corresponding with the atomic weights of the metals. If aluminium be melted in a separate crucible and "conducted to the zinc-bath," this becomes covered by a thin film of aluminium which serves as a protective coating, reducing the formation of ashes and of hard zinc to about one-half the usual amount when protecting covers of salammoniac, fat, and glycerin are employed. Moreover, the coating of zinc given to the articles dipped, is thinner, so that a considerable saving of zinc is effected. The inventor disclaims the inclusion of composite galvanising baths containing both aluminium and zinc, and consequently coating the articles with an alloy of the two metals.—C. R. A. W.

Improvements connected with the Production of Purple Ore Bricks or Blocks for Use in Blast Furnaces or other Furnaces, for the Production of Iron, and for other Purposes. H. Bird, Plymouth. Eng. Pat. 4072, February 24, 1893.

The improvements are effected by a combination of kilns for burning purple ore bricks or blocks, such kilns being so connected by flues that the hot gases from bricks which are being fired in one kiln are used to heat dried bricks placed in another kiln; whilst the hot air produced by cooling bricks which have been fired, is used to dry freshly made bricks. The kilns have fire-places along each side, and are provided with flues for conveying the fire-gases to the upper part of the kilns, whilst the waste gases or air are drawn off through apertures in the centre of the sloping floor, and are led by a flue to the next kiln. The kilns are built in rows of two or more chambers, each of which have filling and discharging wickets at each end, and a firing tunnel down the centre.—H. K. T.

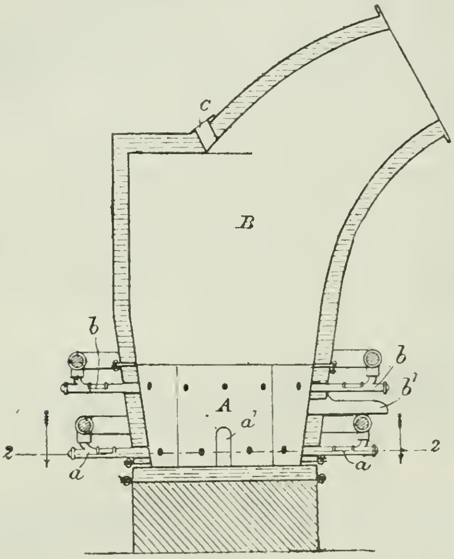
An Improved Process and Apparatus for the Extraction of Gold. E. de Pass, London. From L. C. Daumas, Paris, France. Eng. Pat. 6302, March 24, 1893.

Finely divided ore, containing gold, is immersed in protochloride of sulphur and chlorine is passed through the liquid until it is no longer absorbed, the mixture of ore and chloride of sulphur being heated to 130° C. The gold dissolves in the form of a double perchloride of gold and sulphur and is recovered by cooling the filtered liquor to the ordinary temperature when the double compound crystallises out. This is decomposed by water, giving metallic gold mixed with sulphur, the latter being removed by carbon bisulphide. Any chlorine which is not absorbed in the apparatus is caught by passing the issuing gases through protochloride of sulphur, and is again obtained in the free state by heating the latter to boiling. The protochloride of sulphur used for extracting can be used over again. If the ore contains other metals than gold these must be converted into oxides by roasting. A combined apparatus consisting of leaching vessels with steam heating tubes, filters, &c., is described.—H. K. T.

Improvements in and Relating to the Smelting of Ores and Refining of Metals, and to Apparatus therefor. C. M. Allen, Butte City, Montana, U.S.A. Eng. Pat. 8346, April 25, 1893.

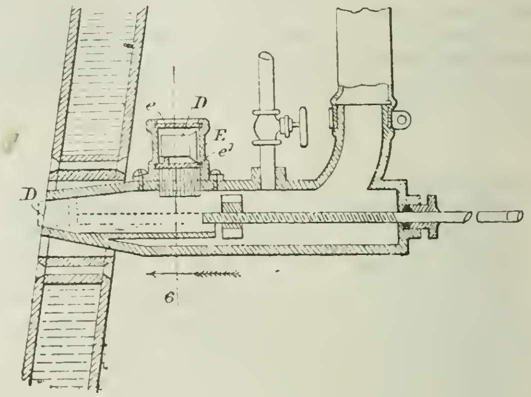
The essential portion of this invention consists in the employment of an arrangement whereby the tuyères of a blast furnace or converter can be mechanically plugged and closed without removal of the tuyères, or tipping of the converter. Fig. 1 represents a vertical sectional elevation of a combination of converter A and blast furnace B, each furnished with a row of tuyères *a* and *b* respectively. The whole is waterjacketted, including the base; a^1 and b^1 are orifices for running off molten metal and slag respectively. A wood fire is built in the bottom converter A, and coke gradually added until a good fire is burning above the level of the tuyeres, the lower row of which is plugged, as also the metal and slag holes a^1 and b^1. A gentle blast is then turned on through the upper tuyères and the raw sulphides to be smelted, added alternately with coke, the blast being gradually increased as the charge becomes greater. By-and-by the molten mass reaches the level of the upper tuyères; the lower tuyères are then unplugged, and a blast of sufficient pressure turned on, when the conversion of sulphides into metals begins, sulphur dioxide being formed and escaping, whilst metallic copper or lead is set free. Pyrites, quartz, lime rock ($CaCO_3$), or other substances are added as flux to promote fusion and formation of slag as required. After the blowing has progressed sufficiently the blast is stopped or checked by plugging the tuyères; the liquid contents quickly separate into two layers, so that on opening the slag hole with a pointed bar or otherwise, a certain quantity of slag is run off. The reduced metal is similarly tapped at the metal hole, and a corresponding quantity of fresh sulphides, &c. added through the upper charging hole. The tuyères being reopened and the blast again turned on, the process is recommenced, the new charge being immediately fired, since the interior and the portion of slag, &c. not drawn off are white hot.

Fig. 1.



The arrangement whereby the tuyères are alternately plugged and opened is indicated by Fig. 2. The plugs D are made of metal, clay, or preferably the same material as that treated, so that if ultimately forced into the converter no foreign matter is introduced. They are contained in a magazine E, furnished with two sliding doors or openings, the upper one, *e*, for refilling the magazine, the lower one, e^1, for allowing one plug at a time to drop down on to a suitable support or trough in a pipe connected with the tuyère in such a position that the plug is immediately forced onwards by the blast into the opening of the tuyère; the plug is made with an enlargement on its outer end so as to prevent its being blown through the tuyère into the converter. The blast is thus shut off from the tuyère affected, and the molten material inside the furnace prevented from running outwards into the tuyère. In order to open the tuyère hole the plug is either driven into the furnace by means of a bar or rod, or is withdrawn in the contrary direction by a rod or screw. This latter may be so constructed as to hold the plug in position so as to prevent its being forced outwards by the internal pressure whenever it is desired to shut off the blast.—C. R. A. W.

Fig. 2.



Improvements in the Manufacture or Conversion of Iron and Steel, and Compounds or Preparations to be used therein. J. A. Hunter, Philadelphia, U.S.A. Eng. Pat. 10,215, May 23, 1893.

In this specification cast-iron is said to be converted into steel by subjecting it to the action of chlorine, oxygen, and hydrogen, generated by introducing into the vessel containing the metal at a yellow or white heat, muriatic acid, chloride of lime, or bleaching powder, and salt; so that hypochlorous acid, HClO, is first formed, its elements being disunited in contact with the hot iron. The oxygen attacks and removes a certain portion of the carbon in the iron, the hydrogen assisting in the operation, and the action of the gases being facilitated by the presence of the chlorine. Or the chemical charge may be heated in a separate vessel so as to generate hypochlorous acid, which is then conducted into the crucible. If a certain proportion of carbon, such as vegetable charcoal, be also present, the mixture of muriatic acid, salt, and bleaching powder possesses the power of "*increasing*" the percentage of carbon in wrought-iron or low steel. The inventor states that metal originally containing 0·32 per cent. of total carbon contained after this treatment, 1·095 per cent.; using for 100 lb. metal 24 ounces muriatic acid, 32 chloride of lime, 32 vegetable charcoal, and 16 ounces of salt; whereas the same proportion of muriatic acid, chloride of lime, and salt without the charcoal gave good results in the way of decarbonising white iron to steel; one hour being requisite in the first case, and two hours in the second, the charge being directly introduced into the crucible when the metal had attained the proper degree of heat.—C. R. A. W.

Improvements in the Manufacture of Mineral or Slag Wool. H. J. White, Brooklyn, New York, U.S.A.—(Communicated by T. E. Halford, Bedford Park, Middlesex.) Eng. Pat. 10,358, May 25, 1893.

In order to prevent the evolution of sulphuretted hydrogen from slag wool during its subsequent use, blast furnace slag is fused in a reverberatory or other suitable furnace; a mixture of alumina and black oxide of manganese is then added (about 10 per cent. of the former, and 12 to 15 per cent. of the latter), "which combines with the sulphuretted hydrogen to form sulphides of aluminium and manganese." After about 30 minutes fusion the resulting compound is treated in the usual way by a jet of steam or air to form mineral wool. Instead of blast furnace slag, a mixture of silica, 2 parts; limestone or chalk, 5 parts; and felspar, 3 parts, may be employed, the last ingredient rendering the fused mass more fluid. When melted the alumina and black oxide of manganese are added as before.

—C. R. A. W.

Improvements in the Method of and Apparatus for Hardening and Tempering Steel Wire. H. B. Goldthorp, Liversedge, Yorks. Eng. Pat. 10,672, May 31, 1893.

In order to harden and temper steel wire suitable for use in the manufacture of card clothing so that it shall still retain its brightness and tensile strain, it is passed through the foundation of the flame from a series of gas burners so that the flame envelopes the wire, excluding air and heating the wire to the required degree. The hot wire then passes successively through a ferrule into which the flame plays; an oil bath which chills and hardens it; a series of pressure pads which wipe off the adherent oil; a tempering bath of melted lead or other soft metal, at the base of which is fixed a guide-bar under which the wire passes so as to submerge it under the fused metal; and finally a cooling bath of oil or other convenient fluid. Instead of a tempering bath of fused metal a gas flame "or the like" may be employed.—C. R. A. W.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electrical Resistance of Commercial Copper. E. Meylan. L'Électricien, 1893, 344.

The author refers to the difficulty he has experienced in obtaining pure copper in the form of sheet or strip when bought in small quantities. He gives the following tests of copper obtained from various sources, some of the samples were annealed, others hardened by rolling:—

Sample.	Specific Resistance.
No. 1	1·68 michrohms at 0° centigrade.
„ 2	1·82 „ „ „
„ 3	2·75 „ „ „
„ 4	4·05 „ „ „

The specific resistance of pure copper varies from 1·616 microhm to 1·653 microhm, according as it is annealed or hardened. Attention is called to the difficulties that might arise if such copper as that tested were inadvertently used.

The author found that, unlike copper, the aluminium of commerce is very fairly pure, its specific resistance varying from 3·16 to 3·35 microhms, while that given in the text-books for the pure metal is 2·945 microhms.

PATENTS.

Improvements in Apparatus for Use in the Electrolytic Decomposition of Metallic Salts. H. H. Lake, London. From I. L. Roberts, Brooklyn, and T. H. McGraw, Poughkeepsie, U.S.A. Eng. Pat. 20,111, December 9, 1890.

The improvements consist principally in the construction and arrangement of a diaphragm for use in the electrolytic production of caustic soda from common salt. The diaphragms are preferably composed of asbestos boards laid on opposite sides of woven asbestos cloth, which are then sewn up in a covering of cotton cloth or the like and exposed for 24 hours to the action of hydrochloric acid of about 12° B., squeezed and rolled in the acid and then thoroughly washed in water and flattened out.

—G. H. R.

Improvements in Apparatus and Means for the Electrolysis of Alkaline Chlorides. D. G. FitzGerald, London, Eng. Pat. 9799, May 24, 1892.

This invention relates to the electrolysis of soda or potassic chlorides, and has for its objects the prevention of the waste of energy caused by the evolution of chlorine, and to provide means whereby lithanode may be used as the anode. The improvement consists in the addition of an insoluble basic oxide, such as lime, magnesia, or oxide of zinc, but preferably the first-named, to the electrolyte in the anode compartment.—G. H. R.

An Improved Process and Apparatus for the Production of Sodium, Potassium, and like Metals by Electroylsis. H. C. Bull, New Brighton. Eng. Pat. 10,735, June 7, 1892.

According to this invention the chloride under treatment, which may be contained in any suitable vessel—say of cast-iron—is melted in a furnace, which is preferably one of the regenerative type fired by gas. The vessel for reducing the chloride is covered, and is separated or divided into two parts or chambers by means of a sleeve within which is placed a porcelain lining. This sleeve descends some distance into the melted chloride and keeps the products of electrolysis from recombining. The electrodes are carbon and iron bars respectively, and suitable means are provided for leading off the separated products.

—G. H. R.

Improvements in Secondary Batteries. H. F. Kirkpatrick-Picard and H. Thame, London. Eng. Pat. 10,855, June 8, 1892.

The improvement consists in forming the plates of a paste made of a mixture of red lead with sulphide of lead with or without the addition of bone ash, asbestos fibre, or other binding material. When the paste is sufficiently dry the plates are heated in a furnace so as to reduce them to metallic lead with evolution of sulphur dioxide, and lead frames for making connection are then cast round the plates so formed.—G. H. R.

An Improved Process for Manufacturing Compound and Elementary Bodies or Chemical Products by Means of Electricity, and Apparatus therefor. H. Nieiverth, Berlin, Germany. Eng. Pat. 11,382, June 17, 1892.

According to this invention the bodies which have to react on one another are acted on by static or induced electricity, which is conducted to them by the aid of a gas or vapour which is electrically conductive, the reaction being assisted or effected by the electricity.

—G. H. R.

Improvements in the Manufacture of Wire strips and the like by Electro-Deposition. R. D. Sanders, Eastbourne. Eng. Pat. 12,382, July 4, 1892.

The improvement consists in a matrix or mandrel (whether grooved, spiral, or otherwise) having the metallic surface or base upon which the metal is to be deposited, and the insulated divisions, arranged in such a manner that the deposition of the metal takes place freely in both the vertical and horizontal directions until it has assumed the required shape or section. The matrix may be oscillated and traversed during the operation. (See Eng. Pat. 7960, 1891.)—G. H. R.

Improvements in the Formation of Plates or Electrodes for Secondary Batteries. G. Carassino, Carshalton. Eng. Pat. 12,665, July 9, 1892.

The electrodes are formed by electrolytically depositing lead in a spongy metallic form upon leaden frames in a warm bath composed of water, caustic potash, and litharge. The frames may be composed of lead or of an alloy of lead and antimony, and to prepare them to receive the deposit must first be immersed for about 12 hours in a bath of 50 per cent. nitric acid and then dipped into a solution of caustic potash and be well washed. A suitable bath for the deposition of the lead is formed by an aqueous solution containing 3 parts caustic potash per 1,000 and litharge 8 parts per thousand.—G. H. R.

Improvements in the Electrolytic Extraction of Zinc. Abel and Imray, London. From Siemens and Halske, Berlin, Germany. Eng. Pat. 12,731, July 11, 1892.

This invention relates to a process by means of which the formation of zinc sponge during electrolysis is entirely prevented. The process is based upon the prevention of the supposed action of the zinc hydride ZnH_2, and the nascent hydrogen in causing the production of zinc sponge, by mixing with the neutral or slightly acid sulphate of zinc solutions free halogens, or such inorganic or organic halogen compounds (hypochlorous or hypobromous acids, or chlorhydrins of the glycols, &c.) which under reduction give off their halogens to the nascent hydrogen.—G. H. R.

Improvements in regulating Temperatures in Manufacturing Metals, and in Means or Apparatus employed therein. R. E. B. Crompton, London. Eng. Pat. 12,776, July 12, 1892.

See under X., *page* 694.

Improvements in the Electrolytic Production of Caustic Soda or Caustic Potash. C. A. Burghardt, Manchester. Eng. Pat. 12,977, July 15, 1892.

This invention relates to the production of caustic soda or potash from the sodium or potassium produced by means of the process described by L. Grabau in Eng. Pat. 15,792 of 1889 and 16,060 of 1890 (this Journal, 1890, 1041, and 1891, 147). The metallic sodium or potassium passing from the apparatus there described is caused to pass through a pipe heated to a point above that at which the metals vapourise and then steam is introduced into the tube through a suitable injector, with the result that caustic soda or potassium respectively are formed. The tube is kept heated above the solidifying points of these substances so that they can be collected at once in suitable iron drums for transmission.—G. H. R.

Improvements relating to the Electric Heating of Pottery and other Furnaces, and Materials therefor. F. von Poschinger, Buchenau, Germany. Eng. Pat. 13,095, July 16, 1892.

This invention applies to the heating of pottery and other furnaces by means of electric circuits in the walls or their surfaces adapted to develop and radiate heat on the passage of the current, and to the construction or lining of a furnace chamber with bricks of conductive but resistant material and similar mortar where required. The bricks are composed of ordinary brick material with the addition of a proportion of ground graphite and the mortar employed is also rendered conductive by the addition of the same substance.—G. H. R.

Improvements in the Manufacture of Electrical Storage Plates. E. B. Bright, Esher, and L. W. Mercier, London, Eng. Pat. 13,381, July 22, 1892.

According to this invention a woven fabric of some incombustible material, preferably asbestos, is treated with a slight coating of lead or carbon, so as to facilitate the subsequent adhesion of the lead. It is then passed over rollers into a bath of molten lead, in a similar manner to the ordinary process of galvanizing iron wire with zinc, and is then drawn out of the bath perpendicularly by guide rollers and quickly cooled, whilst undergoing compression. —G. H. R.

An Improvement in Tanks or Cells for Electrolysis and like Purposes. F. E. Elmore and A. S. Elmore, Leeds. Eng. Pat. 13,542, July 25, 1892.

The tank or cell consists of a wooden box, which is preferably lined internally with canvas or other texture, within which is placed another wooden box preferably covered externally with canvas or texture, leaving a narrow space between the two boxes, which may be from half an inch to an inch wide. The two boxes are held in position by distance pieces having very narrow contacts with the boxes. The space between the two boxes is then filled up with a soft plastic material, preferably of a bituminous character, poured in while the inner box is held firmly in position.—G. H. R.

Improvements in Secondary Batteries. S. A. Rosenthal and V. C. Doubleday, London. Eng. Pat. 14,250, August 6, 1892.

The active material is held in a perforated and corrugated piece of sheet-lead forming the conductor so that the material on both sides is held together by rivets formed from itself. This plate is contained within a frame of ebonite, or other suitable material, of about its own height and thickness. The frame is covered on both sides by a perforated ebonite lid, and the lids and the frame are held together by rivets so as to form a closed box containing the plate. The frame is provided with a recess for the plate tang to pass out.—G. H. R.

Improvements in or Applicable to Electrical Accumulators or Secondary or Storage Batteries. H. W. Headland, Leyton. Eng. Pat. 15,120, August 22, 1892.

The improvements consist in forming battery plates of one or more hollow bars, square, or of other shape in section, each consisting of a series of uprights with transverse ties or cross pieces forming recesses. These hollow bars are connected by transverse strips so as to form one plate, and the bars and recesses are filled with any suitable composition.—G. H. R.

Improvements in and Relating to Electric Batteries. D. Federman, Lerma, Italy. Eng. Pat. 15,319. August 25, 1892.

The improvement consists in adding continuously to the electrolyte the products of the solution of any oxidisable metal, for instance lead, in dilute sulphuric acid in presence of air. The elements are zinc and carbon, and the battery is so arranged that the dilute sulphuric acid circulates through the whole battery after coming in contact with the oxidisable metal, and this circulation keeps the depolarisation constant.—G. H. R.

Apparatus for Continuous Decomposition of Alkaline Chlorides by Electrolytic Fusion. J. Stoerk, Paris, France. Eng. Pat. 15,649. August 31, 1892.

The chloride is mixed with about 25 per cent. of the fluoride of the same metal which, without being itself decomposed, aids the decomposition of the chloride which takes place when the fused material is subjected to electrolysis. Fresh chloride is introduced from time to time, the fluoride being sufficient until the operation is stopped to clean out the apparatus. This consists of a gas-fire chamber of rectangular form covered by a cast-iron plate, which in turn is covered by one of steel, and within a flange projecting up from the plate all round is built a wall of refractory material lined with a number of carbon slabs cemented together with carbon and tar putty. The interior is divided into three compartments by partitions extending about half-way towards the bottom, each partition being of iron on the side facing the middle compartment and of carbon on the other. The two outer compartments are covered with refractory material. The middle with a flanged iron lid covered with ashes or similar non-conducting material. The positive electrodes which are carbon pass through the covers of the side compartments, while a plate or slab of iron or nickel extending through the lid forms the negative. Molten lead on the bottom of the chamber forms a seal and suitable means are provided for removing the products of electrolysis.—G. H. R.

Improvements in and Apparatus for Obtaining Metals by Electrolysis. H. L. Wise, London. From H. H. Frei. Bezirk Horgen, Zürich, Switzerland. Eng. Pat. 15,887. September 5, 1892.

The electrolyte is melted by internally fired heaters placed within the electrolytic decomposing vessel, and the separated molten metal itself serves to transmit the heat due to the combustion of the gaseous or other fuel within the heaters to the electrolyte. On first starting the heat is transmitted directly to the electrolyte, but as the metal separates it should be allowed to accumulate until its level is sufficiently high to cover the heaters during the electrolytic process.—G. H. R.

Improvements in and relating to Dry and other Galvanic Batteries. A. E. J. Ball, Plymouth. Eng. Pat. 16,545, September 16, 1892.

The electrolyte consists of a solution of equal proportions of calcium chloride, zinc chloride, and ammonium chloride, in water. This is thickened by the addition of Russian gelatin in the proportion of about one part of gelatin to ten parts of solution, and then plaster of Paris in the proportion of about two parts to one of solution is stirred in, forming a pulp-like mass which sets to the consistency of stiff dough.—G. H. R.

Improvements in the Production of Chlorine, Soda, and other Products by Electrolysis, and in Apparatus employed therein. H. Blackman, New York, U.S.A. Eng. Pat. 19,170, October 25, 1892.

According to this invention the difference in the densities of the electrolyte and the products of electrolysis are utilised to keep them apart. The electrolytic decomposition is effected in a rapidly-revolving vessel from the central portion of which an outlet passage leads off the chlorine gas and another passage provides for the escape of the hydrogen. As the sodium hydrate is generated against the cathode, it separates from the brine forming an annular layer against the outer portion of the vessel and escapes in drops into a trough through a minute delivery orifice. Carbon plates are preferably employed for the anodes, while the iron-containing vessels form the cathodes.
—G. H. R.

An Improved Diaphragm for Electrolytic Cells. C. N. Waite, Newton Highlands, U.S.A. Eng. Pat. 2586, February 6, 1893.

The diaphragm is composed of asbestos or other acid-resisting fibrous material, containing in its pores bichromatised gelatin. Glue or isinglass is dissolved in the smallest possible quantity of water, and to this is added a quantity of bichromate of potash equal to about 15 or 20 per cent. of the glue employed. After these ingredients are thoroughly mixed, asbestos or equivalent acid-resisting and strengthening material is stirred into the mass, which is then formed into sheets.—G. H. R.

Improvement in Device for Electrically Heating Crucibles and other Articles. W. Mitchell, Malden, U.S.A. Eng. Pat. 6922, April 4, 1893.

The heating receptacle for crucibles and other articles is composed of two sections of refractory heating material of high electrical resistance separated by an interposed strip of insulating material. Provision is made for connections with the electrical circuit, and the receptacle is provided with a filling of pulverised graphite or similar substance.—G. H. R.

Improvement in Electrically Heated Crucibles and Holders therefor. W. Mitchell, Malden, U.S.A. Eng. Pat. 6952, April 4, 1893.

The invention consists partly in a crucible consisting of two parts insulated from one another by an U-shaped bar or partition of asbestos or fireclay or other insulating material; and also in the combination therewith of a holder connected with circuit wires and having terminals in contact with the respective insulated halves of the crucible.
—G. H. R.

Improvements in Electric Accumulators or Storage Batteries, applicable also as a Constant Primary Element. H. Lehmann, Halle, Germany. Eng. Pat. 8808, May 2, 1893.

According to this invention, one of the two electrodes is filled with an active mass consisting of peroxide of barium, while the exciting liquid consists of a solution of barium chloride.—G. H. R.

An Improvement in Dry Voltaic Cells, and in Conducting Connections for the Carbons of these and other Electric Cells. Siemens, Bros. and Co., and E. F. Obach, London. Eng. Pat. 6565, May 6, 1893.

The cell consists of a zinc cylinder fixed on an insulating base, and containing a central carbon surrounded by concentric depolarising and exciting layers covered by granulated cork, or equivalent material for preventing the escape of moisture, and a bituminous seal. The connection to the carbon is made by means of a screw-threaded metal pin and its nuts, or a wire, placed in a hole in the carbon furnished with under-cut grooves or a screw thread, and round this pin is poured an alloy which expands on cooling, consisting of about two parts bismuth to two parts lead and one part tin.—G. H. R.

An Improved Electrolytic Apparatus. Haseltine, Lake, and Co., London. From T. Craney, Bay City, U.S.A. Eng. Pat. 9295, May 9, 1893.

A vat, preferably constructed of wood, and provided with an indestructible lining where necessary, is furnished with a hermetically closing cover and with suitable openings for the admission of brine and for the discharge of the liquid products of electrolysis. The entire bottom of this vat is covered with an indestructible porous medium such as ground slate, glass, &c., and partitions divide the vat into compartments in such a manner that they partially intercept the free flow of the liquid and compel it to flow alternately over the top of one partition and under the lower edge of the next. The cathodes may form these partitions, and the anodes are composed of carbon, and are enclosed in stoneware bells, preferably, non-porous, and provided with an open bottom projecting into the porous medium and supported above the bottom of the vat by a scalloped lower edge.—G. H. R.

An Improved Electrolytic Apparatus. Haseltine, Lake, and Co., London. From T. Craney, Bay City, U.S.A. Eng. Pat. 9297, May 9, 1893.

The invention consists in the construction of an anode composed of an open-ended tubular casing of suitable indestructible material such as stoneware, porcelain, or glass, adapted to form a protecting outer casing for a conducting mass formed of compressed powdered carbon. This tube is inserted into a body of carbon supported upon a porous diaphragm which forms the bottom of the compartment. The cathodes and anodes are supported in suitable apertures in the covers with which the compartments are hermetically closed, and the circulation of the electrolyte takes place through the layer of porous material on the bottom of the containing vessel.—G. H. R.

Improvements in or connected with Electric Batteries. C. P. Shrewsbury, London, and J. L. Dobell, Modbury. Eng. Pat. 9108, May 13, 1892.

This invention relates to the class of batteries in which the electrolyte is fused nitrate of potash, or other suitable nitrate, and the positive element is composed of carbon in any convenient form. It consists in the employment for the negative of a hollow and perforated or porous plate, cell, or chamber, packed with any suitable metallic oxide, such as the oxides of the following metals:—manganese, iron, cobalt, nickel, barium, lead, or copper.—G. H. R.

Improvements in and connected with the Manufacture of Electrode Plates for Secondary Batteries. J. E. Hofmann, Delligsen, Germany. Eng. Pat. 10,283, May 24, 1893.

The plates of lead which serve as supports or a foundation for the active substance, are provided with pocket-like recesses arranged at an acute angle to the surface of the plate; these recesses may be of a conical, pyramidal, cylindrical, or prismatic shape. The active material is firmly packed into these openings so that it may not fall out during formation and later use.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Methods of Testing Fats and Oils. E. Milliau. J. Amer. Chem. Soc. 1893, **15**, 153.

See under XXIII., *page* 714.

Detection of Sesame Oil. G. Ambühl. Zeits. anal. Chem. **32** [23], 255.

See under XXIII., *page* 713.

The Iodine Absorption Method. F. Gantter. Zeits. anal. Chem. 1893, **32**, 178.

See under XXIII., *page* 717.

New Method for Estimating the Iodine Absorption of Fats and Oils. F. Gantter. Zeits. anal. Chem. 1893, **32**, 181.

See under XXIII., *page* 717.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

PATENTS.

Improvements in or connected with, and Apparatus for, the Obtainment or Extraction of Gutta-Percha, or the like. H. E. Sérullas, Paris. Eng. Pat. 11,166, June 14, 1892.

This is a process for extracting gutta-percha from the dried and pulverised parts of the plant by the aid of solvents such as toluene. The material to be extracted is placed in a digestor which is provided with a steam jacket and agitator, toluene is run into the apparatus and heat applied, whereby all the gutta-percha is obtained in solution. This solution is then run into a still where the toluene is driven off. The latter is recovered to be used in subsequent operations, and the dry gutta-percha is removed from the still.—C. O. W.

Improvements in Lined Tubes or Hose of Caoutchouc, Gutta-Percha, or similar Materials. E. Herold, Berlin. Eng. Pat. 14,800, August 16, 1892.

The invention consists in the insertion in the inside of the tube of an articulated lining of metal or leather. The tubular lining and the hose may be manufactured separately. The lining tube is then coated on its outer surface with rubber solution and is introduced into the caoutchouc tubes to which it becomes cemented by this coating, or the rubber tube is formed upon the lining tube as on a core. The metal lining tube may be formed of a helically coiled metal band with overlapping convolutions, or of short and slightly tapered tubular sections, or a continuous metal tube may be employed, provided with annular or helical corrugations so as to afford it flexibility. When the lining tube is of leather it may be strengthened by an internal helical wire coil.—C. O. W.

Improvements in Paints. W. B. Abert and W. Scherer, Washington, U.S.A. Eng. Pat. 2169, February 1, 1893.

This invention refers to a substitute for white lead paint, and it is prepared by first grinding separately in oil, mica reduced to the state of an impalpable powder and gypsum. Then the two mixtures are ground together with addition of some gum tragacanth. The following proportions of these ingredients are quoted—

	Per Cent.
Mica	78·5
Gypsum	18·0
Oil	3·0
Tragacanth	0·5

—C. O. W.

Improvements in Non-inflammable Paint. R. J. Doyle, Owen Sound, Canada. Eng. Pat. 5939, March 20, 1893.

This paint is prepared by adding to a gallon of a mixture of equal parts of lime water and vinegar, one half-pound of salt, one quarter of a pound of alum, and one quarter of a pound of "white vitriol," each in the form of a powder. This mixture is then boiled, one gallon of linseed oil or other drying oil is added, the boiling repeated, and after addition of one gallon of crude petroleum, the mass is once more heated to the boiling point.—C. O. W.

A Varnish or Polish for Leather. C. H. Hollis and A. W. Byron. Duckmanton, Chesterfield. Eng Pat. 7721, April 15, 1893.

See under XIV., *page* 701.

Improvements relating to the Preparation of Solvents for Pyroxyline, Shellac, and similar Materials. L. Paget, Newark, New Jersey, U.S. Eng. Pat. 7784, April 17, 1893.

Fusel oil, wood-spirit, and benzine are mixed in the respective proportions of 8—5, 2—5, and 1—2 volumes, and the mixture dehydrated with calcium chloride. One volume of acetic acid is mixed with 3 to 4 volumes of this mixture, and the whole distilled. It is claimed that the distillate is a stronger and more active solvent of pyroxyline, shellac, and other gums than is a mere mixture of methyl acetate, amyl acetate, and benzine. Ethyl alcohol may be substituted for the fusel oil; oil of turpentine or benzene for the benzine; or a mixture of fusel oil, wood-spirit and ethyl alcohol in equal parts, mixed with $\frac{1}{8}$th to $\frac{1}{12}$th its volume of benzine, may be used with equally good results.

—J. G. W.

Improvements in the Manufacture of White Lead A. B. Browne, Cambridge, through H. H. Lake, London. Eng. Pat. 8345, April 25, 1893.

This is an electrolytic process for the manufacture of white lead, and it is carried out by placing metallic lead in a suitable vessel in electric connection with the positive side of an electric force, in the presence of a solution of an acetate or a nitrate of an alkaline base. A soluble salt of lead is formed on the anode and a solution of caustic alkali on the cathode. In consequence of the flow of the liquid against the cathode these two solutions intermix, with the result that lead hydrate is precipitated, the original alkaline salt being regenerated. The solution containing the lead hydroxide in suspension is then run into a settling tank, from which the clear solution is subsequently drawn off, then is used again in the electrolyser, and the lead hydrate is finally exposed to the air or to an atmosphere of carbonic acid, to convert it into hydrated carbonate of lead.

—C. O. W.

Improvements in Steam Vulcanising Woollen Waterproof Fabrics for Garments. S. Wiener, Salford. Eng. Pat. 14,012, August 3, 1893.

See under V., *page* 675.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENTS.

Improvements in the Process of Producing Tannin, whereby the Minor Products, such as Cellulose, Gum, Acetic Acid, and Bisulphite of Lime are obtained. E. A. Brydges, Berlin, and Upton, Middlesex. From A. Mitscherlich, Münden, Germany. Eng. Pat. 1665, April 6, 1882.

Wood deprived of its bark and sawn up into pieces of moderate size, is placed in a boiler provided with heating tubes, and appliances for supply and escape of fluid, steam, &c. After the closing of the boiler, the wood is steamed, and a solution of bisulphite of lime admitted. The average duration of the process is upwards of eight hours, at a temperature of 110° C., those parts of the wood which surround and penetrate the cells being dissolved, whereas the cells themselves remain in the fluid as a soft mass. Pressure being removed, the contents of the boiler are now heated to boiling point until the excess of sulphurous acid is driven off, which may be utilised for the production of fresh bisulphate of lime. The fluid, which is now separated from the cellular matter and contains, besides salts of lime, tannin, gum, and acetic acid, is employed principally (*a*) as material for tanning hides; (*b*) for the manufacture of gum; (*c*) for obtaining vinegar. The insoluble cellulose is white or nearly white, and the yield is, in some cases (from pine wood) as high as 86 per cent.—E. G. P. T.

Improvements in the Process of and in Means and Apparatus for Ungreasing Hides, Skins, Leather, and other Materials. G. Popp and J. H. Becker, London. Eng. Pat. 5700, March 16, 1893.

The process is a continuous one, the goods being suspended in containers, which are so connected that the solvent can be forced by water pressure from one into the other. The most greasy goods are suspended in the container, which receives the portion of the solvent which contains most grease, and those which are in the most advanced stage of degreasing are treated with the recovered solvent. The recovery is effected by causing the exhausted solvent to flow into a still, from which it is distilled into a receiver sufficiently high to allow of return to the containers by gravitation. Carbon tetrachloride is extolled for the purpose indicated in the title. The whole apparatus is closed.—A. G. B.

A Composition for Glueing Purposes. F. Hess, London. Eng. Pat. 7283. April 10, 1893.

To make 1 cwt. of the composition, 40 pounds of glue, 4 pounds of treacle, 1 pint of turpentine, 1 pint of linseed oil, and 64 pounds of water are boiled together for eight hours with continual stirring.—A. G. B.

A Varnish or polish for Leather. C. H. Hollis and A. W. Byron, Chesterfield. Eng. Pat. 7721, April 15, 1893.

This varnish is an alcoholic solution consisting of—

	Oz.
Shellac	14
Camphor	1
Resin	2
Spirit	20

—C. O. W.

Improvements relating to Softening, Roughening, Waterproofing, and Increasing the Durability of Leather and a Composition therefor. L. Alexander, Geestemunde, Germany. Eng. Pat. 9026, May 5, 1893.

The leather is coated with a mixture consisting of "benzine," two parts; oil of turpentine, 2 parts; colophony, 3 parts; varnish, 1 part. The varnish should preferably be linseed oil varnish, though turpentine oil varnish and spirit varnish may either of them be used with practically the same effect.—A. G. B.

XV.—MANURES, Etc.

Phosphorus in Moorland Soils. M. Schmoeger. Ber. 1893, **26**, 386—394.

It has been established by several chemists that a smaller quantity of phosphoric acid is extracted from Moorland soils by cold 12 per cent. hydrochloric acid than is present in the ash of the same soil. The author shows that such soils do not absorb an additional quantity of phosphoric acid from a solution of phosphate; his experiments indicate that the amount of phosphoric acid which cannot be extracted by hydrochloric acid exists in the soil in combination with a nucleïn-like substance.—A. R. L.

PATENTS.

Improvements in or connected with the Manufacture of Manures and Fertilizers. J. W. Lodge, Sowerby Bridge, Yorkshire. Eng. Pat. 11,724, June 23, 1892.

The improvements are concerned with the combination arrangement, and structure of machinery for drying, pulverising, and separating into fine, dry manure all forms of refuse and excremental matter which have been previously ground together.—A. G. B.

Improved Manure. J. Schmitt, Bubenheim, Germany. Eng. Pat. 10,189, May 23, 1893.

The manure consists essentially of coal, porphyry, granite, and mineral phosphates, with or without other mineral ingredients, the whole in a fine state of division and intimately mixed.—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Predominant Organic Acid in Sorghum Juice. O. Carr, J. Amer. Chem. Soc. 1893, **15**, 144—151.

A peculiar sparingly soluble incrustation has been observed to form on the tubes of the evaporating apparatus employed in Sorghum sugar-houses. The author has examined a quantity of this substance; he found that it contained about 16 per cent. of magnesium oxide, 8 per cent. of calcium oxide, and 50 per cent. of organic matter. On boiling it with 10 per cent. sulphuric acid or with acetic acid, and precipitation of the filtrate with alcohol, re-dissolution of the precipitate in water and final conversion into lead salt, triplumbic citrate, $(C_6H_5O_7)_2Pb_3$, is obtained. Parsons (Amer. Chem. J. **4**, 39) gives the results of an examination of "scale from Sorghum-sugar pans," and concludes that two-thirds of it consists of calcium aconitate. Bearing in mind that the substance examined by Parsons was derived from pans in which the boiling was conducted at the ordinary pressure, whereas that investigated by the author was obtained from vacuum evaporating apparatus, and also that citric acid is when heated converted into aconitic acid, it may be conjectured that the latter acid was a product of the manufacturing process and was not present in the original juice.—A. R. L.

Tunicin. E. Winterstein. Ber. 1893, **26**, 362—364.

Tunicin was isolated from the mantles of ascidians as follows:—The mantles were first repeatedly extracted with boiling water, then with cold 1 per cent. hydrochloric acid, and subsequently dried and pulverised. The powdered substance was boiled for an hour with a 1 per cent. solution of caustic potash, and after removing the alkali by washing with water, it was heated for an hour with 2 per cent. sulphuric acid. The residue was washed successively with water, alcohol, and ether when it consisted of almost pure tunicin, and contained only 0·1 per cent. of nitrogen. The product was dissolved in sulphuric acid, composed of concentrated acid, diluted with quarter of its weight of water. The solution thus obtained was then diluted until the liquid contained 2½ per cent. of sulphuric acid, and the whole was boiled in a reflux apparatus for an hour, then neutralised with baryta, and the filtrate evaporated to a syrup, which was extracted with absolute alcohol. In this way glucose (dextrose) was obtained in the crystalline condition; it was characterised by its rotatory power, its osazone, &c. The fact that glucose is formed by the hydrolysis of tunicin is confirmatory of the observations of other chemists.
—A. R. L.

Trehalum, a New Carbohydrate. C. Scheibler and V. Mittelmeier. Ber. 1893, **26**, 1331—1336.

In Syria and Persia a cocoon or gall nut-like formation produced by a variety of elephant beetle is found on the branches of a thistle or species of *echinops;* the cocoon is composed of the so-called trehala manna, which in these countries is used as a food or medicine Guibert (Comptes rend. 1858, **46**, 1213), isolated a sugar from it which was subsequently named trehalose by Berthelot. The manna was re-examined by Apping in 1885. The authors have obtained a new carbohydrate from trehala manna. The trehalose is first extracted from the manna by boiling it with strong alcohol, and the residue extracted with boiling water. The new compound *trehalum* separates after some hours and is re-crystallised from boiling water.

Trehalum, $C_{24}H_{42}O_{21}$, crystallises in microscopic prisms, is tasteless and very insoluble in cold water; the manna contains 16 per cent. It is extremely hygroscopic, does not reduce alkaline copper solutions, and yields no compound with phenylhydrazine. Aqueous solutions containing 0·2—0·3 per cent. gave a specific rotatory power $[\alpha]_D = 179$. On hydrolysis with sulphuric acid glucose (dextrose) is produced; diastase exerts no action upon it. Other properties are described.—A. R. L.

Adonitol, a New Pentitol. E. Fischer. Ber. 1893, **26**, 633—639.

Adonitol, $CH_2OH[CHOH]_3.CH_2OH$, is a crystalline compound obtained from *adonis vernalis.* It is very soluble in water and crystallises therefrom in colourless prisms, the solution has at first a sweet taste which, however, is soon succeeded by a sensation of numbness. It melts at 102°, does not reduce Fehling's solution, is optically inactive, and has no specific physiological action. On oxidation with sodium hypobromite a sugar, the *osazone* of which melts at 147°, is formed.

A most interesting reaction, and one which may prove of service in the investigation of other polyhydric alcohols, is that with benzaldehyde. When adonitol is dissolved in 50 per cent. sulphuric acid (3 parts) and shaken with benzaldehyde (2 parts), a crystalline magma is formed at the end of 12 hours.

The compound obtained is the *dibenzal* derivative $C_5H_8O_5(CH\cdot C_6H_5)_2$. It crystallises from hot alcohol in slender needles, melts at 164°—165°, and is decomposed when boiled with 5 per cent. sulphuric acid; hence it serves as a means of isolating adonitol in the pure state. Subsequent investigation showed that adonitol is related to ribose, $C_5H_{10}O_5$, a synthetic sugar, in the same way that mannitol is related to glucose. It is the first pentahydric alcohol discovered in the vegetable kingdom, and its occurrence renders it probable that ribose will also be found in nature.—A. R. L.

PATENTS.

Improvements in the Process and Machinery for the Continuous Refining of Sugar. L. E. A. Prangey, Paris France. Eng. Pat. 14,419, August 10, 1892.

This specification relates to the invention of a machine and its accessories whereby massecuite, entering one end of the machine, is, in its passage through, successively moulded into a continuous layer or sheet of sugar, so that refined sugar is delivered at the other end of the machine and requires only to be divided into pieces to render it a marketable article.

The machine consists of a reservoir into which the massecuite is continuously introduced, and passes out at the bottom between plates by means of which it is moulded into a layer or sheet of suitable thickness. This sheet is drawn on an endless perforated band over a horizontal grating composed of solid transverse bars through which the excess of "green syrup" drains off into a receptacle. Subsequently the sheet of sugar reaches another grating composed of zigzag pipes, and thus forming a continuation of the grating previously mentioned. Underneath the second grating are placed a series of conical basins which are connected with exhausted receptacles by means of valves; the vacuum in the first basin is weak but becomes gradually stronger in the succeeding ones. Through some of the pipes forming the second grating a current of cold water may be passed in a direction opposite to that in which the sheet of sugar is travelling; the object of this is to assist in cooling and solidifying the sheet, which latter, is however mainly accomplished by the air. At a certain point before it has become too cool the layer of sugar is treated with clarifying or bleaching agents. As the lower surface of the layer remains the coolest, it is advisable to finish the drying of this surface by passing a stream of hot water through some of the pipes forming the second grating. The sheet is finally dried in a suitable chamber by means of a steam coil.—A. R. L.

Improvements in and relating to Multiple Effect Evaporators for Treating Sugar and other Liquids. A. G. Berry, Aberdeen. Eng. Pat. 14,675, August 15, 1892.

The following claims are set forth in this specification. The construction of multiple effect evaporating vessels provided with a separate or removable heating chamber, placed within the lower case of the outer evaporating vessel, so that an annular space is formed between these vessels, through which space the liquid circulates in a downward direction; the use of segmental plates having rods with tapered heads which pass down a division of the tubes to regulate or shut off the circulation of the liquor through them, or of horizontal segmental baffle plates over the tube plates and a division of the tubes in the heating chamber, which are actuated by rods and levers, for the same purpose. —A. R. L.

Improvements relating to the Production of Dry Yeast. G. Francke and O. E. Rycander, Berlin, Germany. Eng. Pat. 16,048, September 7, 1892.

See under XVII., *page* 704.

Improvements in the Treatment of Molasses. F. Graeger, Vysocan, Austro-Hungary. Eng. Pat. 8795, May 2, 1893.

Certain kinds of molasses ferment only with difficulty. By treating such samples, after being neutralised with sulphuric acid, with a slight excess of the same acid at a temperature of 60°—75° C., and then filtering, either at the original concentration or when diluted, they ferment more readily. A "better" attenuation is also attained when the process is applied to samples of molasses which ferment readily.—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

Hops. L. Briant and C. S. Meacham. Trans. Inst. Brew. 6, 1893, 149—168.

Directions are given as to the sampling of hops by means of their external characters. The authors are of opinion that the proper use of sulphur, either during growth or kilning, is not objectionable, and may, in the latter case, be of advantage. Sufficient attention, they think, is not given to the different brewing values of hops of different years' growth.

Hops, on storing, lose tannin, resin, and their preservative power on beer. Beers brewed with new and yearling hops compare to the great disadvantage of the yearling hops, from their acidity and unsoundness on storing. Foreign hops have a greater preservative power than English, being, in the case quoted, as $2\frac{1}{4}:1$, but their peculiar harshness precludes their use in any large proportion.

The time of boiling with hops has no effect on the amount of albuminoids precipitated, but the beers are brighter the longer the time of boiling. It has no influence on the stability of the beers, but 60 minutes' boiling is necessary to produce the full hop flavour. The preservative power of the hops used in the copper was shown by a sounder beer being produced with 16 lb. of hops per quarter than with half that quantity. There was no difference in the amount of albuminoids precipitated in the two experiments.

The practice of reboiling the hops does not produce sounder beers, and the authors find a further large proportion of tannin is extracted during the second boiling. They are hence of opinion that Hayduck's explanation of the preservative power of hops as being due to resin is correct, rather than Griessmayer's, as owing to the tannin, new hops are extracted with much greater difficulty than are older ones, the common practice of brewers being, however, as though the reverse were true.

J. Heron, in the discussion which followed, said he had found that sulphured hops possess a remarkable keeping power, and also that, contrary to the authors, nearly all the tannin is extracted during the first boiling.—J. G. W.

Some Observations on Mr. Valentin's recent Paper on "The Analysis of Black Beers." G. H. Morris. Trans. Inst. Brew. 6, 1893, 169—172. (See also this Journal, 1893, 368.)

The method of beer analysis described by Valentin gives no information as to the form or state of combination in which the maltose and dextrin exist, but only their total amount.

The author claims priority (Brew. Trade Rev. 1890, 476), for the recognition of an unfermentable, reducing residue in beer and for the use of a correction on the results of beer analysis, for its reducing power. Valentin's hypothesis that the residue may be C. J. Lintner's isomaltose is erroneous, as Lintner describes his so-called isomaltose as being completely fermentable by vigorous yeast and easily and readily converted into maltose by diastase. The residue is a constituent of the malt, freely soluble in cold water and is not a product of the conversion of starch.

Two analyses of a stout are quoted, showing that it is possible with care to analyse black beers by the polarimetric method and obtain concordant results.—J. G. W.

PATENTS.

Improvements in the Production of Non-Alcoholic Beers or Ales. A. H. Hobson, London. Eng. Pat. 7663, April 22, 1892.

The inventor prepares a non-alcoholic malt liquor, at least from an excise point of view, by mashing malt in the ordinary way, only taking care that the infusion shall have a specific gravity exceeding by three times or more that of the finished beverage. By this means comparatively little of the nitrogenous matter will pass into solution.

After mashing, the temperature of the liquid is raised to about 88° C., sufficient to arrest the diastatic action of the malt. The wort is after some time drawn off and strained through spent hops from which the bulk of the tannin and the bitters have been removed. The greater part of the nitrogenous matter is removed by the little tannin still present in the hops.

The hops are now washed out with water, which is then added to the wort, and the mixture is concentrated below 100° C., until it acquires a specific gravity three times in excess of what the finished product is to possess. After cooling, till about 16°, the beer is filtered through swansdown cloths and diluted with water up to the proper gravity. If desirable it may be aerated with carbonic acid in the usual manner. No salicylic acid or similar preservatives are wanted.—L. de K.

An Improved Filter for Wine and other Liquids. W. Parkinson, London. Eng. Pat. 12,556, July 7, 1892.

The filter is made in the form of a vertical cylinder, divided into two halves by a perforated plate resting upon a ledge formed inside and supporting the finer filtering material. A bag suspended from the open top contains the coarse filtering material. The liquid, such as wine or water, is poured in at the top, and after percolating through the layers of filtering material, flows into the lower part, where it can be drawn off by means of a tap. An air tube admits air into the lower part of the filter.—E. G. C.

Improvements relating to the Production of Dry Yeast. G. Francke and O. E. Nycander, Berlin, Germany. Eng. Pat. 16,048, September 7, 1892.

The patentees claim the use of lactic acid as an agent for decolourising dark coloured molasses and similar waste products. The molasses, &c. are, when necessary, neutralised by heating at 75° C. with sulphuric or hydrochloric acid, mixed with nutritive materials, such as malt germs, rye bran, lupines, vetches, peas, and the like, and subsequently heated at 50°—55° C. for 15—20 hours with dilute lactic acid, either as such or as acidulated milk impregnated with the pure lactic ferment. A cheap source of lactic acid is the spent wash from distilleries.—A. R. L.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

New Method for Estimating Fat in Milk. L. Liebermann and S. Székely. Zeits. anal. Chem. 1893, **32**, 168.

See under XXIII., *page* 717.

A General Method for Testing Butter. R. Brullé. Comptes rend. **116**, 1255.

See under XXIII., *page* 717.

PATENTS.

Improvements in or relating to Powders or Preparations for Producing Custard, Blancmange, and the like. W. Chivers, J. Chivers, and S. Chivers, Histon. Eng. Pat. 4657, March 3, 1893.

The inventors mix the usual ingredients with a sufficiency of sugar, so that nothing but milk or water and heating is required for the desired article of diet.

In making a custard powder a good recipe is: Sago flour, 1 cwt.; powdered Valencia saffron, 3 oz.; sugar, 1½ cwt.; and almond or vanilla essence, 3 or 4 oz.

For blancmange powder the proportion of sago flour should be increased.—L. de K.

An Improved Process of and Apparatus for Sterilising Liquids. G. Popp and J. H. Becker, London. Eng. Pat. 5425, March 13, 1893.

Liquids, milk in particular, when sterilised by heat, often become unpalatable, probably owing to a local overheating which cannot be entirely avoided. Sterilisation by direct introduction of steam has not been attempted for fear of imparting an objectionable taste and of diluting the milk. The inventors have, however, found that by a combination of the two processes, very satisfactory results may be obtained, a milk after 35 minutes' application of steam being only found diluted to the extent of 3 per cent.

The apparatus consists of a closed vessel having an inner casing or shell, a steam-tight space or chamber being left between the two. The milk having been run into the vessel, steam is slowly admitted through a pipe to the steam space of the chamber between the vessel and the inner shell, and when the thermometer shows the temperature high enough, steam is conveyed into the liquid through a perforated pipe preferably in an oblique position for the purpose of promoting the circulation. By carefully regulating the temperature scarcely any condensation of steam will occur.

A vacuum-pump may be attached to the apparatus if it be desired to inspissate liquids during or after their sterilisation.—L. de K.

Improvements relating to Methods of Producing and Apparatus for Producing and containing Aërated or Gaseous Liquids. C. Hatton, London. Eng. Pat. 5549, March 15, 1893.

The chief feature of the inventor's aërating apparatus consists in the provision of a principal container for the highly-compressed gas, and of one or even two supplementary containers, which are intended to allow of the measuring off of the gas, which it is proposed to supply to the siphon containing the liquid to be aërated. The thoroughfare leading from the principal container is closed before any gas could go to waste, and all danger of bursting the vessel is obviated by means of exit valves.—L. de K.

The Manufacture of Improved Compounds to be used in Making Bread, Biscuits, and the like. S. Preston, Ramsgate. Eng. Pat. 6538, March 28, 1893.

By using the inventor's composition when making bread, biscuits, and the like, the dough can be made direct without either stirring in a ferment or setting the sponge.

For the so-called quick process, the inventor prepares a mixture of 20 lb. of glucose, which should be melted at a low temperature, and 40 lb. of common salt. When quite dry it is powdered and mixed with 2½ lb. of ammonium nitrate, 14 oz. of potassium phosphate, and 4 oz. of either magnesium phosphate or sulphate. For the slow process, 20 lb. of malt flour are substituted for the grape sugar.

The compound is used in the proportion of 5 lb. 5 oz. to a sack (280 lb.) of flour when the quick process is wanted; 1 lb. 4 oz. of the malt-flour mixture is required for the slow process.—L. de K.

An Improved Composition for Use as a Cattle Food. F. Ursin, Cöthen, Germany. Eng. Pat. 6974, April 4, 1893.

Any suitable feeding cake or meal—for instance, oil cake, meal, or groats, or cocoanut meal or groats—is mixed with half its weight of molasses, which will be readily soaked up without yielding a moist article. To better preserve the food the inventor proposes to add 1 per cent. of lime.

The materials are well mixed and pressed into cakes of any suitable form, or put up in bags as meal. It provides a food for cattle of a very rich and fattening nature.
—L. de K.

Apparatus for the Production of Sparkling Drinks. C. Malmendier, Cologne, Germany. Eng. Pat. 8683, April 29, 1893.

This is an apparatus for the rapid production of sparkling drinks, and is distinguished by the arrangement of a mixing vessel M (Fig. 1), corresponding to the capacity of the different bottles for gas and liquid, vertically above the neck of the bottle, as well as by the attachment of the bottle-holders together with the mixing vessel on a flat iron E, which can swing at the point Z about an axis lying between the bottle and mixing vessel, thereby allowing the bottle and mixing vessel to occupy a position alternately one above the other, as also of a thorough shaking together of the gas and fluid in the mixing vessel. Two or more similar apparatus as shown in Fig. 1 can be combined into a battery (Fig. 2), in which the flat-iron E is replaced by a frame revolving about an axis. Other improvements are also described so as to produce in different bottles different sparkling drinks under different pressures of gas, viz., the combination of one or more low-pressure reducing-valves branching off from the chief pressure-reducing valve, also the working of the shaking arrangement of the apparatus by an eccentric disc with crank motion.

Fig. 1.

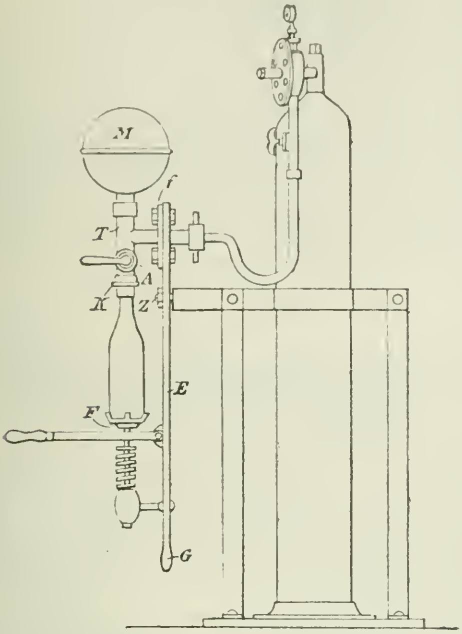
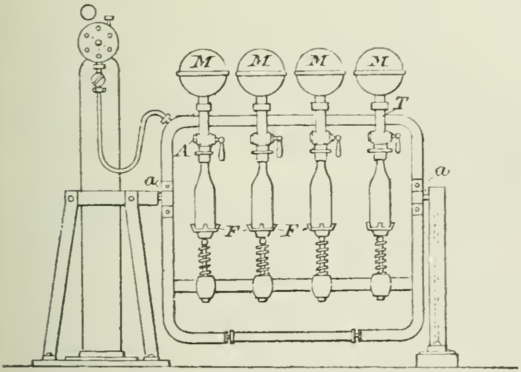


Fig. 2.



Improvements in the Method of and Means for Preserving Articles of Food. L. Häusler, Hamburg, Germany. Eng. Pat. 9145, May 8, 1893.

The articles, such as poultry, fish, meat, fruit, or vegetables, are immersed in and coated with a mixture of glycerin, gelatin, and boracic acid, which completely isolates them from atmospheric influences and thoroughly preserves them. If they have to be sent to some distance they may be packed in tins or other suitable air-tight vessels. The antiseptic is prepared as follows:—Glycerin is strongly heated to expel any water, and whilst hot, saturated with boracic acid. After being kept at a temperature of about 200° C. until nothing more evaporates, the mixture is allowed to cool, then mixed with 20—40 parts of hot water and kept for 24 hours at a temperature of 60° C. If required, a little more glycerin may be first added. After cooling it forms the inventor's boroglycerin. The mixture itself is made by diluting the boroglyceride with a judicious amount of hot water and dissolving in it, with the usual precautions, one half or an equal weight of gelatin. It is, of course, used before it enters the jelly-like condition. Before use the articles are washed with luke-warm water.—L. de K.

(*B.*)—SANITARY CHEMISTRY.

Experiments on the Action of Very Dilute Sulphuric Acid when used in Water-Mains to destroy Cholera-Bacteria. A. Stutzer. Zeits. für Hygiene, 1893, 116. Proc. Inst. Civil Eng. **113**, 39.

The author having previously satisfied himself by practical tests that a solution of 0·05 per cent. of free sulphuric acid was fatal to cholera bacteria in a quarter of an hour, repeated the experiments with percentages of acids varying in strength from 0·01 to 0·05 per cent., and obtained corresponding results. The 0·02 per cent. solution needed 24 hours, and the 0·03 per cent. solution was fatal in five hours; a few colonies escaped an hour's exposure to a 0·03 per cent. solution, and a few preserved their vitality after a like exposure to a 0·04 per cent. solution; but all the bacteria were destroyed, as before, by a 0·05 per cent. solution, even in a quarter of an hour. The results of these tests are set forth in a table. As the action of this weak acid upon the disease-germs was thus proved to be very energetic, it appeared that it might be employed to disinfect the service-pipes, if it did not attack the metal too strongly. In order to test this point, the author obtained from the Bonn waterworks some specimens of pipes in common use.

The author concludes that it is possible, by the use of this very dilute acid, to speedily destroy cholera-germs without any noteworthy injury to the pipes; further, that in the case of rusty pipes a mechanical separation of the incrustation takes place, and he believes also that it is probable that algæ and other vegetable growths, and even animal substances contained in them, would be destroyed. The treatment is not over costly, as he estimates that 100 kilos. of 60-degree sulphuric acid would suffice for the disinfection of 40,000 litres of water (about 1 lb. of acid to 40 gallons of water, or at an expense for acid of about $\frac{9}{10}$*d.* per 100 gallons of water treated).

Arsenic Works on the Tamar. Graphic, 1893. Rev. S. Baring Gould.

See under X., *pages* 692—693.

(*C.*)—DISINFECTANTS.

The Value of the Salts of Copper as Disinfectants. Dr. Green. Zeits. für Hygiene, 1893, 495. Proc. Inst. Civil Eng. **113**, 42.

From among the numerous salts of copper, the author selected for examination only those that are soluble in water. The substances used for his experiments were the crude and the pure sulphate, the dichloride, the nitrate, the acetate, the aluminate, the sulpho-carbonate, and the ammonia-sulphate of copper. Of all these salts, solutions were prepared of the following percentage strengths—1, 2, 2½, 5, and 10. It was found, however, impracticable to make 10 per cent. solutions of the nitrate, the acetate, and the aluminate of copper, on occount of their sparing solubility. The test objects were 24-hours-old bouillon cultures of cholera *vibrios*, enteric fever baccilli, and the *Staphylococcus pyogenes aureus*; also anthrax bacilli freed from spores, and the spores of the same dried on to silk threads, a mixture of excreta and urine, stale urine several days old, and a sterilised mixture of excreta and urine, impregnated, in the one case with cholera vibrios, and in the other with enteric fever bacilli. The effect of the eight selected salts upon these various test objects is set forth in a series of tables. The 5 per cent. solutions were in most cases fatal after two hours, but the anthrax bacilli, dried on to silk threads, were destroyed only by the dichloride of copper, and even this salt needed 27 days with the 5 per cent. solution, and 18 days with the 10 per cent. solution. In all the other experiments extending over 30 days, the remaining copper salts merely retarded the growth of the anthrax bacilli. As the general result, the dichloride of copper proved the most active of all the salts of copper, and the most fatal to the various bacilli. The relative values of the remaining salts are discussed; the second place is assigned to the acetate, and the third to the nitrate. All the salts of copper, except the dichloride, cause a coagulation in solutions containing albumen, and the effect of this action is investigated. It is suggested that the relative activity of the different copper compounds is in direct proportion to their contents in copper, the ratio of the copper to the other constituents being, in the dichloride 1 to 2·7, in the acetate 1 to 3·1, in the nitrate 1 to 3·8, and in the sulphate 1 to 3·9. Hence, arranged in the proportion of copper present in them, these various substances take exactly the same order as that of their value as disinfectants. From the aspect of price, it is shown that the 5 per cent. solutions of copper salts cost approximately the same as does carbolic acid of equal strength. It is pointed out that the sulphate of copper is now somewhat extensively employed as a disinfectant, and the author considers that the dichloride should take its place.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

Improved Manufacture of Paper or Cardboard resembling Leather. W. P. Thompson, Liverpool and Manchester. From The Göppinger Papier Fabrik, G. Kreem, Göppingen, Germany. Eng. Pat. 6802, April 1, 1893.

By this process it is claimed that paper or cardboard made of any suitable material and thickness can be treated during the manufacture in such a way as to render it as supple as leather, and to impart to it the elasticity necessary for leather embossing. The paper is passed, whilst in the paper machine, and preferably before undergoing the last wet pressing, through a vessel which is filled with glycerin, or with a mixture of water and glycerin "or some other easily-soluble oil," or with a more complex mixture of all the substances named. Mixtures of non-drying oils soluble in alcohol may also be employed. The best liquid has been found to be one obtained by mixing glycerin and water to a strength of about 7° B.
—E. G. P. T.

Unbreakable Substitute for Glasses for Clocks, Watches, Lockets, Spectacles, and Optical Lenses. N. Browne, London. From R. Hansel, Dresden, Saxony. Eng. Pat. 7954, April 19, 1893.

For this purpose the inventor employs transparent celluloid, which "experiment has shown" to behave, as regards refraction, similarly to glass. The elasticity not only greatly facilitates the insertion of all such glasses into their settings or frames, but also obviates the chipping of the edge, at the same time diminishing the wear upon the frame or setting. They are bevelled in order to enable them to be fixed more firmly in their mounts.—E. G. P. T.

Method of and Apparatus for the Manufacture of Blotting Paper. G. L. Jaeger, Maywood, New Jersey, U.S.A. Eng. Pat. 8334, April 25, 1893.

The invention has reference to the manufacture from ordinary paper, preferably unsized, as delivered from the machine, of commercial blotting paper having the appearance and all the essential qualities of the paper made by the more expensive and slow processes now in use. To this end, "the stock is simultaneously and repeatedly subjected to an indenting action, as distinguished from a mere fluting or bending action," to disturb, loosen, and separate the fibres throughout the body of the paper, whereby it is rendered highly absorbent and very pliable. This result is secured by means of a machine consisting of a series of stamps and dies (or rolls) provided with indenting faces gradually varying in fineness, through which the paper is slowly drawn. The dies and stamps are set in such a way as to cause the projections and recesses to *mesh*, when said stamps and dies are brought together, whereby numerous small indentations and protuberances are formed throughout the body of the paper. In other words, the paper is pushed in and out from both sides in small portions, whereby its fibres are disturbed and loosened.—E. G. P. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Absolute Alcohol. E. R. Squibb. J. Amer. Chem. Soc. 1893, **15**, 126—140.

In a former paper (Ephemeris, 1884, **2**, 522) the author obtained as a mean result of the specific gravity of alcohol dehydrated by slow cold percolation through quicklime the value at $\frac{15 \cdot 6^\circ}{15 \cdot 6^\circ}$ C. 0·79350. Hopes were expressed in this communication that the subject would be taken up by other chemists and the results checked. This has not however been done, and the author, who still considers that absolute alcohol has up to the present time not been obtained, has therefore returned to the subject.

The specific gravity determinations were taken in a flask of 500 cc. capacity, and the weighings made on a balance sensitive to 0·002 grm.

The "original" alcohol used throughout this investigation had a specific gravity at $\frac{15 \cdot 6^\circ}{15 \cdot 6^\circ}$ C. = 0·793824.

Dehydration by Metallic Sodium.—The mean of the values obtained for the specific gravity of alcohol dehydrated in this manner was not below that of the original alcohol; it is therefore regarded by the author as a negative result.

Dehydration by Quicklime.—A portion of good quicklime was slaked with just enough water to make a fine dry powder, it was then introduced into the centre portion of a piece of 3-inch wrought-iron pipe, to the ends of which caps were loosely screwed on, and the pipe was subjected to a dull red heat for four hours; it was then cooled over night. 2·5 litres of the original alcohol were mixed with 500 grms. of this lime and shaken with it for half an hour at a time during an aggregate of 60 hours in five weeks; the alcohol was then filtered off, excluding, as much as possible, atmospheric contact, and distilled. The various fractions were mixed and passed 10 times through a lime percolator which contained almost 1 kilogrm. of alternate strata of fine and coarse lime, supported on a layer of glass wool, and the product redistilled. The most trustworthy determination of the specific gravity gave a value at $\frac{15 \cdot 6^\circ}{15 \cdot 6^\circ}$ C. = 0·793549. A portion of the original alcohol was now passed 25 times through the lime percolator and distilled. Two trustworthy determinations were here obtained, viz., 0·793576 and 0·793561 at $\frac{15 \cdot 6^\circ}{15 \cdot 6^\circ}$ C. The mean of the three trustworthy results is therefore 0·793562, a somewhat higher value than that previously obtained, although the experiments were carried out with "better apparatus and better management" than formerly.—A. R. L.

Action of Acetic Anhydride on Linalool; its Transformation into Geraniol. G. Bouchardat. Comptes rend. **116**, 1253—1255.

The author has arrived at results identical with those obtained by Barbier when allowing acetic anhydride to act on licaréol. The author, however, has started from a linalool recovered from oil of lavender (*Lavandula spica*). The linalool acetate obtained by the action of acetic anhydride boils at from 120°—125° C. at a pressure of 25 mm., and its sp. gr. = 0·9377—0·9467 at 0° C. On saponification with alcoholic potash at 100° C. it yields an alcohol, $C_{20}H_{18}O_2$, optically inactive, having the property of absorbing four atoms of bromine. This alcohol is identical with geraniol. (See Semmler, this Journal, 1892, 706.)

—J. L.

Conversion of Quinine Alkaloids into their Isomerides. Z. H. Skraup. Ber. **25**, 2909—2912.

According to Königs, the halogen hydride addition products of cinchonine are decomposed on boiling with alcoholic potash regenerating cinchonine and also giving an isomeric base, isocinchonine. Skraup finds that when the hydric iodide addition products of several quinine alkaloids are subjected to this treatment that the original base is not always regenerated. In the case of cinchonidine, for instance, the alkaloid is converted completely into a new base, viz., β-cinchonidine, which differs from cinchonidine in having a higher melting point, 244° C., and in giving a neutral sulphate, hydrochloride, and nitrate, none of which salts will crystallise. Larger yields of these new bases are obtained if silver nitrate be used instead of caustic potash. When treated in this way cinchonine hydric iodide gives a small quantity of isocinchonine, together with a new base, β-cinchonine, which, like cinchonine, is sparingly soluble in ether and melts at 250°—252° C., but differs from it in giving a neutral sulphate—

$$(C_{19}H_{22}N_2O)_2 2H_2SO_4 2H_2O,$$

which crystallises in thin matted needles. Cinchonidine hydric iodide with silver nitrate gives γ-cinchonidine, which differs from β-cinchonidine in its melting point, 238° C., and also in giving only a crystalline acid tartrate, whereas the neutral tartrate and the oxalate of the β-derivative are both crystalline. Both isocinchonine and β-cinchonine give compounds with hydric iodide of the formula $C_{19}H_{22}N_2O.3HI$ very similar to the cinchonine derivative, but whilst the β-cinchonine compound on treatment with either caustic potash or silver nitrate is reconverted into β-cinchonine and some isocinchonine, the isocinchonine compound when treated with caustic potash is converted chiefly into a new base, γ-cinchonine, which melts at 230°—235° and gives an anhydrous neutral sulphate—

$$(C_{19}H_{22}N_2O)_2H_2SO_4$$

crystallising in needles. These compounds β- and γ-cinchonine are possibly identical with compounds obtained by Jungfleisch and Lèger by heating cinchonine with sulphuric acid. When quinine hydric iodide is treated with caustic potash it yields quinine and two new bases, pseudoquinine and nichine, in about equal quantities, whilst by using silver salts more nichine is obtained. Pseudoquinine, $C_{20}H_{24}N_2O_2$, is isomeric with quinine, melts at 191°, and resembles its isomeride in being levo-rotary. It crystallises easily and is anhydrous, and its neutral hydrochloride, $C_{20}H_{24}N_2O_2HCl$ and nitrate, crystallise easily and are sparingly soluble. A very sparingly soluble basic nitrate $(C_{20}H_{24}N_2O_2)_2HNO_3$ was also obtained. On treatment with hydric iodide, pseudoquinine gives an addition product which is probably identical with that obtained from quinine, since on decomposition with caustic potash it yields quinine, pseudoquinine, and nichine. Nichine appears to have the formula $C_{19}H_{24}N_2O_2$, and its formation would be expressed by the following equation :—

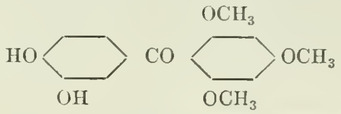
$$C_{20}H_{24}N_2O_2 + 2H_2O = C_{19}H_{24}N_2O_2 + HCHO + H_2O.$$

The base crystallises more easily than pseudoquinine, gives an acid hydrochloride and hydric iodide sparingly soluble in alcohol and water, a well crystallised acid sulphate, and an oxalate almost insoluble in hot alcohol, which has the composition $C_{19}H_{21}N_2O_2 2C_2O_4H_2$. With hydric iodide an addition product is formed, $C_{19}H_{21}N_2O_2 3HI$, which, however, differs from that of quinine and when decomposed with caustic potash regenerates nichine and gives a smaller quantity of an isomeric base isonichine. All the hydric iodide addition products of quinine, cinchonine, and cinchonidine when boiled with water give a neutral distillate which reduces silver nitrate, and hence probably contains formaldehyde, so that cinchonine and cinchonidine are also possibly converted into bases containing one atom of carbon less, in the same way that quinine is.—T. A. L.

The so-called Leucotin and Cotogenin. G. Ciamician and P. Silber.

Leucotin.—This substance was isolated by Jobst and Hesse (Liebig's Annalen, **199**, 40) from paracoto bark. A sample of leucotin was placed at the disposal of the authors by the firm of E. Merck. This was found to consist of a mixture of nearly equal parts of methylprotocotoïn and methylhydrocotoïn together with about 10 per cent. of paracotoïn, all of which have been described (this Journal, 1891, 383 and 1025), It is not to be regarded as certain that Jobst and Hesse's leucotin was identical with the substance examined. When, however, a mixture of methylprotocotoïn and methylhydrocotoïn in the proportion 3:2 is dissolved in glacial acetic acid, the solution evaporated, and the residue crystallised from dilute alcohol, homogeneous crystals are obtained agreeing with Jobst and Hesse's description of leucotin. Since, therefore, leucotin cannot be regarded as a definite compound it must be cancelled from the list of substances isolated from paracoto bark.

Cotogenin.—Jobst and Hesse obtained this compound by fusing either leucotin or oxyleucotin (methylprotocotoïn) with potash. The authors show that it is a dihydroxybenzoylphloroglucinol trimethyl ether—



—A. R. L.

Vanilla Cultivation in Mexico. Revista Fin. Mexicana, June 11, 1893.

At the time of the conquest of Mexico the Aztecs used the vanilla for flavouring chocolate. The Spaniards learned its use from them and introduced it into Europe. Gathered at first from the vines growing wild in the forests, its cultivation as a special industry became profitable, though at what date there are no records to show; but as early as 1760 there were *vainillales*, or vanilla plantations, in the vicinity of Papantla.

A native of Eastern Mexico, this plant grows wild in the State of Veracruz, from one extremity to the other of its coast line, and from the sea beach up to the mountains of the Sierra. It is cultivated mainly in the cantons of Misantla and Papantla, in that State, the little that is produced in Oaxaca being for the most part gathered from the vines which grow wild and uncultivated in the forests.

The vanilla plant belongs to the orchid family, has a pulpy stem which grows to several yards in length, attaches itself to trees, and appears to be little dependent on the soil for nourishment. The leaves are lanceolate and pulpy, and the yellow flowers bud from the axilla formed by the leaves with the stem. The fruit is a pod from 6 to 12 inches long, and about half an inch in diameter at its thickest part, tapering down towards the stem, curved in its entire length, dark green in its earlier stages, and yellow when fully ripe. It is filled with minute black seeds, somewhat resembling iron filings. When prepared for market the pod becomes reduced to about a quarter of its original thickness, is black in colour, and emits a very agreeable perfume.

Six varieties of vanilla are known in Mexico, namely, the *mansa*, the *cimarrona*, the *mestiza*, the *pompona*, the *puerco*, and the *mono*. Of these the *mansa* is the only one cultivated. The cimarrona, or wild vanilla, has a more pointed leaf and a thinner vine than the mansa; the pod is shorter, rounder, and thinner. The mestiza has more pointed leaves than the mansa, but less so than the cimarrona; the size of the pods is smaller than those of the mansa, and larger than those of the cimarrona. This variety is scarce, and when prepared it can hardly be distinguished from the mansa. The pompona (*siguexante* or banana vanilla, as the Totonaco Indians, who occasionally eat it, call this variety) has larger and rounder leaves, and a vine one-half thicker, than the mansa: the pod is double the size, and triangular in shape, resembling somewhat a badly nourished plantain; it has an extremely pleasant smell, not unlike anise, and is used in Habana by the tobacco manufacturers to mix with cigars. The puerco and mono, which grow wild and resemble the cimarrona, are not used in commerce.

There is yet another vanilla, called the tarro, or bamboo vanilla, which is considered by many as a distinct species, but is really nothing else than the mansa grown in the *tarrales* or bamboo thickets in the depths of the virgin forests, where it does not receive a sufficiency of sun and air, and produces a pod thinner and longer than the ordinary mansa.

The vanilla buyers formerly divided the prepared bean into four classes, namely:—

1. The beans or pods from $6\frac{1}{2}$ inches long and upwards, short in the neck or stalk, sound, and black; the beans which become split or open, providing they have the foregoing qualities, and the split does not extend more than a third of the pod. This class was again subdivided into *terciada*, which is composed of the shortest pods; *primera chica*, which contains the next in size; *primera grande*, the next; *marca menor*, the next; and *marca mayor*, the largest of all.

2. Those pods which differ from the *terciada* only in being shorter, two of them counting as one of the first class.

3. *Zacate*, or the pods of all sizes which are imperfect through being gathered before becoming properly ripe, or being over cured *pescozuda*, *vana*, *cueruda*, and *aposcoyonada*, all names for pods in a more or less damaged condition; and *cimarrona*, or wild vanilla, in good or fair condition, three pods counting as one of the first class.

4. The *rezacate*, composed of the very short pods; of those split clear up to the stalk; of the badly damaged; of the very immature; and of the very much over cured, which resembles a piece of wood; of this fourth class, six pods counted as one of the first class. The quantity of this and of the second class was always very limited.

At the present day the only distinction made is between the best class and the cimarrona and rezacate, the two last being sold at a very much lower price than the former.

Estimation of Vanillin. F. X. Moerk. Amer. Jour. Pharm. **63**, 572.

See under XXIII., *page* 718.

Valuation of Ipecachuana. C. C. Keller. Schweiz. Wochenschr. f. Pharm. through Zeits. Anal. Chem. **32** [2], 262.

See under XXIII., *page* 718.

Constitution of Nicotine. F. Blau. Ber. **26**, 1893, 628.

See under Anal. and Scient. Notes, *page* 718.

PATENT.

Improvements in and Apparatus for Obtaining Oxygen and Nitrogen from Atmospheric Air. L. Chapman, London. Eng. Pat. 11,504, June 20, 1892.

This invention consists of an improved method of and apparatus for effecting the separation of oxygen from air by the alternate oxidation and reduction of a mixture of manganese dioxide (or a similar substance) and caustic soda by means of air and steam respectively, and it is claimed that it obviates the difficulty experienced in the ordinary process through the two substances not remaining in a state of thorough mixture. Finely-divided manganese dioxide and sodium hydrate in the proportions necessary for the formation of manganate, are mixed with an amount of sodium sulphate equal in weight to the sodium hydrate used, the sulphate being added as a flux. Air is passed into the molten mass through small pipes, which reach nearly to the bottom of the containing vessel, so that in its passage upwards it keeps the mixture in a state of agitation, and so ensures thorough oxidation. When oxidation is complete, the air is shut off, and the air in the upper part of the vessel and in the supply and exit pipes removed by steam. Dry steam is then passed into the contents of the vessel in the same manner in which the air was, and the oxygen evolved collected.

The supply of air and of the steam used both for removing the air and for deoxidation, is effected by an elaborate automatic apparatus, to understand which the specification and its accompanying drawings must be consulted. Nitrogen may be obtained by slightly modifying the apparatus and by collecting the gas which escapes from the vessel during oxidation, and passing it again through the manganate mixture until the whole of the oxygen has been removed.

If sodium sulphate is used as a flux, iron cannot be used as the material for the heating vessel unless it be coated with a metal on which the sulphate has no action.

—J. G. W.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Manufacture of Pyroxylin. W. D. Field. J. Amer. Chem. Soc. 1893, **15**, 140—144.

For the manufacture of pyroxylin, cotton fibre, wood fibre, and flax fibre in the form of raw cotton, scoured cotton, paper, and rags, are most generally used and give the best results. The fibres differ greatly in their manner of nitrating, and the difference is undoubtedly due to their physical structure rather than to variations in their composition, as Hardwick assumes (Manuel Phot. Chem., p. 136).

One of the largest manufacturers of pyroxylin uses the "Memphis Star" brand of cotton, which is an upland cotton, and its fibres are very soft, moist, and elastic. Its colour is a light creamy white, and is retained after nitration; the staple is short, and the twist inferior to other grades, the straight ribbon-like filaments being quite numerous. This cotton is carded but not scoured before use; it contains a large quantity of half-ripe fibre which is extremely thin and transparent, a significant fact when it is known that a very soluble pyroxylin can be produced from this cotton.

Pyroxylin of an inferior grade only as regards colour, can be produced from scoured cotton wastes. Paper made from the pulps of the sulphite and sulphate processes yields a very soluble pyroxylin; it can be nitrated at high temperatures, and still give an increase in weight. The manufacturers of celluloid in the United States employ a tissue made of flax-fibre and of a thickness amounting to 0·002—0·003 inch; the paper is cut into squares of about one inch before nitrating.

Mowbray (U.S. Pat. of 1890, No. 443,105) states that a pure cotton tissue paper, even of less than 0·002 inch in thickness, takes on a glutinous or colloid surface, and thus requires some 30 minutes for the immersion to take place. The same patentee (this Journal, 1891, 271), recognising the importance of the structure of cellulose on the nitrating process, saturates the fibre with a solution of sodium nitrate, claiming that the salt diffuses into the fibre, and opens it up to the action of the acid.

De Chardonnet (this Journal, 1892, 939) heats the cellulose to about 150° C. previous to nitration, and claims an increase thereby of the solubility of the pyroxylin produced.

Henry and Spill (Eng. Pat. of 1870, No. 1017) use "esparto grass" in a finely-divided state, which is the essential condition of the operation.

Dietz and Wayne (U.S. Pat. of 1872, No. 133,969) use ramie, rheea, or China grass, and state that pyroxylin made from ramie is always of uniform strength and solubility. It is also said that such pyroxylin requires a much smaller quantity of solvent when made into collodion than does that made from cotton. The author's experience is, however, to the contrary.

Such is the influence of the physical form of the fibre on the process of nitration that when flax fibre and cotton fibre are nitrated with nitro-sulphuric acid of exactly the same strength and at the same temperature, the solution of the former is glutinous or thick, whilst that of the latter is fluid or thin; flax yields a pyroxylin giving rise to a collodion as fluid as that obtained from cotton by simply performing the nitration at a higher temperature.

The presence of chlorine in the fibre must be avoided, otherwise a pyroxylin will be obtained which is acid and cannot be rendered neutral by washing.

The drying of the fibre previous to nitration is essential, and is best carried out in the form of drier used for wool. It is a vessel or frame, the top of which is gabled and constructed of galvanised wire net of half-inch mesh; heater coils are placed within the vessel and hot air is forced through the fibre by means of a fan.—A. R. L.

PATENT.

Improvements in and relating to the Colouring of Photographic Prints, Transparencies, and Negatives. C. Klay, Paris. Eng. Pat. 7343, April 10, 1893.

The photographic prints or films are painted on the back with colours of appropriate shade, and consist of strong solutions of the aniline colours in alcohol. In the case of solutions of such colours as will not soak properly into or through the paper, acetic acid is added to the alcohol used.

—C. O. W.

XXII.—EXPLOSIVES, MATCHES, Etc.

Manufacture of Pyroxylin. W. D. Field. J. Amer. Chem. Soc. 1893, **15**, 140.

See under XXI., *page* 708.

PATENTS.

Improved Methods of Testing Percussion Caps and the Apparatus therefor. W. D. Borland, Green Street Green, Kent. Eng. Pat. 12,546, July 7, 1892.

This "invention consists essentially of improved methods and apparatus for testing percussion caps in respect to—

(1) Sensitiveness to blows of varying and accurately-determined degrees of intensity.
(2) Effect of size and shape of striker.
(3) Effect of variations in respect of the direction of the blow delivered by the striker on the cap.
(4) Explosive force of cap.
(5) Time between delivery of blow on striker and ignition of cap.
(6) Comparison of igniting power of caps."

For detailed description of the apparatus and manner of carrying out the tests the original specification must be consulted.—W. M.

Manufacture of Explosives. O. Imray, London. From Chemische Fabrik Griesheim, Griesheim a Main, Germany. Eng. Pat. 16,567, September 16, 1892.

In order to avoid the dangers arising from filling shells by pouring in picric acid in a molten condition or pressing it in when solid, the inventor proposes to mix the picric acid with from 5—10 per cent. of trinitrotoluol. The shells or moulds are charged with this mixture and then heated to a temperature slightly above 82° C.

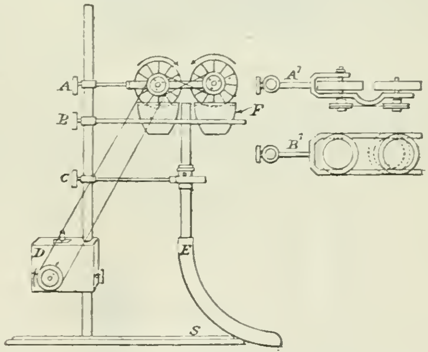
"The tri-nitrotoluol melts and cements together the crystals of picric acid so that the mixture on cooling forms a hard mass."—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS, ETC.

Lamp for Constant Monochromatic Flame. H. W. Wiley. J. Amer. Chem. Soc. 1893, **15**, 121—123.

The apparatus figured below consists of two wheels having perimeters of platinum gauze and spokes of platinum wire, driven by clockwork D and mounted upon the supports A A^1. A saturated solution of sodium chloride or bromide is placed in the porcelain crucibles F, supported by B B^1; the rims of the wheels should dip just beneath the surface of the solutions. The salt is volatilised by the lamp E. By means of the crossed bands the wheels are caused to revolve in opposite directions as indicated by the arrows; the solution of salt which is taken up has thus time to thoroughly dry before it enters the flame, and the spluttering which moist salt would produce is avoided.

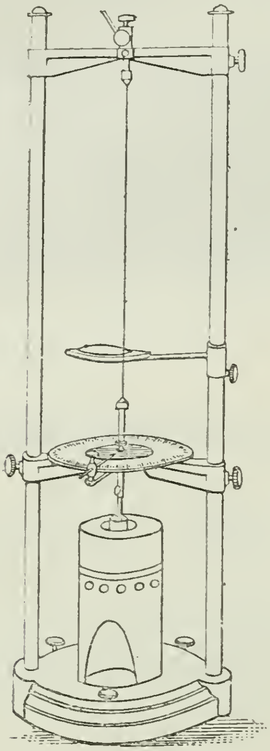


By this arrangement there is introduced into the flame at every instant a minute fresh portion of salt, the result being that a perfectly uniform light is produced, which can be used for hours without undergoing perceptible variation. The wheels are 8 cm. in diameter, and are driven at the rate of one revolution in 6—10 minutes.—A. R. L.

The Torsion Viscosimeter. O. S. Doolittle. J. Amer. Chem. Soc. 1893, **15**, 173—177.

The apparatus shown in the cut consists of a steel wire suspended from a firm support and fastened to a stem, which passes through a graduated horizontal disc, by means of which the torsion of the wire may be measured. It is adjusted so that the index point reads exactly zero, showing that there is no torsion on the wire. A cylinder, 2 in. long and $1\frac{1}{2}$ in. in diameter, having a slender stem by which to suspend it, is then immersed in the oil and fastened by a thumb-screw on the lower part of the stem of the disc. The oil is surrounded by a bath of water or paraffin according to the temperature at which the viscosity is to be taken. This temperature being obtained while the disc is resting on its supports, the wire is twisted 360° by means of the knob at the top. The disc being released, the cylinder rotates in the oil by virtue of the torsion of the wire. If there were no resistance to be overcome the disc would revolve back to zero, and the momentum acquired would carry it 360° in the opposite direction. The resistance of the oil to the rotation of the cylinder causes the revolution to fall short of 360°, and this resistance is directly proportional to the viscosity of the oil. The simplest way in which this viscosity may be expressed is the number of degrees of retardation between the first and second complete arcs covered by the pendulum. For example, suppose the wire is twisted 360° and the disc released so that it is free to rotate. The end of the first swing is taken as the first reading. Suppose the readings to be as follows:—Right, 350°; left, 338°; right, 328°, and keeping in mind the vibrations of the simple pendulum, it is seen that two complete arcs have been read whose difference is 22°, completed as follows:—first arc, right 350° + left 338° = 688°; second arc, left 338° + right 328° = 666°; 688° − 666° = 22° retardation. In order to secure freedom from error two tests are made, one by rotating the wire to the right, and the second by rotating it to the left. If the instrument is in correct adjustment the two results should be the same, but if it is slightly out of adjustment the mean of the two readings will be the correct one. The exact value due to the retardation of the oil itself is obtained by allowing the cylinder to rotate in the air and deducting the resistance of the air thus found from the value obtained as above for the oil. This correction remains constant for each instrument.

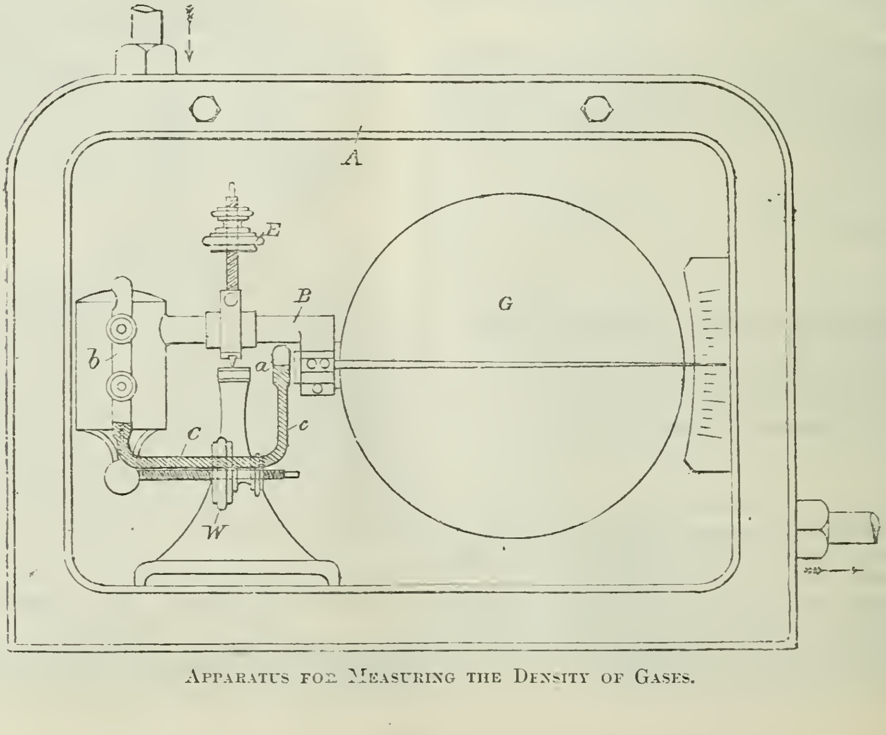
—A. R. L.



PATENT.

Improvements in Means for Measuring the Density of Gases, and like Purposes. R. Haddan, London. From W. Dürr and A. Custodis, Munich, Germany. Eng. Pat. 13,035, July 15, 1892.

The object of the present invention is to improve instruments of the balance kind for measuring the density of gases and the like, by automatically reducing the reading to that for standard pressure and temperature. In the figure B is the balance beam, carrying a light hollow glass globe G at one end and a counterweight at the other. The compensating arrangement for alterations in pressure



Apparatus for Measuring the Density of Gases.

and temperature, consist of a U-tube C closed at one end *a* and open at the other *b*. The closed end is filled with dry air, which is prevented from escaping by means of mercury or sulphuric acid, and the centre of gravity of the compensator in the normal state lies in the vertical plane passing through the knife-edge of the beam.

When a change of temperature or pressure occurs, the liquid enclosed in the tube C is moved by the expansion or contraction of the air to compensate for the change.

The whole apparatus is enclosed in a casing A with a glass front, and the gas whose density it is required to ascertain is passed into the chamber. The density is then read off by a pointer moving over a graduated scale.

—E. G. C.

INORGANIC CHEMISTRY.—QUALITATIVE.

Microchemical Identification of Sulphur. F. Emich.

Zeits. Anal. Chem. 1893, **32**, 163—167.

The substance to be tested is finely ground, a small portion of it is placed on a microscope slide and covered with a drop of calcium chloride solution. The slide is then inverted over a bottle of saturated bromine water for from three to five minutes, or in the case of some natural sulphides for a longer time. When the drop is examined under the microscope it is found to contain the characteristic crystals of calcium sulphate. In testing the limit of this test the author found that he could recognise the calcium sulphate crystals when only one fifty-thousandth of a milligram of free sulphur was taken. He gives a list of 59 minerals to which he has applied the method with success; molybdenum glance and pyrites required prolonged exposure to the bromine vapour, but this may be diminished by a previous momentary roasting. The reaction is not generally applicable to organic compounds containing sulphur, but may be employed for thiocyanates, thiourea, mustard oils, ethyl thiocyanate, and potassium xanthate.

—A. G. B.

INORGANIC CHEMISTRY.— QUANTITATIVE.

On the Use of Nitroso-β-naphthol in Quantitative Analysis

G. v. Knorre. Zeits. ang. Chem. 1893, 264—269.

Cobalt, iron, and copper are quantitatively precipitated by nitroso-β-naphthol from their solutions (acetates), whilst aluminium, lead, cadmium, calcium, magnesium, manganese, nickel, zinc, beryllium, &c., remain in solution.

The presence of nitroso-β-naphthol does not prevent the precipitation of aluminium by ammonia, of calcium as oxalate, and of magnesium as ammonium magnesium phosphate.

In presence of both iron and phosphoric acid, part of the phosphoric acid is precipitated with the iron by nitroso-β-naphthol; if the solution contains free hydrochloric acid the whole of the phosphoric acid may be precipitated with the iron if after approximately neutralising the acid, ammonium acetate be added.

The dried precipitates obtained with nitroso-β-naphthol are likely to explode when ignited; the author avoids this danger by enclosing the still wet precipitate in filter-paper and exposing it at once in a covered crucible to the full heat of the flame of a Muencke's gas-burner.—K. E. M.

Determination of Nitrogen in Nitrates and Nitric Acid.

J. Stoklasa. Zeits. ang. Chem. 1893, 161—163.

The author shows as the result of a number of nitrogen determinations in nitrates and nitric acid that with regard to accuracy the methods of Schlösing-Grandeau, of Lunge, of Stutzer, and of Devarda are equally reliable.

With Lunge's nitrometer one determination takes from 30 to 40 minutes, by Devarda's reduction method 60 minutes, whilst by the other methods more time is required.

Devarda's alloy is obtained by fusing together 50 parts of copper and 45 parts of aluminium, and adding to the molten mass 5 parts of zinc.—K. E. M.

A Reaction of Nitrites and its Applications. C. M. van Deventer.

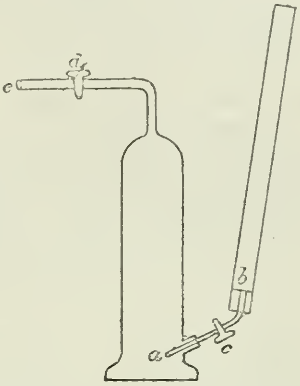
Ber. **26**, 1893, 589—593.

As long ago as 1851 Schäffer showed that when a few drops of a solution of potassium ferrocyanide and then a little acetic acid are added to a very dilute solution of potassium nitrite, an intense yellow coloration is produced. The author finds that the reaction is expressed by the equation—

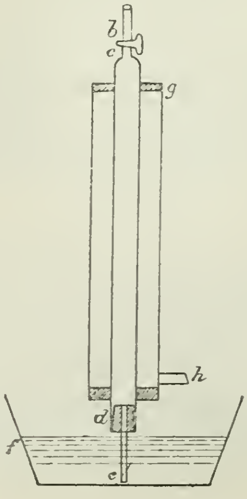
$$2K_4FeCy_6 + 2HNO_2 + 2C_2H_4O_2 =$$
$$K_6Fe_2Cy_{12} + 2KC_2H_3O_2 + 2NO + 2H_2O$$

and that it takes place quantitatively even in the cold.

Preparation of Nitric Oxide.—A small gas-holder is filled with a saturated solution of salt and arranged as in the figure; the stop-cock *c* is opened, a funnel is attached at *e*, and through this the following solutions are successively introduced: concentrated potassium ferrocyanide solution, acetic acid, and nitrite solution. The reaction commences at once and the gas evolved displaces the sodium chloride solution.



Detection and Estimation of Nitrites.—The above reaction affords a convenient test for nitrites when the amount present is not too minute, in which case no gas would be evolved. Nitrous acid can be readily detected in the presence of nitric acid.



For the estimation of nitrous acid a eudiometer is employed as shown in the figure. The eudiometer is filled with a solution of potassium ferrocyanide (containing about 14 per cent.) and the lower end is placed in a vessel containing the same liquid. The nitrite solution is introduced through the funnel *a*, the traces adhering to the latter being washed down with a little water, then some acetic acid is added, and finally a little ferrocyanide solution. When the evolution of gas becomes sluggish the apparatus is vigorously agitated for about 20 minutes, and when the level of the liquid in the eudiometer has become constant, water is introduced at *a* until the ferrocyanide solution is almost completely displaced. The end *e* is then closed with the thumb and the apparatus vigorously shaken; water is passed through the jacket, the temperature determined, and the gas measured. In addition to the usual corrections, the volume dissolved by the water must be allowed for. The volume of nitric oxide is observed and corrected for temperature, pressure, and vapour tension, and is also increased by 3 per cent. (according to the second paper) of the volume of the liquid in the eudiometer to allow for the solubility of the gas in the liquid. The results given by this method agree amongst themselves, but are from 1 to ½ per cent. higher than those yielded by the permanganate method.—A. K. M.

Estimation of Potassium. E. W. Hilgard. Zeits. Anal. Chem. 1893, 32, 184—185.

The author finds that the best method for arriving at the weight of a precipitate of potassium platinochloride is to ignite it in a platinum crucible, the lower half of the interior of which is coated with spongy platinum. To prepare such a crucible a few decigrms. of the double platinum salt are ignited in it while it is being rotated, so that the salt may flow over the surface; the spongy platinum is then treated as described below for the treatment of a precipitate, which is distributed over the surface, as much as possible, in the same way, and then strongly ignited, whereby most of the potassium chloride is volatilised. A few drops of strong hydrochloric acid are then added; should this become yellow on warming it is evaporated and the ignition repeated, a little oxalic acid being added if desirable. The yellow colour may be due to a trace of ferric chloride, in which case it will appear again after the second heating with hydrochloric acid. A thorough washing by decantation and strong ignition conclude the treatment previous to weighing.

The results are generally a trifle lower than when the platinochloride is weighed as such, because the treatment with hydrochloric acid and the washing remove traces of alkaline earths and sodium chloride. Such of the platinum as does not adhere is removed after the crucible has been used, but the remainder should be left in, for the crucible works better as it gets older.—A. G. B.

Rapid Reduction of Potassium Platinochloride. H. Borntrüger. Zeits. Anal. Chem. 1893, 32, 188.

The potassium platinochloride is dissolved in hot water and precipitated with a solution of potash soap, whereby a double salt of potassium chloride and platinum oleate is thrown down. The supernatant liquor is poured off and the precipitate ignited; the residual spongy platinum is easily washed with hot water.—A. G. B.

Separation of Strontium from Calcium. R. Fresenius. Zeits. Anal. Chem. 1893, 32, 189—203.

The author finds that Rose's modification of Stromeyer's method for the separation of strontium from calcium is the only accurate method among those which he has examined. The mixed salts are converted into nitrates, which are dried at 130°, rubbed down to a fine powder in the dish, and macerated five times with a mixture of equal volumes of ether and absolute alcohol in successive portions of 5 cc., each of which is decanted into a small flask. The residue in the dish, freed from alcohol and ether by evaporation, is dissolved in water and evaporated. The residue is again dried at 130°, rubbed down, and transferred as completely as possible to the flask, the dish being washed with three portions of 5 cc. of the alcohol and ether mixture.

The flask is intermittently shaken for 24 hours, and at the end of this time the solution of calcium nitrate is filtered through a small filter, the undissolved strontium nitrate being washed by decantation with 12 portions of 5 cc. of the mixture of ether and alcohol. The calcium is precipitated from the solution as sulphate; the strontium nitrate is dissolved in water and the strontium precipitated as sulphate with the addition of alcohol.—A. G. B.

Separation of Ferric Oxide from Alumina. H. Borntrüger. Zeits. Anal. Chem. 1893, 32, 187.

The ferric and aluminium hydroxides are precipitated and weighed together as oxides. The ignited precipitate is dissolved in hydrochloric acid, the solution nearly neutralised with potash (not soda), and precipitated with a solution of neutral potash soap whilst still hot, care being taken to avoid an excess of soap. The precipitated oleates are filtered and washed with hot water until all the potassium chloride is eliminated. The filter with its contents is partially dried over calcium chloride and then extracted with hot petroleum spirit until colourless, by which time all the ferric oleate will have been dissolved out. The aluminium oleate is ignited and weighed as alumina. The petroleum solution may be evaporated and the residue ignited and weighed to ascertain the quantity of ferric oxide present.
—A. G. B.

Methods of determining Chromium, with Notes on the Distribution of Chromium in British Irons. J. E. Stead. Iron and Steel Institute, Spring Meeting, 1893.

Clark's magnesia and soda method (this Journal, 1892, 501) is first roughly described, after which Galbraith's permanganate method is discussed. In the latter case the author finds that with chrome steels the small quantity of chromium insoluble in sulphuric acid is not altogether lost in the analysis, as most of it, and sometimes all, is rendered soluble by the boiling with permanganate. With alloys containing up to 5 per cent. chromium the loss is very small, so that with chrome steels, which rarely exceed 1·5 per cent. chromium, the method is reliable, but it is not applicable to the analysis of rich ferro-chromes. A modification of the acid-permanganate process is described, and consists of dissolving the precipitated manganic peroxide with dilute hydrochloric acid previous to attacking the chromate with the ferrous salt. Manganese chloride and free chlorine are produced, but the latter is got rid of by evaporating the solution for some time. Strong hydrochloric acid attacks the chromate, forming chromous salts and chlorine, so that the solutions must be kept dilute, when accurate results are obtained.

Another modification of the above-mentioned process is to separate the chromium from the iron by adding phosphate of soda and boiling with hyposulphite of soda till free from sulphurous acid, and then adding ammonium acetate and again boiling for five minutes. The precipitated phosphate of chromium is filtered off, washed with ammonium nitrate, dried, calcined, and fused with "basic mixture," and proceeded with by Clark's method. Vanadium, when present in the iron or steel, affects the results if bichromate is used to titrate the unoxidised iron in the end operation, but not if permanganate is used for this purpose, so that it is advisable when vanadium is suspected to use the latter reagent. In the case of rich ferro-chromes the author prefers to fuse with a mixture of magnesia or lime with potassium and sodium carbonates, which is the "basic mixture" previously mentioned, instead of magnesia and caustic soda. Vanadium in pig iron is not altogether dissolved by hydrochloric or sulphuric acid a large proportion sometimes remaining insoluble. The vanadium is most readily detected qualitatively in the insoluble residue by heating it with the magnesia mixture or the basic mixture, extracting with water, and, after filtering and acidulating with sulphuric acid, adding a few drops of hydrogen peroxide. If vanadium is present the solution assumes a deep red colour, which is dissipated on boiling.—A. W.

The Determination of Chromium in Ferro-Chromium. W. Galbraith. Iron and Steel Institute, Spring Meeting, 1893.

The author discusses the question as to whether the method of estimating chromium by the permanganate and ferrous salt method is reliable in cases of ferro-chromium rich in chromium. With an excess of iron present the process is accurate, but with a preponderance of chromium his experiments show that, and the reason why, low results are obtained. If when boiling the chromium solution with permanganate and sulphuric acid the boiling is prolonged for a few minutes till the precipitate is black, caustic soda does not dissolve any manganates from the precipitate, and the chromic acid is easily dissolved out of the precipitate by its means. Consequently the process should be conducted as follows:—Dissolve the finely-powdered material in sulphuric acid (1 to 6), add permanganate, and boil till the precipitate is black; dilute and make alkaline with caustic soda, filter, wash, acidulate the filtrate, and treat as usual with a known quantity of a ferrous salt in excess, and measure the unoxidised portion by standard bichromate solution. This gives accurate results, but in ferro-chromiums there is the portion insoluble in sulphuric acid to be dealt with. This is filtered off before the permanganate is added, dried, ignited in a porcelain crucible, and fused for about 15 minutes with 6 grms. of caustic soda and a little nitrate of potash in a platinum or silver crucible. It is then dissolved in water, filtered, washed, and the filtrate made acid with HCl, reduced with sulphurous acid, and the oxide of chromium precipitated with ammonia, filtered, dissolved in dilute sulphuric acid, and either heated with permanganate like the original solution or else added to it.—A. W.

ORGANIC CHEMISTRY—QUALITATIVE.

Detection of Nitrobenzene. J. Marpurgo. Pharm. Post. **23**, 258; through Zeits. Anal. Chem. **32** [2], 235.

Two drops of molten phenol, three drops of water, and a small piece of potassium hydroxide are brought together in a porcelain dish and heated to the boiling point. The aqueous solution to be tested is then added, and the boiling continued; a crimson-red ring will appear at the margin of the liquid if phenol be present, and will give place to an emerald-green colour on the addition of a solution of bleaching powder.

To apply the test to soap, the aqueous solution thereof is decomposed by an excess of milk of lime and extracted by ether; the residue from the ethereal solution is treated as described above.

For the recognition of nitrobenzene in oil of bitter almonds advantage may be taken of the fact that the latter loses its odour when heated with sulphuric acid and manganese dioxide, whereas nitrobenzene is not affected by this treatment.—A. G. B.

Detection of Phenols. L. M. A. Lambert. L'Union Pharm. **33**, 17; through Zeits. Anal. Chem. **32** [2].

Phenol, resorcinol, phloroglucinol, and pyrogallol give a rose or red colour when iodoform is dissolved in them and potash added. Orcinol and salicylic acid give a red-violet colour, guaiacol and thymol a violet colour, and hydroquinone and the two naphthols a blue colour by the same test. Iodoform may be replaced by chloroform or bromoform, so that an inversion of the reaction will serve to detect iodoform, chloroform, chloral, or bromoform. The colours are bleached by acids, but restored by alkalis.
—A. G. B.

Detection of Sesame Oil. G. Ambühl. Schweiz. Wochenschr. f. Pharm; through Zeits. Anal. Chem. **32** [2], 255.

To carry out this well-known test, the author dissolves 0·1—0·2 grm. of white sugar in 20 cc. of hydrochloric acid (sp. gr. 1·18), adds 10 cc. of the oil, and shakes vigorously. Sesame oil gives an intensely red colour; olive oil with 10 per cent. of sesame oil gives a dark rose colour; pure Tuscan, San Remo, Nizza, and Provence olive oils give no red colour; Bari oil yields a reddish colour, but this rapidly gives place to a more bluish violet shade. Rancid sesame oil gives an indigo-blue colour.—A. G. B.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Extraction of Fat. L. Gebek. Zeits. ang. Chem. 1893, 253—255.

The author points out the unreliability of the estimation of fat in fodder by cohobation with ether or similar substances, because of the liability of solvents to take up colouring matter, resinous matter, &c., which cannot be easily separated from the fat. With a view of eliminating these errors he introduces into the extraction apparatus a suitable filtering material, which separates the fat from extraneous substances. If gypsum or animal charcoal be used as a filtering medium clear extracts are obtained, but the yield is too low owing to the retention of some of the fat in the pores of the filter. "Spanish earth," after having been washed with dilute sulphuric acid, ignited, and passed through a 12 mm.-mesh sieve, gave very satisfactory results, and is recommended. Anhydrous ether gives lower, but no doubt more accurate, results than ether containing water. The substance should not be dried before cohobation, as resinification is liable to take place in many cases giving rise to low results.—K. E. M.

Gas-Volumetric Estimation of Organic Acids and of Iodic Acid. H. Kux. Zeits. Anal. Chem. 1893, **32**, 129—163.

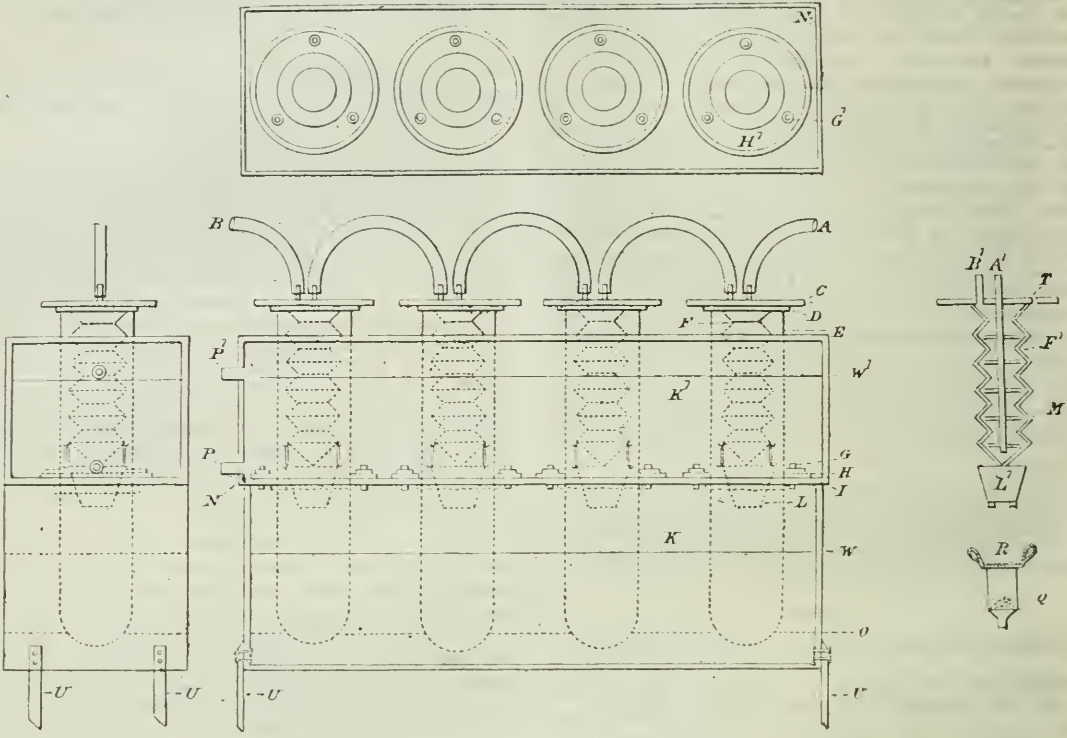
The principles underlying this method are—(1), the liberation of iodine from a mixture of potassium iodide and potassium iodate by an acid; and (2), the evolution of oxygen from a mixture of an alkaline solution of iodine and hydrogen dioxide in the proportion of two atoms of oxygen for two atoms of iodine.

As an example of the manner in which the author proposes to take advantage of these principles the following experiment with formic acid may be quoted. The measurement of the volume of oxygen evolved is effected in a Wagner's modification of Knop's azotometer (this Journal, 1886, 505), the modification consisting in the division of the evolution flask into two chambers by sealing a small cylinder on to the bottom of the flask. Into the outer chamber of this flask there are introduced 0·2 grms. of finely-powdered potassium iodate and 2 grms. of potassium iodide. These are dissolved in a little water, 15 cc. of the formic acid (of approximately N/5 strength) are added, the mixture shaken and made up to 40 cc. with distilled water which must be free from carbon dioxide. A cooled mixture of 2 cc. of hydrogen dioxide (2—3 per cent.) and 4 cc. of caustic potash solution (1 : 1) is introduced into the inner chamber, and the flask connected with the measuring tube. After the usual precautions to ensure equality of temperature between the flask and measuring tube have been observed, the two solutions are mixed suddenly in order that none of the oxygen may be absorbed. When the evolution of oxygen has ceased, the apparatus is allowed to cool and the volume of gas ascertained.

Much depends upon the length of time during which the acid is allowed to act on the mixture of iodide and iodate. In the case of formic acid half an hour in the cold is necessary; for acetic acid 2 hours in the cold or 10 minutes at 70°—80°, is recommended. The method has also been tested for vinegar and for propionic, butyric, oxalic, lactic, succinic, malic, tartaric, citric, and iodic acids. Tables for the calculation of the volume of oxygen into weight of acid are given for the more important acids in the above list.
—A. G. B.

Improved Extraction Apparatus. H. W. Wiley. J. Amer. Chem. Soc. 1893 **15**, 123—126.

The extraction apparatus already described (this Journal, 1893, 547—548) is more conveniently constructed as follows:—The bath for holding the tubes is made in two separate portions K and K^1. The box K may be made of galvanised iron, and furnished with legs V and V^1 of such a height that a lamp may be placed underneath; the liquid serving as the heating medium should stand at a height represented by the line W. The box has a false bottom O, having circular perforation to receive the bottom of the extraction tubes, and its sides may be made of glass or mica to enable the operator to watch the evaporation of the solvent. The box K^1 rests lightly on K, but is not fastened to it; it may also have one or both of its sides constructed of glass or mica. The bottom of the box carries rubber diaphragms perforated to admit the extraction tubes, the connections being water-tight; its plan is shown in the figure H^1 N^1 G^1. The rubber diaphragms are held by two brass rings fastened together above and below by small bolts. Water may be allowed to flow in a thin film over the bottom and escape at P, or the latter may be closed, when the level of the water will be W^1 and its outflow P^1.



Improved Extraction Apparatus.

The four condensers shown in the illustration are cooled by a single stream of water entering at A and escaping at B. A section of the condenser is shown which explains itself; the vent at T is left open until the interior of the apparatus is filled with the vapour of the solvent.

The material to be extracted is held in the perforated crucible L^1 or preferably the glass tube R which has a perforated platinum disc fused into it at Q carrying an asbestos felt.

When using the apparatus with ether there should be a space between K and K^1, and the tubes should be thrust through the diaphragm, until at least one of the corrugations of the condenser passes below the diaphragm; otherwise the ether condenses on the sides of the tubes and flows down thence instead of passing into the extraction tube. Furthermore, P is closed and P^1 left open.

When 80 per cent. alcohol is being used as solvent, P is to be left open and a convenient liquid for the heating medium is in this case a mixture of glycerol (2 parts) and water (1 part). Bumping is avoided by the addition of fragments of platinum foil.

The residues in the test tubes can be dried and weighed in the tubes, or the amount of the extracted matter can be ascertained by weighing the crucibles or glass tubes containing the matter which has been extracted; the latter method is preferable with dry substances inasmuch as it is possible especially in the case of ether that substances may be extracted which are subsequently volatilised during the drying of the extract. Whenever it is desired to weigh the extract, especially the ether extract, it may be received in a small cylindrical glass vessel with flat bottom 4—6 cm. in height and of a diameter just permitting its introduction into the extraction tube. About 10 cc. of mercury are first poured into the extraction tube on which this vessel rests. The necessity of weighing the heavy test tube is thus avoided and the extract is more easily dried in the small vessel.—A. R. L.

The Methods of Testing Fats and Oils. E. Milliau. J. Amer. Chem. Soc. 1893, **15**, 153–174.

Among the difficulties met with in the chemical analyses of fatty substances may be mentioned the following:—The slight differences which characterise the various glycerides, the numerous cases of isomerism, the phenomena of oxidation and fermentation, the resins, essential oils and other matter that they contain and which vary according to the nature of the soil on which the plant was grown, the methods of extraction, the age, and numerous others. Accordingly methods of analysis have been sought having regard rather to an examination of the principal constituents of the fatty substances rather than to that of their impurities.

To obtain precise results the material must be submitted to a preliminary purification, and thus by removing the impurities, the fatty substances of the same species are reduced to a type which is practically the same. Sometimes this is attained by washing with hot distilled water, or with strong or dilute alcohol; frequently the fatty matter is refined by treating it with 10 per cent. caustic soda lye employed in the proportion of 10 per cent. of the fat. The emulsion is poured into a saturated solution of common salt, and the mixture generally heated when the oil holding in suspension pieces of soap rises to the surface. Since even neutral fatty substances dissolve notable quantities of alcohol, these must be removed when washing with alcohol has been the method of purification adopted. The nature of this preliminary operation cannot be fixed as it varies according to the nature of the impurities and the object of the research. In determining the amount of volatile acids simple filtration must suffice, and caustic soda must not be used with the oils of the *cruciferæ* as it changes the organic sulphur to soluble sodium sulphide.

The fatty acids, collected as soon as they rise, have much stronger chemical affinities than when they have been melted and dehydrated; this difference is particularly noticeable in cotton-seed and sesame oils. It has been demonstrated that skilfully conducted purification in no way destroys the chemical character of the oil. The author states that by working upon the fatty acids of neutral oils he has been able to demonstrate their purity, and to disprove that they were adulterated with cotton-seed and sesame oils, the presence of which was indicated by the old process. (*Circulaire du ministre de la marine français*, 26 *juillet*, 1892. *Rapport du Resident général de Tunissie*, 9 mai, 1892. Circulaires des ministrés du commerce et de l'agriculture &c.)

Whilst he admits that in practice these preliminary operations may seem tedious, and does not advise them except in cases where adulterations have been indicated by the usual methods, the author strongly deprecates the discovery of an infallible reagent for the detection of adulteration.

General Methods.—1. *Specific Gravity.*—This is taken by the Mohr balance; the specific gravity of the same fat varies greatly with individual samples, and its determination is insufficient to decide on purity or adulteration.

2. *Action of Nitrous Fumes.*—Cailletet's process is used as follows:—Into a tube 10 cm. long and 2·5 cm. wide are introduced 20 cc. of the fat to be analysed, 6 drops of sulphuric acid (66° B.) are added, the mixture is shaken for one minute, after which 9 drops of nitric acid (40° B.) are added, the mixture again shaken, and the tube allowed to remain in boiling water for exactly five minutes, when it is kept in a cold water bath at 8—10° C. for two hours. It is well to note the different colorations obtained thus, after the addition of sulphuric acid, after the addition of nitric acid, after the removal from the hot water bath, and after cooling.

3. *Sulphuric Saponification* (Maumené's test).—Fifty grms. of the fat are weighed into a conical glass of 100 cc. capacity, the temperature is noted, and 10 cc. of sulphuric acid (66° B.), at the same temperature as the oil, are run in. After stirring together the two liquids for one minute, an accurate thermometer is immersed into the upper portion of the mass, and the maximum temperature is noted, slow stirring being meanwhile maintained. The initial temperature must be at least 20° C., and the mean of several determinations not varying more than 2° C. is taken. To obtain the "relative sulphuric saponification" the rise of temperature is noted with 50 grms. of distilled water at the same temperature as the oil and 10 cc. of the same sulphuric acid. The number of degrees obtained with the oil is multiplied by 100, and the product divided by the number of degrees obtained with the water. The author states that the application of "sulphuric saponification to semi-solid vegetable oils working 2°—3° C. above their melting points gives very satisfactory results, because the differences between them and the fluid oils often amounts to 45° or more—as between palm-nut oil and sesame oil."

4. *Iodine Number.*—Hübl's test is thus applied.—The solutions required are—alcoholic solution of iodine, containing 50 grms. per litre; solution of sodium thiosulphate, containing 24·8 grms. per litre; solution of mercuric chloride, containing 60 grms. per litre; and solution of potassium iodide, containing 100 grms. per litre.

Five grms. of fatty acids are weighed out, and diluted to 100 cc. with 92 per cent. alcohol, 10 cc. of this solution are taken, and to it are added 20 cc. of iodine solution and 15—20 cc. of mercuric chloride solution. The flask is closed and placed aside for three hours, after which 20 cc. of potassium iodide solution are added, and the excess of iodine titrated with thiosulphate solution and starch in the usual manner.

5. *Freezing Point.*—Determined with the aid of a freezing mixture.

6. *Melting Points of Fatty Acids.*—Determined in a capillary tube; the reading of the thermometer is taken the instant the substance passes from the solid to the liquid state.

7. *Solidification Point of Fatty Acids* (*Titer*).—The dried and melted fatty acids are placed in a tube 15 cm. long and 2 cm. wide, which is suspended in a wide-mouthed stoppered bottle, with a perforated stopper. A thermometer, graduated to tenths, is inserted so that the bulb reaches the centre of the material. At the moment solidification commences a circular movement is given to the thermometer, stirring the whole mass; the thermometer is then left at rest and carefully watched, the point of solidification being when the mercury ceases to rise.

8. *Saturation.*—This is the number of cc. of normal solution of caustic soda absorbed by 5 grms. of the melted and dried fatty acid.

9. *Solubility in Absolute Alcohol.*—The fat is neutralised by agitating it in a closed separating funnel for 30 minutes with twice its weight of 95 per cent. alcohol; after settling, it is drawn off, and the alcohol held in solution driven off at a low temperature, after which it is agitated at 15° C. or at a few degrees above its melting point, if solid, at 15° C., with twice its weight of absolute alcohol. A known quantity of this alcohol is evaporated, the residue weighed, and the quantity of oil dissolved by 1,000 grms. of alcohol is calculated.

Olive Oil.—The specific gravity of this oil varies from 0·915 to 0·918, as compared with 0·917—0·918 for undecorticated peanut; 0·921 for decorticated peanut; 0·923 for sesame; 0·921—0·924 for cotton seed; and 0·924 for poppy oils. These variations do not allow of the recognition of a mixture with any certainty.

Action of Nitrous Fumes.—If the oil contains much peanut oil, it will appear red when taken from the water-bath; pure olive oil is, on the contrary, lemon yellow, and when taken from the cold bath it has completely solidified. With a mixture of 15 per cent. of other oils there is no solidification. The method gives good means of detecting peanut and poppy oils in edible olive oil, but is of less use for industrial oils, which may not solidify, though pure.

Sulphuric Saponification.—The rise of temperature with olive oil is 35°, the "relative sulphuric saponification" 94°. A rise of temperature above 35° usually indicates adulteration; equal or lower results do not absolutely indicate purity, as some pure olive oils give a rise of only 31°—33°, and consequently after the addition of seed oils show only 34°—35°. The iodine number is 80°—85°, and helps to discover seed oils; it likewise affords a quantitative method with a mixture of known oils. The variation in the composition of the same oil renders its sensitiveness useless for determining mixtures of 5—10 per cent. The author then gives the special reactions characterising the presence of the three oils—peanut, sesame, and cotton seed—used most frequently to adulterate olive oil.

Examination for Peanut Oil.—Density almost the same; the sulphuric saponification, and especially the Cailletet process (see above), give good results. The certain recognition of peanut oil is accomplished only by the presence of arachidic acid, $C_{22}H_{44}O_2$, melting point 75°. The following modification of Renard's process is adopted:—20 grms. of the oil are saponified with 20 cc. of caustic soda solution of 36° B., diluted with 100 cc. of 90 per cent. alcohol. The soap is precipitated by 50 per cent. alcoholic lead acetate (*neutral*), the precipitate washed with alcohol, and subsequently shaken with ether until the last traces of lead oleate are removed. The residue is then put into a porcelain dish containing 2—3 litres of distilled water and 50 cc. of hydrochloric acid. When the decomposition is complete the solution is decanted and the fatty acids washed with distilled water, subsequently dried, and dissolved in 40 cc. of 90 per cent. alcohol. A drop of hydrochloric acid is added and the solution is cooled to 15° C., when peanut oil gives a deposition of arachidic acid in crystals. These are washed twice with quantities of 20 cc. of 90 per cent. alcohol, and thrice with 20 cc. of 70 per cent. alcohol, the washing being discontinued when the filtrate gives no residue on evaporation. The acids are warmed with absolute alcohol, and the filtrate evaporated till the weight of the residue is constant; if its melting point is between 73° and 75°, the presence of peanut oil can be affirmed. To ensure the crystallisation of the fatty acids, they must be freed from all traces of oleïc acid.

Examination for Sesame Oil.—For this purpose the specific gravity, the sulphuric saponification, and the Cailletet process can be used, but the author invariably employs the following method:—15 cc. of the fat are saponified with 10 cc. of caustic soda of 36° B., with the addition of 10 cc. of 92 per cent. alcohol. When the boiling mixture has become clear 200 cc. of hot distilled water are added and the liquid is boiled until the alcohol is expelled. After acidifying with 10 per cent. sulphuric acid the fatty acids are removed from the surface, washed by shaking with cold distilled water, and heated at 105°; after the greater portion of the water has been eliminated and they commence to melt, half the volume of pure hydrochloric acid saturated in the cold, with pulverised sugar, is added. The presence of sesame oil is indicated by the red colour of the acid solution; other oils leave the acid colourless, or impart to it a slightly yellowish tinge. The reaction permits of the recognition of 1 per cent. of sesame oil, not only in olive oil, but in all fatty mixtures and in soap.

Examination for Cotton-Seed Oil. — Bechi's process frequently leads to fallacious results leading to condemnations of unadulterated oils. The author's process is as follows:—Into a porcelain dish of 250 cc. capacity 15 cc. of the oil is introduced, a mixture of 10 cc. of caustic soda solution of 36° B., and 10 cc. of alcohol of 90° B. is then added. On boiling the mixture it becomes clear, 150 cc. of hot distilled water are added, and the alcohol boiled off; after acidifying with an excess of 10 per cent. sulphuric acid, the fatty acids are removed by means of a platinum spoon. They are repeatedly washed with cold water, drained, and poured into a tube 2·5 cm. in diameter, and 9 cm. long; 15 cc. of 95 per cent. alcohol are added, and 2 cc. of 3 per cent. silver nitrate solution. The tube is protected from the light and heated at 90° C., until about $\frac{1}{3}$rd of the alcohol is expelled, which is then replaced by 10 cc. of distilled water. After continuing the heating for five minutes, the coloration of the acids is observed. The presence of cotton-seed oil in any proportion whatever causes the production of a metallic mirror, which blackens the fatty acid of the mixture.

Peanut Oil.—This oil presents no special characters beyond the arachidic acid which it contains.

Sesame Oil.—The author has devised the following process for the rapid identification of castor oil in industrial sesame oils:—10 grms. of the oil are shaken with four drops of sulphuric acid of 66° B., and a drop of nitric acid at 40° B., is added. The mixture is shaken violently; pure sesame oil blackens immediately, whilst that containing castor oil remains turbid yellow.

The following method serves for the detection of castor oil in other oils. Most oils are soluble in light petroleum, but castor oil is insoluble; the latter is also distinguished by its solubility in alcohol. The oil is shaken with two volumes of light petroleum and the mixture cooled to 16° C. At the end of a few minutes the mass coagulates and the oil separates when castor oil is present, whilst the liquid remains homogeneous if it is pure.

Solid Vegetable Oils. Cocoanut and Palm-Kernel Oils.—The saturation value is determined, *i.e.*, the number of cc. of normal caustic soda required for the saturation of 5 grms. of the fatty acids of these oils. The saturation value of cocoanut oil is 24·1, and of palm kernel oil 22·5, whilst with the average of liquid oils which are used as adulterants it is 17—18 only. It is necessary to be very circumspect in this use of this process. As an example it may be mentioned that 5 grms. of acids from a mixture containing 45 per cent. of palm-kernel oil, 45 per cent. of cocoanut-oil, and 10 per cent. of pea-nut oil require 22·5 cc. of normal solution for saturation, the value obtained with pure palm-kernel oil. As these oils are rich in saturated acids and the iodine number is accordingly low, its determination is very useful. Peanut-oil gives 97, whilst cocoanut and palm-kernel oils give 9—16. Unfortunately the difference of seven between the maximum and minimum precludes the detection of small quantities of admixture. The author has discovered a process which depends upon the fact that at a temperature of 30°—31° C., cocoa-nut oil dissolves in two volumes of absolute alcohol, and palm-kernel oil requires four volumes, the smallest addition of vegetable or animal oil destroys this solubility in the same amount of absolute alcohol. *Mode of Procedure.*—20 cc. of the oil are shaken in a test tube with 40 cc. of 95 per cent. alcohol. Oils soluble in 95 per cent. alcohol—castor, resin-oil, &c., are thus discovered, whilst Mowrah and Karite oils give a milky turbidity to the alcoholic stratum. Five cc. of the neutralised cocoa-nut oil are measured into a graduated test-tube and 10 cc. of absolute alcohol added. The tube is shaken for half-a-minute at a temperature of 31° C., and then placed in a bath slightly above that temperature. Pure cocoa-nut oil dissolves completely, and the solution remains clear. Any addition of another fatty matter causes precipitation, the state of molecular equilibrium of the material in solution being destroyed by the slightest modification. Cocoa-nut oil containing palm-kernel oil precipitates when the proportion of the mixture amounts to 20 per cent.; below this the mass remains turbid. The verification of palm-kernel-oil is made in the same manner, only 20 cc. of absolute alcohol are used instead of 10 cc. Five cc. of palm-kernel oil containing 20 per cent. of cocoa-nut oil dissolves in 15 cc. of absolute alcohol, whereas pure palm-kernel oil does not dissolve in these proportions, but the mixture remains turbid. A mixture of cocoa-nut, palm-kernel, and pea-nut oils in such proportions that the oil would appear pure by the saturation test is readily discovered by this process.

The chemical properties of palm-oil present nothing of distinctive character except the partial solubility of the oil in absolute alcohol, which amounts to 10 per cent.; Mowrah oil is identified by the milky-white turbidity which it communicates to alcohol on shaking.

The titer of Illepe oil is 52·5. Karite oil comes from French Soudan. The fatty acids have a titer of 52·5, and combine with soda to produce a very hard soap; they would probably give better results for candle-making after preliminary treatment to remove the resinoïd matters which prevent their crystallisation. The presence of these resins lower the saturation to 14·9, and like Mowrah this oil causes turbidity on being shaken with alcohol.

Solid Animal Fats. Butter.—The specific gravity, iodine number, and freezing-point of the neutral fat are lower than that of tallow or lard, but the saponification and solubility in absolute alcohol are higher. Melted butter shows under the microscope a collection of small regular spheres, whilst adulterated butter shows abnormal figures as well as crystals which appear brilliant in the dark field of the polariser. By determining the fixed and volatile fatty acids and the solubility in alcoholic toluene, admixtures above 10 per cent. can be determined; below this point adulteration is probably not profitable. Natural butter contains "about 11 per cent. of soluble and volatile fatty acids," and 87 per cent. of fixed fatty acids; alcoholic toluene dissolves it almost entirely.

Tallow.—Beef and mutton tallow can only be distinguished by observing differences in the melting-points of the neutral fats and of the fatty acids.

Lard. — Adulteration with cotton-seed oil is easily detected with silver nitrate, but if the lard has undergone alteration by time or other causes it is necessary to submit the fat to a preliminary purification as already indicated. The iodine number is quite illusory for the detection of a small proportion of cotton-seed oil. Adulteration below 5 per cent. may be detected by the action of silver nitrate on the fatty acids; tallow is detected by observing the crystallisation of the fat from the ethereal solution under the microscope.

Fish Oil.—This is detected by its iodine number, its solubility in absolute alcohol, presence of cholesterol, and finally the brown coloration by chlorine and the red coloration by caustic soda and phosphoric acid.

Resins.—These are detected by their density, their saturation, their solubility in absolute alcohol, and the rotation of the plane of polarised light. It is easy to isolate them, because the majority of compounds which they form with metallic salts are soluble in ether, whilst those of the fatty acids are insoluble.

Resin Oils.—By their property of not saponifying with caustic soda, by their insolubility in glacial acetic acid, and by the characteristic purple coloration which they give with fuming stannic chloride.

Oleïn Oil of Commerce.—By its solubility in alcohol, and by its specific gravity.

Mineral Oils.—By their iodine numbers, their indifference towards caustic soda, and their insolubility in absolute alcohol at 15° C.—A. R. L.

The Iodine Absorption Method. F. Gantter. Zeits. anal. Chem. 1893, **32**, 178—181.

A solution of iodine in carbon tetrachloride is not liable to alter in titre; moreover this solvent is an excellent one for fats, so that it is much to be recommended as a substitute for alcohol and chloroform in the Hübl method.

In order to study the influence of excess of iodine and of mercuric chloride on the Hübl process, a solution of 10 grms. of iodine in 1,000 cc. of carbon tetrachloride, and one of 5 grms. of mercuric chloride in the smallest possible quantity of absolute alcohol made up to 100 cc. with carbon tetrachloride were prepared. Twenty-five cc. of the iodine solution, mixed with 10 cc. of the mercuric chloride solution lost no free iodine in 24 hours. Experiments were then made upon 100 mgrms. of linseed oil dissolved in 10 cc. of carbon tetrachloride, and it was found that the iodine absorption increases with the quantity of mercuric chloride and iodine added.

The following table shows the iodine absorbed by 100 mgrms. of linseed oil when the quantities of iodine and of mercuric chloride added, are varied.

Iodine.	Mercuric Chloride.	Iodine Absorbed.
Mgrms.	Mgrms.	Mgrms.
100	50	83·5
150	250	141·0
150	500	148·0
600	0	85·3
600	250	156·4
600	500	173·6
600	1,000	188·4

Analogous results were obtained with lard.

That both the iodine and mercuric chloride are concerned in the ordinary Hübl's process, and that the iodine absorption is not a simple iodine addition are shown by experiments with the saturated fatty acids, lauric and stearic acids. These absorb no iodine in the absence of mercuric chloride, but take up 4·3 mgrms. and 6·8 mgrms. respectively in the presence of 1,000 mgrms. thereof.—A. G. B.

New Method for Estimating the Iodine Absorption of Fats and Oils. F. Gantter. Zeits. anal. Chem. 1893, **32**, 181—184. Compare preceding abstract.

It is found that when one part of a fat is dissolved in carbon tetrachloride containing 4—5 parts of iodine, the saturation of the fat with iodine is complete in 50—60 hours; when a smaller proportion of iodine is used a much longer time is necessary for saturation.

The iodine solution is made by dissolving 10 grms. in one litre of carbon tetrachloride. It is titrated by a sodium thiosulphate solution in the usual way. To ascertain the iodine absorption of an oil, 100 mgrms. or 200 mgrms., according to the probable absorption, of the dried sample are weighed into a stoppered vessel; 50 cc. of the iodine solution (=500 mgrms. of iodine) are added, and the vessel is shaken until the oil has completely dissolved. To avoid loss of iodine by volatilisation, the liquid is covered with a layer of water some millimetres deep, and the whole set aside for 50 hours. At the end of this time the unabsorbed iodine is titrated with thiosulphate solution.—A. G. B.

New Method for Estimating Fat in Milk. L. Liebermann and S. Székely. Zeits. anal. Chem. 1893, **32**, 168—173.

The authors reject ether as a solvent for milk-fat on the ground that it extracts other matter beside fat; they claim that this is proved by redissolving the extracted fat with ether, and again weighing the residue left on evaporation, the second weight being found to be lower than the first.

When petroleum ether is used as the solvent the percentage of fat corresponds with that obtained by a second ethereal extraction.

The new method consists in the following:—50 cc. of milk are measured into a glass cylinder (25 cm. × 4½ cm.) together with 5 cc. of caustic potash solution (1·27 sp. gr.), the cylinder is closed with a good cork and shaken. Fifty cc. of light petroleum (sp. gr. 0·663, B. P. 60° C.) are next introduced and a further shaking administered. To the emulsion thus formed, 50 cc. of alcohol (95·8—96 per cent.) are added and the cylinder once more shaken. After 4—5 minutes, the petroleum ether will have separated, but it is well to shake three or four times for ¼-hour each time. Twenty cc. of the petroleum ether layer are pipetted into a tared flask, the liquid evaporated and the fat dried at 110—120°.

Using petroleum ether for the Adams method as a standard, the authors find that the above described process yields results which are correct to within ± 0·08 per cent.
—A. G. B.

A General Method for Testing Butter. R. Brullé. Comptes rend. **116**, 1255.

The author uses the following two methods for the detection of adulterants in butter:—

Presence of seed oil is proved by characteristic colour reactions when 12 cc. of the butter are heated with 5 cc. of an alcoholic solution of silver nitrate (25:1,000). Olive oil alone cannot be detected by this reagent, but its presence may be recognised by a microscopical examination of the crystals obtained on cooling.

Fats of animal origin are detected by the following method:—5 cc. of butter, previously heated to 148° C. on an oil-bath and filtered, are placed in a dish of 7 cm. diameter and heated to 130° C., when a pinch of powdered pumice stone and eight drops of fuming nitric acid are added. The substances, well mixed by stirring, are heated for about 12 minutes and then allowed to cool to 21° C. After one hour an examination is made of the mass by means of the *Oleogrammeter*. This is an instrument consisting of a vertical rod on the top of which is fixed a large plate. The rod is allowed to slide in a ring fastened to a stand. The end of the rod is placed on the surface of the solidified fat, and then weights are put on the dish until the rod briskly sinks through the fat. The weights required represent the resistance of the butter to the oleogrammeter. The results are said to be of a surprising character. Whilst pure butter has a resistance of 250 grms., the corresponding figure for pure margarin is 5,000 grms. If values be obtained lying between these extremes it is easy to determine the amount of margarin admixed with the butter. Thus, a resistance of 900 to 1,000 grms. would correspond, according to the author, to a fraudulent admixture of 10 per cent. margarin.

If, however, the margarins used as adulterants contain notable quantities of seed oils the indications of the oleogrammeter are uncertain, but in that case the silver nitrate reaction is said to give satisfactory results. In fact, in such case, the two methods supplement each other.

The above given figures for the temperatures have been found by experiment, as the author distinctly states, as those giving the best results.

More than 200 samples, both of pure butter of different origin, and of artificially prepared mixtures thereof with different margarins, have been examined in the laboratory of the "*Société des Agriculteurs de France*" under the strict control of a specially appointed committee. In each case the results were found to correspond to the actual composition of the butter.—J. L.

Estimation of Vanillin. F. X. Moerk. Amer. Jour. Pharm. **63**, 572; through Zeits. anal. Chem. **32** [2].

The vanilla extract is treated with freshly-precipitated lead hydroxide and to an aliquot part of the filtrate, after dilution, bromine water is added, drop by drop, until the odour of bromine no longer disappears on shaking the liquid. By careful addition of a 1 per cent. solution of ferrous sulphate a bluish-green colour is developed, which gradually increases in intensity to a maximum. By comparing this colour with that produced in a solution of known vanillin content, the estimation of the quantity of the vanillin in the extract may be effected.—A. G. B.

Valuation of Ipecachuana. C. C. Keller. Schweiz. Wochenschr. f. Pharm.; through Zeits. anal. Chem. **32** [2].

To estimate the emetine 10 grms. of the finely-powdered and dried sample of ipecachuana are placed in a small funnel, the tube of which is plugged with an extracted wad, and washed with ether (15—20 cc.) until the filtrate comes through colourless. The plug is then withdrawn from the funnel and the material washed through with ether into a tared flask, the total amount of ether used being 60 grms. Forty grms. of chloroform and, after a few minutes shaking, 10 grms. of ammonia (10 per cent.) are now added, whereby the emetine is dissolved. By further shaking at intervals during an hour and adding another 5 grms. of ammonia, the ipecachuana is made to clot together and settle. Fifty grms. of the clear solution are distilled, the residue is dissolved twice in ether, the solvent evaporated, and the alkaloid dried and weighed. Finally the emetine is dissolved in decinormal hydrochloric acid and titrated back with centinormal potash solution, haematoxylin being used as an indicator.

Kottmayer (Pharm. Post. 1892, 34 and 35) digests 15 grms. of the ipecachuana powder with 148 cc. (at 15°) of 90 per cent. alcohol and 2 cc. of hydrochloric acid (sp. gr. 1·12) in a closed flask for four days at 40°, with intermittent shaking. When the liquid has cooled to 15°, 100 cc. are pipetted into a dish, 20 cc. of an alcoholic solution of lead acetate (one part of the salt to 9 parts of 50 per cent. alcohol) and 1·5 grms. of potassium hydroxide are added, and the whole is evaporated to a thick consistency on the water-bath. At this stage 5 grms. of powdered glass are added and the evaporation is continued with constant stirring until the mass is dry. A 10 hours' extraction with chloroform follows, and the solution thus obtained is evaporated to dryness. The residue is weighed and treated with 2 cc. N-hydrochloric acid, any insoluble matter being collected, washed, and weighed; this weight subtracted from that of the chloroform residue gives the weight of the emetine.—A. G. B.

ANALYTICAL AND SCIENTIFIC NOTES.

Hyponitrous Acid. A Lecture Experiment. W. Wislicenus. Ber. **26**, 1893, 773—774.

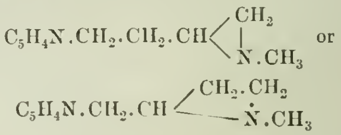
Two solutions are prepared, containing, respectively, hydroxylamine sulphate (2—3 grms.) and the equivalent quantity of sodium nitrite. These are mixed and rapidly heated to about 50°, when a vigorous evolution of gas takes place; and this can be shown to be nitrous oxide by means of a glowing splint of wood. A solution of silver nitrate is quickly added, and a *yellow* precipitate of silver hyponitrite is produced.—A. K. M.

Direct Conversion of Aniline into Nitrobenzene. E. Bamberger and F. Meimberg. Ber. **26**, 1893, 496—497.

This is effected as follows:—A solution of 8 grms. of aniline in 360 grms. of water is allowed to drop slowly into a solution of 120 grms. of potassium permanganate in 3 litres of water, cooled to 0° C., and kept continuously agitated; the product is extracted with ether, and, on distilling off the latter, a brown oil is left, and when this is distilled in a current of steam, nitrobenzene and azobenzene pass over, whilst a white crystalline substance (melting point 226°) remains behind; the nature of the latter substance has not been determined. 48 grms. of aniline yielded only about 3 cc. of pure nitrobenzene. —A. K. M.

Constitution of Nicotine. F. Blau. Ber. **26**, 1893, 628—633.

When nicotine is treated with alcohol and sodium, it yields a mixture of bases, the chief product being *octohydronicotine.* When the hydrochloride of this base or nicotine hydrochloride is heated in a current of hydrogen chloride, methyl chloride is obtained. From these results, and facts previously established, the author suggests the following constitutional formula for nicotine—



$$C_5H_4N.CH_2.CH_2.CH\left\langle\begin{array}{l}CH_2\\ |\\ N.CH_3\end{array}\right. \quad \text{or}$$

$$C_5H_4N.CH_2.CH\left\langle\begin{array}{l}CH_2.CH_2\\ \quad\quad\dot{N}.CH_3\end{array}\right.$$

—A. K. M.

New Books.

Index to the Literature of Explosives. Part II. By Charles E. Munroe, Professor of Chemistry, Columbian University. Baltimore: Deutsch Lithographing and Printing Co. 1893.

This Index has been made, it is stated, by a careful search of each page of the 984 volumes referred to in it, and it is believed to be complete from the date of the first issue of the following periodicals:—

Amer. Jour. of Arts and Sciences	1819—1890
Phil. Trans. of the Royal Soc.	1665—1890
Proc. of the U.S. Naval Institute	1874—1890
Revue d'Artillerie	1871—1890
J. of the Royal U. Service Inst.	1857—1890
H.M. Inspectors of Explosives Reports.	1873—1890
Dingl. Polyt. J.	1820—1890
Nicholson's Jour. Nat. Phil.	1797—1813
Edinburgh Jour. of Science	1824—1832
Popular Science Monthly	1872—1890
Proc. Amer. Chem. Soc.	1879—1890
Brande's Jour. of Science and Arts	1816—1830

It is an 8vo. volume, in paper cover, and the matter fills 195 pages.

Vapour Density Methods. Historically treated. By Jas. T. Brown, F.C.S. Printed and published by Wightman and Co., 104, Regency Street, Westminster, S.W. 1*s*.

This pamphlet contains, in a series of brief abstracts of the apparatus and methods used for vapour density determinations, a kind of index report, filling 16 pages. References are given to the various original sources of information. The marginal numbers adjoining each abstract refer to the now well-known sheet of diagrams compiled by Mr. Brown.

Report of the Commission appointed to Investigate the Waste of Coal Mining with the View to the Utilising of the Waste. (Commonwealth of Pennsylvania, U.S.A.) May 1893. Present Commission: E. B. Coxe, H. S. Thompson, and Wm. Griffith. Philadelphia: Allen, Lane, and Scott's Printing House, 229—233, South Fifth Street.

This 8vo. volume, in paper cover, contains a report of carefully conducted experiments and legislation with the object of preventing the great waste which is apt to occur in the immediate vicinity of coal-pits. The frontispiece consists very properly of a carefully prepared and clear skeleton map of Pennsylvania, showing the space covered by the Bituminous Coalfield and also by the Anthracitic Coalfield, and at the same time illustrating the data given in the volume with the object of forming an "Estimate of the original Pennsylvania Anthracite Coal field." Without including a copious collection of illustrative Tables, Maps, &c., at the end, the volume contains 152 pages of subject matter. Amongst the latter is a valuable diagram, showing the general columnar sections of the Anthracite Coal Measures and the relationship of the coal beds therein The subject doubtless presents sufficient economic importance to justify the following excerpt of the contentsof the volume containing this inquiry :—General Report of the Commission. What is Coal Waste ? Causes of Waste : Geological, Waste by Mining of the Available Coal left in the Ground. Unavoidable Waste by Mining. Waste due to Preparation. Results of Experiments in burning Small Anthracites ("Anthracite Smalls"). Commercial Causes of Waste. Sizes of Small Anthracites. Uses of Small Anthracites and Culm. Remarks on burning Small Anthracite. Grate Bars. Importance of Analysis of the Small Anthracites, and of their Purity. Utilisation of Culm Banks. Test of Slate Bank at Drifton, Pa. Notes on Test. Burning of Part of Slate Banks as Fuel. Then follows an Appendix giving descriptions of individual Collieries and Coalfields, &c.

Chemische Präparatenkunde. Von Dr. Adolf Bender und Dr. Hugo Erdmann. Zwei Bände. Band I. Anleitung zur Darstellung Anorganischer Präparate, von Dr. Adolf Bender. Mit 102 in den Text Gedruckten Abbildungen. Stuttgart: Verlag von Ferdinand Enke. 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. 12*s*.

This handbook of Inorganic Chemical Preparations forms the first of two volumes, the second of which has yet to appear. It will be devoted to Organic Chemical Preparations.

The present work is by Dr. Adolf Bender, of Berlin, and is an 8vo. volume, in paper cover, containing Table of Contents, Introduction, Index to Literature quoted in the text, List of Abbreviations, &c. Subject matter covering 524 pages and an Alphabetical Index. On page 520 is a list of reagents suitable for testing the preparations, and the method of preparing them concisely given, according to Krauch.

The text is copiously illustrated with 102 admirably executed engravings, representing the apparatus recommended, &c. The first 83 pages are devoted to physical or mechanical processes commencing with "1. *Crystallisation*" and ending with "14. *Frigorific Mixtures*." The remainder of the work is concerned with descriptions of the preparation of Hydrogen, Chlorine, Bromine, Iodine, Fluorine, Oxygen, Sulphur, Selenium, Tellurium, Nitrogen, Phosphorus, Arsenic, Antimony, Vanadium, Titanium, Zirconium, Carbon, Silicon, Boron, Potassium, Rubidium, Sodium, Lithium, Calcium, Strontium, Barium, Magnesium, Beryllium, Zinc, Cadmium, Mercury, Copper, Silver, Gold, Aluminium, Thallium, Tin, Lead, Bismuth Chromium, Molybdenum, Tungsten, Uranium, Manganese, Iron, Cobalt, Nickel, Platinum, Iridium, Palladium, and their principal compounds.

It is stated that the object of this work is to aid the purely scientific chemist in his methods for preparing the chemicals, &c. necessary in the general routine of his labours, and further, to serve the technologist and pharmacologist in the solution of their practical problems.

Reactions. A Selection of Organic Chemical Preparations important to Pharmacy in Regard to their Behaviour to Commonly-used Reagents. By F. A. Flückiger, Ph. D., M.D. Translated, revised, and enlarged by J. B. Nagelvoort. Authorised English Edition. George S. Davis, Detroit, Mich., U.S.A. 1893.

This is a work that will be especially valuble to pharmacists and pharmaceutical chemists, but it is almost imperative that Dr. Flückiger's preface be carefully read before the tests as described are followed. In this preface he details sundry constant conditions to be observed in carrying out his reactions. The translator's preface is also valuable to a similar end. The substances described, to which the tests refer, number about 153, and include the recently discovered synthetical organic preparations. The volume is large 8vo in size, bound in cloth, and contains, besides the contents, a "List of the principal Reagents recommended," with strengths, methods of preparation, or tests to recognise required purity. The tests under each heading are very concisely and clearly given, and testimony in this direction is afforded in the fact that the text covers not more than 154 pages.

Mineral Resources of the United States for 1891. Department of the Interior, United States Geological Survey. By David T. Day, Chief of Division of Mining Statistics and Technology. Washington: Government Printing Office. 1893. 50 cents.

Large 8vo. volume, bound strongly in black cloth. It contains the Introduction, a Summary of the Metals produced in the States during 1880 to 1891, Reports on Mineral Products from p. 10 to p. 610, and the Alphabetical Index. These reports, which are most systematic and complete, are each by a specialist. Iron Ores (J. Birkinbine), pp. 10—46. Iron and Steel in the United States for 20 years (J. M. Swank), 47—73. Gold and Silver (Hon. Edw. O. Leech, Director of the Mint), 74—80. Copper (C. Kirchhof), 81—110. Zinc (C. Kirchhof), 111—116. Quicksilver, 117—125. Manganese (J. D. Weeks), 126—146. Aluminium (R. L. Packard), 147—163. Tin, 164—166. Nickel and Cobalt, 167—170. Chrome Iron Ore, 171—173. Antimony (E. W. Parker), 174—176. Coal (E. W. Parker), 177—356. Coke (J. D. Weeks), 357—402. Petroleum (J. D. Weeks), 403—435. Natural Gas (J. D. Weeks), 436—451. Asphaltum (E. W. Parker), 452—456. Stone (W. C. Day), 456—473. Clays (Robt. T. Hill), 474—528. Natural and Artificial Cements (Spencer B. Newberry), 529—538. Precious Stones (G. F. Kunz), 539—551. Abrasive Materials (E. W. Parker), 552—556. Fertilisers, 557—563. Sulphur (E. W. Parker), 564—571. Salt, 572—578. Bromine, 579—580. Gypsum (E. W. Parker), 580—583. Magnesite, 584—585. Fluorspar, 586. Borax, 587—588. Graphite (E. W. Parker), 589—590. Asbestos (591—592). Soapstone (E. W. Parker), 593—594. Mineral Paints (E. W. Parker), 595—598. Barytes, 599—600. Mineral Waters (A. C. Peale), 601—610.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

France.

Customs Decisions.

The following decisions affecting the classification of articles in the French Customs tariff have recently been given by the French Customs authorities:—

Grease intended for machinery and consisting of coal-tar and of a neutral fatty saponaceous substance.—Category 30. Duty free.

Paste or plastering composed of rosin, linseed oil, and a small proportion of oxide of lead.—Category 298. Duty, 45 francs per 100 kilos.

Bricks of pumice-stone with silica base, not baked.—Category 332. Duty, 75 centimes per 100 kilos.

Paper, rose dyed, without albumen, for photographic uses.—Category 461. Duty, 30 francs per 100 kilos.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

The Mineral Production of Russia.

The mineral industry of Russia has been in a depressed condition for the past few years, owing to bad crops. During 1889 and 1890 there was very little water in the large rivers, and intercommunication was rendered difficult and expensive. Following this there was a heavy drop in the rate of exchange, and new purchases were therefore limited in amount.

In 1890 there were 172 establishments in the empire devoted to the production of pig-iron, 146 to cast-iron, and 32 to steel. Cast-iron was consumed for government and other manufactures in the following amounts: shells, made in seven government factories, 723 metric tons; iron wares, 4,727; manufactures of iron and steel, 111,983; steel shells, 700; cannon stands, 200; nails, 22,356; ships, 1,372; iron wire, 22,749.

The production of clay for porcelain in 1889 amounted to 4,521 tons. Cobalt was produced in the Caucasus in 1890 to the amount of 14·69 tons. The amount of coke manufactured in 1890 was 295,571 tons. The production of glauber's salt was 3,267 tons, against 10,177 in 1889. The amount of iron ore mined in 1890 was 1,793,416 tons, in addition to which 2,367 tons of chrome iron ore were mined in Ural. The production of petroleum in 1889 was 3,306,814 tons, and in 1890, 3,974,531.

Phosphate rock is found in many parts of Russia, but at present is mined in but three governments. The production in 1890 was 12,896 tons; of pyrites, 17,125 tons were mined in that year.

Quicksilver is found in the government of Ekaterinoslav, and there in one place. The production in kilos. from 1887 to 1890 both years inclusive, was as follows: 1887, 63,984; 1888, 164,614; 1889, 166,905; 1890, 291,781.

The latest complete statistics attainable are given in the accompanying table, which has been compiled from official sources:

Year.	Coal.	Copper.*	Gold.†	Iron.	Cast Iron.	Lead.	Manganese Ore.	Platinum.	Silver.	Spelter.	Steel.	Salt.
	Tons.	Tons.	Kilos.	Tons.	Tons.	Tons.	Tons.	Kilos.	Kilos.	Tons.	Tons.	Tons.
1881	3,488,901	3,460	36,763	291,854	467,905	685	11,224	2,981	9,423	4,542	292,964	830,013
1882	3,765,957	3,587	36,152	296,963	461,962	571	14,412	4,077	8,000	4,462	247,267	1,664,950
1883	3,972,192	4,350	35,735	322,411	481,097	542	17,029	3,520	7,362	3,809	221,612	1,136,566
1884	3,925,107	6,211	35,677	361,787	508,897	631	18,180	2,233	9,652	4,313	226,911	1,022,521
1885	4,623,056	4,715	33,019	361,838	526,882	714	60,458	2,587	11,239	4,579	192,659	1,131,791
1886	4,570,869	4,515	33,439	362,559	344,475	776	74,313	4,310	13,251	4,190	241,495	1,194,359
1887	4,528,104	4,983	34,865	368,949	611,388	988	58,135	4,502	15,362	3,621	225 204	1,155,280
1888	5,179,478	4,597	35,166	364,095	666,108	798	32,640	2.713	15,116	3,869	222,017	1,111,679
1889	6,206,166	4,793	37,258	427,263	739,149	577	77,937	2,632	13,840	3,681	258,418	1,392,599
1890	6,007,457	5,718	39,371	432,649	925,322	836	182,346	2,841	14,544	3,678	377,961	1,388,365

* Refined. † Unrefined.

In obtaining the product of gold and silver in 1890, there were 82,108 men employed. The silver product from lead ores in that year was derived from 74 mines. Several new mines of argentiferous lead were opened during that year. The gold product for 1892 amounted to 35,419 kilos., valued at 23,539,900 dols., and the silver to 13,204 kilos., valued at 548,749 dols.

Statistics lately received show that the output of coal from the Donetz Basin for 1892 was 2,526,801 metric tons. This basin has been developed at a rapid rate, and in eastern and south-eastern Russia the coal is rapidly taking the place of English coal heretofore imported. With the developments now in progress, it is estimated that the output for the present year will reach 3,650,000 tons, of which about 400,000 tons will be required for the ironworks in the Donetz Basin, and the rest will be available for the different markets. The figures above given are for bituminous coal; in addition in the Grushefskoi district anthracite coal of good quality is mined, the output of which last year was 484,560 tons. Most of this is used locally, but some finds its way to the Danube and even to Constantinople by way of the Black Sea ports.

The Donetz district has one quicksilver mine, which is owned by private parties. In 1892, 64,836 tons of ore were hoisted from this mine, from which 344 tons of quicksilver was obtained, a small increase from the previous year, although there was an increase of nearly 25 per cent. in the quantity of ore taken from the mine. The workings have now reached a depth of 290 ft. and the quality of ore depreciates as the mine increases in depth.

Zinc ore has recently been discovered at Sadok, about 50 miles from Darkotsk, a station on the Vladikaukas Railroad. Some 1,200 tons were taken out last year and sent to different smelting works, the results obtained being very fair, so that the mines will probably be worked on an extensive scale.—*Engineering and Mining Journal.*

Franco-Russian Commercial Convention.

In a report to the Foreign Office, dated the 6th July, Sir J. A. Crowe, Her Majesty's Commercial Attaché at

Paris, writing on the subject of the Franco-Russian Commercial Convention, states :—

What we have to study is the prospect opened to us by the reduction of the duties on mineral oils by 25 to 50 per cent.

During the period which preceded the tariff changes of France in 1882, the duties on mineral oils were very high and complicated in their incidence. On crude oil the duty was 5 per cent. *ad valorem,* plus 22 centimes per kilo. of lighting oil and 32 centimes per kilo. of essence in every 100 kilos. of oil imported. Refined petroleum and essence paid 5 per cent. *ad valorem,* plus a high excise. Heavy oils, at a fixed minimum of density, were charged 6 francs per 100 kilos.

Under this tariff the imports of England under all the heads of crude, heavy, and refined oils, did not exceed 200,000 kilos. The great mass of refined oils and essences came to France from the United States, heavy oils from Russia.

After the duties were brought within other limits in 1882, and the tariff was set at—

18 fr. for raw;
25 „ refined; and
6 „ heavy, the trade of England in heavy oils enjoyed a considerable increase; but the progress of Russia was proportionately large and important.

In 1888 the duty on heavy oils was raised from 6 to 12 frs. per 100 kilos.; and this caused a loss to Great Britain which was not compensated, as in the case of Russia and the United States, by increased production and cheaper output.

The progress of the changes which occurred in the trade of the great oil-producing countries during these years and up to 1891 will clearly appear from the following table of imports from different countries into France, viz. :—

FROM ENGLAND.

—	1879.	1885.	1891.
	Kilos.	Kilos.	Kilos.
Crude	26,716	Nil	Nil
Refined	36,864	49,243	1,471,018
Heavy	129,484	4,692,562	3,308,747

FROM RUSSIA.

Crude	Nil	1,652,456	Nil
Refined	Nil	498,849	613,134
Heavy	5,399,430	7,881,655	14,091,212

FROM UNITED STATES.

Crude	54,730,039	121,206,821	179,259,897
Refined	13,543,656	13,955,786	11,600,040
Heavy	175,869	8,500,332	7,408,577

Now that the duties are reduced to—

9 francs per 100 kilos. for raw,
12–50 „ „ „ refined,
9 heavy oils,

we may hope that some of the ground we lost in 1888 may be regained. Russia of course has the first chance. She doubled her export of heavy oils to France in spite of the doubling of the duty against her between 1889 and 1891. Increased consumption consequent upon reduction of the duty will give her trade an additional impulse. We may recover the loss incurred after 1888, and perhaps also increase our imports of refined, but much in this respect depends upon the course which France may think fit to take in favour of the United States. Negotiations are going on between the two Governments of France and America; and it may be that, by a provisional arrangement, France will grant the minimum tariff for mineral oils to the United States pending a treaty. If not, and as Russia exports no refined oils, there may come a short period during which the United States will be under the maximum tariff for petroleum, and those who can refine best and by the most finished processes must necessarily reap advantage.

Meanwhile the French producers of schist oils declare themselves unable to bear the loss of protection involved in the change of duty from 12 to 9 francs, and so far again Russia, the United States, and Great Britain will compete for the French market.

In a subsequent report, dated the 8th July, Sir J. A. Crowe states :—

The duties on petroleum conceded to Russia under the convention are those established in the minimum tariff by the law of June 30th, 1893. Crude and heavy oils remain at 9 francs per 100 kilos., refined oils and essences at 10 francs per hectolitre, equivalent to 12·50 per 100 kilos.

Meanwhile, the provisional arrangement under which the United States are to share in the advantages of the law of June 30th has actually been made, and is promulgated in the same *Journal Officiel* as the Franco-Russian Convention itself.—*Board of Trade Journal.*

JAPANESE CAMPHOR TRADE.

Mr. J. J. Enslie, Her Majesty's Consul at Hiogo, in his report to the Foreign Office on the foreign trade of that district for the year 1892, writing with respect to the camphor trade and production of Japan, states :—

The total purchases of foreign exporters reached 1,713 tons, which is below the business of an average year. Prices ruled in favour of Japanese producers, the lowest having been 35 dols. per picul of $133\frac{1}{3}$ lb. in May, and the highest 63 dols. in December.

These figures represent common crude, which during the year has been doctored and adulterated worse than ever, in spite of high values paid, and the strong protests of purchasers, some of whom now absolutely refuse to have dealings in camphor which has not drained in the warehouses during at least 48 hours.

The Formosa drug threatens Japan's monopoly, whenever work in the interior can be conducted regularly and free from the dangerous attacks of aborigines.

The camphor tree of Japan is a huge evergreen of singularly symmetrical proportions and not unlike a linden. Its blossom is a white flower, and it bears a red berry. Some of the trees are fully 15 feet in diameter, and are upwards of 300 years old.

In times gone by camphor was produced in Sumatra and Borneo, and in other parts of the East Indies, as well as in China; now, however, the crude camphor of commerce is a product of Japan and Formosa exclusively, the Formosa supplies having since the war between China and France been very small and uncertain until lately, when the industry was resumed by a German syndicate, upon concessions obtained from the Chinese Viceroy of the island, leading to increased exportation.

However, great difficulties remain to be surmounted before the trade can be depended on, for the trees are only found inland, where the inhabitants are aboriginal barbarians, who make matters most unpleasant for explorers.

The Formosa drug is inferior to the Japanese, the latter, by reason of its greater purity, pinkish colour, and bold grain, commanding in foreign countries higher prices, by some 2 per cent. or 3 per cent., in spite of its comparative abundance.

The annual export of Japan camphor averages about 5,000,000 lb., of which about one-quarter reaches the United States of America either direct or *viâ* Europe, the remainder being shipped to Europe, excepting a small quantity sent to India.

The districts in Japan famed for camphor trees are Kiushu, Shikoku, Iga, Suruga, Isé, and Kishiu. The forests owned by the people are now almost denuded of timber, and very little will be left a few years hence. However, the Government forests are still very rich in camphor trees, and it has been estimated that this alone will maintain annually, during the next 25 years, the full average supply of crude camphor.

Formerly very little care was bestowed upon the preservation and cultivation of this valuable timber. More recently, however, not only the Government, but also the people, have been giving to this most important question the attention it long ago deserved. Numerous young trees have now been planted, and their growth is being carefully tended. Consequently, although hitherto the youngest wood from which camphor was extracted was about 70 or 80 years old, it is expected that under present scientific management the trees will give equally good results after 25 or 30 years.

The roots contain a much larger proportion of camphor than the trees, 10 lb. of crude camphor out of 200 lb. of wood-chips being thought satisfactory. The Suruga timber yields a much smaller percentage.

In a village in Kochi (Tosa) there is a group of 13 trees about 100 years old; it has been estimated that they will produce 40,000 lb. of crude camphor, and are worth, as they now stand, 4,000 silver dols.

It appears that the only process of extracting camphor from the wood among the mountains in this Empire, and the materials used, are of the roughest and most unscientific description. The wood-chips are boiled, the vapour being conducted into a receptacle containing several partitions, surrounded by cold water. In the sides of these partitions are apertures alternating contrarily, which, when open, cause the vapour to fill the divisions by a circuitous route, thus improving the grain of the camphor.

The crude article is brought to market, as a rule, in very rudely constructed wooden tubs.

To make it fit for shipment requires much work, diligence, and experience. Each tub is carefully sampled, vertically and diagonally, and the samples are tested by fire and sometimes by alcohol. If no solid adulterant is discovered, the condition of the drug is next inquired into, the difficulty of this step being best explained by at once stating that this crude camphor contains a quantity of water, or oil and water, varying anywhere between 5 per cent. and 20 per cent.

This trouble overcome, the rest is comparatively easy, and consists in weighing, cutting, mixing, and packing for shipment, the packing being in tubs prepared on the premises, partly out of the original packages.

Of course the camphor cannot be packed in its present condition; much of it has to be drained and dried, and frequently a special parcel of "dry" must be bought, at a very high figure, for mixing with it.—(*No.* 1260, *Foreign Office Annual Series.*) *Ibid.*

Tenders for Silver Ore in Greece.

Her Majesty's Chargé d'Affaires at Athens has informed the Secretary of State for Foreign Affairs that the Greek Government is inviting tenders for the purchase of 150,000 tons of silver ore from the island of Milo. Such particulars as are in the possession of Her Majesty's Government can be seen on personal application to the Commercial Department of the Foreign Office between the hours of 11 and 6 daily.—*Board of Trade Journal.*

Roumanian Paper and Cardboard Trade.

According to the Belgian *Bulletin de Musée Commercial* for July 8, the Austro-Hungarian Consul at Bucharest states, in his last report, that since the application of the new Customs tariff the Austro-Hungarian importation has increased. It principally consists of writing paper of various kinds, drawing paper, and white cardboard. Straw paper, packing paper, and common writing paper are manufactured in Roumania itself. Germany supplies the fine drawing and packing papers, coloured letter paper, and fancy papers for the adornment of boxes. France imports finest letter paper and cardboard for visiting cards. From Belgium come cardboards of all kinds, and from England drawing and letter papers of the finest quality. There exists in Roumania itself two factories which produce note-books, registers, memorandum-books, envelopes, playing cards, visiting cards, and other small objects.—*Ibid.*

The Export Trade of Jeddah.

Her Majesty's Consul at Jeddah has forwarded to the Foreign Office a report upon the trade of his district, from which the following is extracted:—

The possible field of operations in the export trade is strictly limited, being confined to mother-of-pearl, gum, skins and hides, and a few minor articles, of which henna is the principal.

Jeddah gum is of a good quality, but is not equal to that of Kordafan, which is nearly white and more friable than that which is found in this district. Gum is found in large quantities throughout this district, but more especially in those of Yembo and Medina. There are several qualities of gum, the best being almost white in colour, while the darker-hued red varieties are considered much inferior. The chief markets for Jeddah gum are London and Trieste. Unfortunately, the dock charges at the former port being excessively heavy (so, at least, it is stated by the principal gum exporter here), it is much more profitable to export to Trieste than to London. Trieste being a free port, the only dues paid on imported goods amount to about $\frac{1}{4}$ per cent. of their value.

Even this charge, which is made for storage, and is paid to the commission agent (consignee), who stores the goods in his own warehouse, is not always exacted, in which case imported goods are free of all dues and charges whatever.

In London, on the other hand, the dock dues amount in many cases to 6 per cent. of the value of the goods themselves. Generally speaking, nine times as much is paid in London for dock charges as is paid in Trieste, *i.e.*, under the most unfavourable existing conditions in the latter port. This being so, it is not surprising that exporters should, other things being equal, prefer the Austrian to the English port.

Of other exports, ox hides and sheep and goat skins are sent mostly to the United States and Great Britain, while in the latter country is also found the best market for senna and tortoise-shell.

The honey and beeswax are exported to India, the amount of either, however, being very small.—(*No.* 1264, *Foreign Office Annual Series.*)

The Metal Production of Mexico.

The following details of the metal mines of Mexico are published by the *Revista Financiera Mexicana* in its issues of the 27th May and the 3rd June.

Lead is found in many portions of Mexico, at some points in the form of galenas in connection with argentiferous ores, in others entirely independent of the silver. Lead mines, properly so called, are found in considerable quantities, and among them special mention is due to the Lomo de Toro lode, in the district of Zimapan in Hidalgo, forming a large deposit of galena, generally associated with brown iron, calc, and fluorspar, with pyrites, white lead, and some sulphur. The galena mines of Lomo de Toro have yielded, it is said, as much as 11,000 tons of metal.

Queretaro has valuable lead mines, quite a number of high-grade ores lying in the vicinity of the Cerro del Doctor, whence have been extracted by the aborigines all the ores used for reducing the argentiferous minerals of the San Juan Nepomuceno lode. In Cadereyta there are many mines in which the silver ore is not milled, but left with the lead taken out of it; galenas, sometimes rich in silver, are also common in the Sierra de San Francisco, where carbonate of lead is also found in abundance. The lead found in several silver veins of the Santo Domingo district, near Chihuahua, being extremely flexible, is used in smelting its argentiferous ores. There is much lead also in the cantons of Iturbide, Victoria, Galeana, and Rayon. Noticeable for their size and richness are the lead deposits of Matamoros Izucar in Puebla, which would, if properly worked, yield excellent returns; and the same may be said of the extensive galena beds existing in Tehuacan and other localities. Compact antimonial galena is found in Tehuacan, flattened in the fissures of the slate it joins together. Oaxaca has a very fine lead mines in Magdalena de Teitipac, district of Tlacolula, San Miguel Sola, Villa Alvarez, Choapam, and in the mineral region of Yucucunda in Nochistlan, all of them in the best condition for exploitation. In addition to these, lead is found in Oaxaca in all the argentiferous lodes of the districts of Hostotipaquillo, Piguano, Cuale, Etzatlan, and Tamazula. In the Bramador, Jalisco, there are several different varieties of galena of a grade suitable for profitable reduction. The galenas on the Campechana hill, district of Leon in Guanajuato, are very rich in lead, which is found in argentiferous lodes forming a belt about 23 inches in width. These galenas, if melted by blast, exhale a strong odour of selenium, and yield nearly 80 per cent. of lead and six of silver. There are many other lead mines in the State, those of Atargen being extensively worked.

Nuevo Leon has argentiferous sulphides of lead in Santa Catalina, Mederos, and Zaragoza; and the same metal abounds in Agualeguas, Galeana, Vallecillo, Salinas, Victoria, Monterey, and Villa Aldama. In the district of Asientos de Ibarra, Aguascalientes, the Peñuela lode is very rich in white carbonate and sulphide of lead. The same remark applies to the San Jeronimo, Refugio, Veta de Eumedio, and Palmira lodes, which, when lead predominates, are used as fundentes or aids for the treatment of silver ores. In the State of Mexico lead ores are abundant, especially in Sultepec, where many mines of argentiferous ores, as well as of pure lead, are being worked, most of them yielding excellent results. Nevertheless, with lead as with other mines, comparatively little has been done in Mexico in the way of their exploitation, and here lies neglected another source of almost inexhaustible wealth.

Mexico possesses immense copper beds, most of which are still untouched. It is doubtful whether her production of this metal exceeds 7,000 tons a year, and yet its working might be made as profitable as that of the precious metals, with the advantage that its fluctuations in prices in the markets of the world are, as a rule, comparatively small. Among the most noted mines are those of Michoacan, the Oropeo, Inguaran, and Churumuco.

Copper beds are found in Tejupilco, in the State of Mexico, the metal occurring in the varieties of grey and native copper, and in either case abudantly. The Bramador lode, in Jalisco, has the Santa Catalina mine, where copper is obtained with a small grade of silver; the metal is found also in the mining districts of Ameca and Autlan, and on the Roble, Rebozadero, and Fuerte hills, in the mining region of Comanja. The Ameca ores are oxides of copper, together with malachite, flecked copper, yellow sulphides, and a large percentage of silver, and in those of Autlan sulphurous copper with malachite exists in large masses.

Sonora possesses rich beds of copper, all available for profitable working, the principal deposits lying in the districts of Hermosillo, Guaymas, Sahuaripa, Oposura, Magdalena, Altar, Alamos, and Arizpe. In Hidalgo, copper lodes are found, in the district of Zimapan. Zacatecas has the copper mines of Mazapil, where yellow copper is found, and with it malachite, bournonite, azurite, and other varieties. In Veta Grande, Ramos, and Bolaños, in the same State, copper ores are utilised in the amalgamation of silver ores, and the same use is made of those found in Tepezala, Aguascalientes, and the districts of Leon, Sierra Gorda, and Guanajuato.

Guerrero has copper in the district of Taxco, in several varieties, grey, green, and yellow, and oxide of fluted blue copper, which class of ores also abounds in the Aldama, Morelos, Minas, and Tabares districts. There are beds near the Tlatlay hill in Tlaxcala and in Sinaloa in the districts of Sinaloa, Rosario, and Concordia, where flecked copper predominates, though pure black oxide exists near San Ignacio, and copper pyrites and silicates of copper in Bacamari. Vera Cruz has copper in Zomelahuacan, and San Luis Potosi in Catorce and Salinas. The districts of Miahuatlán and Villa Juarez contain valuable beds, and Chihuahua is also a large producer of the metal. In the north-eastern corner of the latter State, in the Galeana Partido, lies the Santa Rita del Cobre mine, on the Sierra del Cofre, where are numerous deposits; others are found in Jimenez, Iturbide, Arteaga, Matamoros, and near Mineral del Oro, where are many beds of pyrites and carbonates of copper.

Lower California contains an abundance of this metal. In Santa Agueda there are more than 30 mines in operation, and yet their total product is little more than 5,000 tons a year, this slender output being due to imperfect methods and lack of enterprise. Other beds exist in the municipalities of La Paz, San Antonio, Todos los Santos, Santiago, Mulege, and Comondu. In the State of of Chiapas were recently discovered the great copper mines of Santa Fe, in the mountainous regions near Tabasco.

A continuation of the Santa Fe beds toward the southeast are those of Victoria, recently discovered, the assays of their ore showing 108 ounces of silver, $\frac{3}{4}$ of an ounce of gold, and 30 per cent. of copper per ton.

Zinc ores are but little known in Mexico, at least in the shape of calamine, though blende abounds in all the mining regions; but the heavy expense necessary for its exploitations has thus far prevented the extraction of the metal on any considerable scale.

In the mining districts of Xochiapulco and Xochitlan, in the State of Puebla, blende is often found, assaying, according to some authorities, 50 per cent. of zinc. Taxco, in Guerrero, contains blende in large quantities, mixed with argentiferous ores, which compound also occurs in Mazapil, Sombrerete, and Plateros, in Zacatecas, whose rich deposits almost justify the working for zinc, apart from the silver contained in them. In the Remedios, Jalisco, there are beds that might be profitably worked, and in Comanja, of the same State, blende forms the main component of argentiferous lodes.

As to platinum, only insignificant quantities have thus far been obtained in the municipality of Acapulco and the district of Tabares, Guerrero. The ferruginous clays of Santa Maria de los Alamos, in the district of Jacala, Hidalgo, have been carefully assayed by mining experts, without detecting in them the metal in paying quantity. In the State of Vera Cruz, in Zorra, Ixtatetla, and Huastequillo of the district of Chicontepec, and at some other points in Mexico, platinum is said to exist, but the information as to this mineral is so scanty and incomplete that it is unnecessary to treat of it at length.

Tin is one of the metals as yet but little utilised, although there are plentiful deposits in many portions of the Republic. Guanajuato has several varieties in the district of that name at Mesa de Moreno, Cacachilas, Cerro Macho, Estañera, Rancho Estrada, Mesa Encina, and Presa Arroyo in Allende, and in Jaralillo and Estancia in the district of San Felipe. Most of the metal found in Guanajuato is Cornwallis tin or estaño de acarreo, rarely appearing in veins. Sonora has beds in the districts of Sahuaripa, Arizpa, and Ures; and there are others also in the croppings of trachytic porphyry on the Chiquihuitillo Hill, Aguascalientes, in the form of oxides.

The district of Catorce, in San Luis Potosi, contains good tin mines, and in the washed soil of the mesas or table-lands of San Jose Buenavista and La Cruz there is an abundance of tin. The granitic rocks on the summits of the Sierra de la Estañera, close to the Comanja mining district, contain tin ores, both rich and plentiful, some of them yielding, it is said, from 70 to 75 per cent. of metal. Tin ore is likewise found in the canton of Teocaltiche, in veins or lodes, one of which has been worked by the company which owns the Vallecitos mines, and with excellent results. At San Jose del Estaño the metal occurs plentifully in placers of great extent, where it is found to a depth of 5 ft. or 6 ft. from the surface.

But of all the Mexican tin mines none can be compared with the immense deposits of the Coneto region, situated about 36 miles south of the Partido of Inde, in Durango, near the Sierra of San Francisco. The predominating formation is calcareous trachyte, and the beds, which are of vast extent, if properly worked, could not fail to give large returns, the ores yielding 35 to 75 per cent. of metal, most of them in the form of oxides. In the Sierra Bacaria is found, also in trachytic rock, tin ore associated with arsenic, bismuth, iron, and tungsten, carrying from 18 to 23 per cent. of metal.

Several species of bismuth have been discovered in Mexico. In its native form it is obtained from the Cristo mine; in sulphides on the Gonzalez Hill, near Ojo Caliente, in the State of Zacatecas; on the Sierra of Santa Rosa in Guanajuato there is selenide, which has yielded from 59 to 67 per cent. of metal, the ore being a sesqui-selenide, which has received the name of guanajuatita.

Ochre exists in San Luis Potosi, close to the tin beds situated at a short distance from the Santuario del Desierto, the assays running as high as 71 per cent. of metal. These beds of ochre are apparently in favourable condition to be utilised, and would produce at least sufficient for the requirements of the home market. Bismuth has also been discovered in Queretaro in the Sierra del Doctor and in Vizcarron, and the tellural bismuth, found on the Sierra of Tapalpa, Jalisco, yields 48 per cent. of metal.

Manganese Production in the United States.

The following particulars of the production of manganese in the United States are taken from the New York *Engineering and Mining Journal* for the 1st July :—

The production of manganese ore in the United States in 1892, independent of manganiferous iron ores, manganiferous silver ores, and manganiferous zinc ores, was about 17,000 tons. The production for the census year 1889 was 24,197 tons, valued at 240,559 dols., or 9·94 dols. per ton; while the largest annual production in the country was that of 1887, when 34,524 tons were mined. The total production of manganese ore in the United States from the time it was first mined, over 30 years ago, up to December 31st, 1892, has been almost 300,000 tons. As the United States consumes annually something over 50,000 tons of manganese ore in the various industries to which this material is applied, during the year 1892 it produced less than 50 per cent. of its consumption. The remainder came mostly from Cuba, Canada, Russia, and Chile.

Manganese has been found in many places in North America, but it has been mined profitably in only a few of them. At present Virginia, Georgia, Arkansas, Colorado, and to a lesser degree California and the Canadian Provinces of New Brunswick and Nova Scotia furnish practically the entire output of the United States and Canada. Vermont has in the past produced a considerable amount of manganese and manganiferous iron ores, but at present its mines are idle. Small quantities have also been mined in Pennsylvania, Tennessee, North Carolina, South Carolina, Missouri, Michigan, and Nevada, but the production of these States has been insignificant. Manganese occurs in Central Texas, but no ore has been shipped from that region; it has also been found in Alabama, though no important deposits have yet been developed.

Virginia, up to the present year, has always been at the head of the manganese producers of this country. Georgia has usually been second, with Arkansas third. In 1892, however, Arkansas produced probably more than Virginia, and considerably more than Georgia. The production of Virginia in 1892 was unusually small, being only about 5,000 tons. This was due to the fact that the principal producer in that State, the Crimora mine, was closed the larger part of the year. The production of Georgia was about 2,000 tons. In Arkansas there was unusual activity, and the production was about 6,000 tons, which is more than that State ever produced before in any one year. Colorado produced about 4,000 tons of ore, containing from 25 per cent. to 40 per cent. of manganese. In Canada, which usually furnishes an important quantity of the ore, only 85 tons were mined in 1892, and this amount came from the provinces of New Brunswick and Nova Scotia, and from the Magdalen Islands. The island of Cuba shipped about 18,000 tons in 1892.

The above six regions, therefore—that is Virginia, Georgia, Arkansas, Colorado, Canada, and Cuba—produced in 1892 about 35,085 tons of manganese ore, which quantity represents almost the entire manganese production of North America in 1892.

Manganese was first mined in the United States in Tennessee in 1837, but the production was small, and the amount mined there and elsewhere in the United States previous to 1880 is very uncertain. The chief market for manganese ores is found among the steel manufacturers.

The metal manganese occurs in nature in a great number of different forms, but the only ones that are, according to present standards, applicable to any considerable extent in the arts are the oxides and the carbonates. The latter, though of frequent occurrence in small amounts, are so rarely found in large quantities in America that the oxides represent practically all the ores of manganese now used in the United States. Besides these, numerous other manganese-bearing minerals are found, which, on account either of their chemical composition or of their limited quantity, are not available as sources of manganese. In some special cases, where such minerals are worked as a source of other metals, their residue has been profitably used for its contents of manganese. This is the case with the zinc ores of northern New Jersey, which contain a considerable percentage of manganese, and, after the extraction of the zinc, the residue is used in the manufacture of spiegeleisen.

Among other recent uses, manganese steel, on account of its remarkable combination of great hardness with great toughness, recommends itself especially as a material for making car-wheels. They must resist the abrasion of the brakeshoe and of the track, and should be at least moderately tough, so that they may endure safely the blows which they receive on striking frogs and crossings. Mine-car wheels, indeed, often strike other obstacles violently, and they are especially subject to abrasion, for in many mines they are set fast, or spragged, and slid down the entire length of the inclined road. Under these conditions cast-iron wheels flatten quickly; thus far, manganese steel wheels have never flattened. They excel cast-iron wheels not only in toughness and endurance, but also in lightness, for manganese steel is so strong and the methods of casting it are so well in hand that wheels made of it are very much lighter than cast-iron wheels can safely be. A little over a year ago mine-car wheels of manganese steel were set at work in a large Pennsylvania anthracite mine. They gave such remarkable results that their use is now spreading rapidly through the anthracite region, and should also extend widely in other mining regions, especially in remote ones, where the freight charges are severe, and where, therefore, both great endurance and lightness are important.

The Metal Production of Germany.

The following particulars respecting the metal production of Germany are taken from a recent report of the United States Consular Clerk at Berlin, and the information contained in the report in question, which chiefly deals with the year 1891, has been supplemented by particulars relating to the year 1892 extracted by the Board of Trade from the German *Vierteljahrshefte zur Statistik des Deutschen Reichs* :—

The quantity of iron ore obtained in Germany amounted in 1892 to 11,539,235 tons, valued at 41,279,000 marks, and of iron produced to 4,913,174 tons, with a value of 227,948,000 marks. The corresponding figures for 1891 are, quantity of iron ore produced 10,657,522 tons, valued at 39,408,000 marks, and of iron 4,619,600 tons, valued at 231,119,000 marks.

Zinc is produced in Germany almost exclusively from domestic ores, as the importation of zinc ores into the German Customs district very little exceeds the exportation.

Of the entire amount of zinc ore obtained in Germany (in 1891, 793,544 tons valued at 25,000,000 marks, and in 1892, 800,167 tons, with a value of 21,000,000 marks), the province of Silesia yields about four-fifths, the rest coming principally from the Rhine Province and Westphalia. The amount of zinc produced in the German Empire increased from 58,386 tons, valued at 23,000,000 marks in 1872 to 139,353 tons, valued at almost 63,000,000 marks in 1891, and to 139,938 tons, valued at 55,000,000 marks in 1892. This is an increase of 139 per cent. in 20 years.

Of the entire 1891 production 88,421 tons (63·5 per cent.), valued at about 39,000,000 marks, were from the Government district of Oppeln; 13,357 tons (9·6 per cent.) from the district of Arnsberg; 14,939 tons (10·7 per cent.) from the district of Dusseldorf; 17,198 tons (12·3 per cent.) from the district of Aix-la-Chapelle, and the remaining 5,438 tons from other parts of Germany (principally from the Government district of Cologne and from the Kingdom of Saxony).

In 1891 there were in operation altogether 28 zinc foundries employing 9,586 workmen. Besides these, there were three others in which zinc was a secondary product. Of these zinc foundries two were situated in the Government district of Oppeln, the most important being the two "Silesia" foundries near Lipine, the Hohenlohe Foundry and the Wilhelmine Foundry, near Schoppinitz, which, in 1891, turned out more than 10,000 tons. Not one of the seven foundries in the Rhine Province and Westphalia produced in 1891 less than 5,000 tons. More than one-third of the entire world's production of zinc (according to a French authority, 368,000 tons were produced in 1890) comes from the German Empire. Next in importance are Belgium (83,000 tons in 1890) and the United States (about 58,000 tons).

Lead in Germany is produced chiefly from potters' ore (*Bleiglanz*), which generally contains silver. This comes from the vicinity of Aix-la-Chapelle, the Harz Mountains, Silesia, the neighbourhood of Ems, and in part from abroad. In 1891, in the German Empire, 159,215 tons of lead ore, valued at 16,656,000 marks, were produced. In 1892 the figures were 163,372 tons and 14,688,000 marks. In 1872 there were 53,550 tons of lead produced, against 95,615 tons (an increase of 78·6 per cent.) valued at 23,000,000 marks in 1891. In 1892 the quantity amounted to 97,936 tons, and the value to 20,582,000 marks. Of the amount produced in 1891 the Government district of Oppeln supplied 18,430 tons (19·3 per cent.); the district of Hildesheim, Communionharz, and Anhalt, 13,564 tons (14·2 per cent.); the district of Wiesbaden, 13,455 tons (14·1 per cent.); the district of Aix-la-Chapelle, 41,770 tons (43·7 per cent.); the rest of Germany (principally the Kingdom of Saxony), 8,396 tons.

There were in 1891, 13 lead foundries in operation, exclusive of 10 in which lead was a secondary product. Of these, two were in the Government district of Oppeln, four in the Harz Mountains, two in the district of Wiesbaden, four in the district of Aix-la-Chapelle, and one elsewhere. The largest amount of lead (over 20,000 tons) was produced in 1891 in the Mechernich Foundry in Aix-la-Chapelle, over 10,000 tons being produced by the Royal Friedrichs Foundry, in Silesia, and by the Münsterbuscher Foundry, near Stolberg.

Among lead-producing countries Germany is third, only Spain and the United States producing larger quantities. The total production of the world in 1890 was estimated at 646,000 tons. From this it appears that about one-seventh of the world's production of lead is German.

The heaviest production of copper in Germany is at the Mansfeld works. On an average the ore in these mines does not yield more than $2\frac{1}{2}$ per cent. of copper, and from 4 to 5 kilos. of silver to each ton of finished copper. The Duisburg Foundry and the Königs Foundry, in Silesia, use foreign (Spanish and Portuguese) copper ore, as do also two foundries in the Hamburg free port district. Copper is also obtained in Westphalia and the lower Harz mountains.

The entire amount of copper produced in the German Empire in 1872 was 6,356 tons. In 1891 24,092 tons (about four times as much), valued at 28,000,000 marks, and in 1892, 24,778 tons, valued at 24,754,000 marks, were produced. Of the total amount obtained in 1891, Prussia yielded 20,448 tons. The copper production of the entire world in 1890 was estimated at 270,000 tons, of which the United States supplied 116,000 tons, Spain and Portugal 52,000 ons, and Chili 26,000 tons. Of the entire amount Germany supplied about 9 per cent.

Silver is obtained in Germany from domestic lead and copper ores, and also from foreign ores, chiefly Central and South American. In 1872 there were 127,007 kilos., valued at about 23,000,000 marks, produced. In 1891 the production amounted to 444,852 kilos. (almost four times as much as in 1872), valued at 59,000,000 marks, and in 1892 to 487,784 kilos., valued at 57,026,000 marks. To what an extent silver prices have fallen in the past 20 years is shown by the fact that in 1872 the selling price of 1 kilo. of silver at place of production was 177·74 marks, while in 1891 the price had fallen to 132·62 marks. The German works in which the greatest quantities of silver are produced are the fiscal works at Freiburg, in Saxony and the Mansfeld copper works (each in 1891 over 80,000 kilos.); furthermore the North German Affinerie in Hamburg, the lead foundry Münsterbusch, near Stolberg, and the silver works at Lautenthal, in the Harz.

About one-tenth of all the silver produced in the world is German. The entire production of the world in 1891 was, according to the estimate of the United States Mint, 4,465,822 kilos.

The gold production of the German Empire, obtained chiefly from ores from which silver is taken, amounted in 1872 to 328 kilos., worth nearly 1,000,000 marks. In 1891 there were produced 3,077 kilos. (nearly ten times as much) valued at 8,568,000 marks, and in 1892 2,877 kilos. valued at 8,005,000 marks. Of the 1891 product the two Hamburg works produced 1,992 kilos. valued at 5,500,000 marks. Large quantities are also produced by the fiscal works at Freiburg, the Communion Foundry at Oker, and the foundry at Lautenthal. The entire gold production of the world in 1891 was, as estimated by the United States Mint authorities, 188,531 kilos.

The above figures show that of the entire production of the world Germany's share in 1891 was: zinc, 38 per cent.; lead, 15 per cent.; copper, 9 per cent.; silver, 10 per cent.; gold, $1\frac{1}{2}$ per cent.

GENERAL TRADE NOTES.

THE ADULTERATION OF CUTCH.

Cutch is an important article in the trade of Burmah, the exports averaging from 20 to 25 lacs annually in value; but of late the Chinese have been doing their best to discredit the trade in the markets of Europe by wholesale adulteration. Cutch is mainly used (outside Burmah, where the native takes it medicinally or eats it in *pan*) for tanning purposes, and the Chinese adulterate it by adding extracts from the barks of lein tonkyan and panya, which contain a considerable amount of tannin, but nevertheless render the cutch exported spurious and utterly worthless. The adulteration is easily recognised by local merchants thoroughly accustomed to the article, but it has been successfully passed on to consumers in other countries by unscrupulous vendors. The Forest Department and the Chamber of Commerce in Rangoon are both highly interested that the purity and good fame of Burmah cutch shall be beyond question, and the Chief Commissioner has now, on their earnest recommendation, proposed to levy a heavy tax on the manufacture of extracts used for adulteration.—*Chemist and Druggist.*

THE CHINESE TRADE IN ANILINE COLOURS.

The *Journal des Mines* announces that the importation of aniline colours into China is increasing every year. The colour most in demand is scarlet, which is used for dyeing paper and cotton. Yellow, the imperial colour, is only employed in the Government workshops. For this article great attention should be paid to the labels and description under which it is introduced and brought under the notice of Chinese purchasers. Shanghai is still the centre for the importation of colours. The trade is in the hands of German houses, although all the products introduced are not of German origin; they also come from England, Belgium, and France.—*Society of Arts Journal.*

The Russian Quicksilver Output.

At the quicksilver mine belonging to a German firm in the Donetz Basin, the output of ore in 1892 was 64,836 tons, as against 50,114 tons in 1891. Of this quantity 60,888 tons were kilned, producing 334 tons of pure quicksilver, being an increase of 20 tons as compared with the previous year. The mine is now being worked at a depth of 290 ft., and the quality of the ore is found to be much inferior to that previously extracted, the yield of quicksilver showing a decline of about 25 per cent. in comparison with 1891.—*Chemist and Druggist.*

Chemical Workers.

In the House of Commons, on August 4, Mr. J. H. Lewis asked the Home Secretary whether a departmental committee had been appointed to consider the conditions under which chemical workers carry on their employment, and, if so, whether he would state the terms of reference, and when the committee might be expected to present their report.

Mr. Asquith said such a committee had been appointed. The terms of reference required the committee to deal with the matter both generally, and in the case of alkali works and in the manufacture of bichromate and chromium compounds, with particular reference to the following points:—(1) How far these manufactures as at present carried on injuriously affect the health of the workpeople, and how far the injurious effects depend upon the age and sex of the operatives; (2) what means can be adopted to abate the injurious effects of the manufacture; (3) what special regulations should be adopted to protect vats and other dangerous places and utensils used in the manufacture? As regards the date when the committee may be expected to present their report, he could only say that the field of the inquiry is an extensive one. Much valuable information had been obtained at Widnes and St. Helens, but the committee still proposed to visit Flintshire, Glasgow, Northwich, and Newcastle, and therefore their report could not be expected until next month.

The committee engaged on this work consists of Professor P. A. Simpson (chairman), Dr. D. J. O'Neill, Mr. A. E. Fletcher (inspector under the Alkali Acts), and Mr. H. S. Richmond (inspector of factories). The kindred committees have also been appointed to inquire into the conditions of labour in other dangerous or unhealthy industries—namely, white-lead manufacture, potteries, and quarries.—*Ibid.*

The German Tar Distilling Industry.

In describing the various chemical exhibits from Germany at the World's Fair, *Kuhlow's Review* gives an account of the tar distilling industry in that country, which is treated under the following headings:—

(1.) The obtainment and working up of wood tar, which is carried out in the richly wooded districts of Germany (Hess, Alsace, Silesia). Dry beach-wood is distilled in retorts. The residual charcoal finds a good market, and the distillate is utilised for the preparation of methyl-alcohol, acetic acid, acetone, and creosote.

(2.) The distillation of brown coal or lignite is exclusively carried out in the Prussian province of Saxony. The coal is slowly heated in special retorts, the residual coke (grude) is used for burning purposes, and from the distillate are extracted paraffin, solar oil, and lubricating oils. In the year 1880, in the 20 factories of the province of Saxony, with a total number of 1,536 retorts, 9,458,603 tons of lignite were distilled, yielding 48,421 tons of tar. From these were obtained:—

7,500 tons paraffin,
700 tons solar oil,
50,000 tons lubricating and gas oils,
1,500 tons creosote and asphaltum,

total value ten million marks.

(3.) The distillation of the tar obtained as a by-product in the manufacture of gas. This manufacture has undergone vast expansion and generalisation in Germany, although the consumption of gas per head of the population has not reached by a long way the figures which hold good for England, France, and the Eastern States of North America. The largest consumption of gas takes place in the Rhine country and the large towns of north Germany. By fractional distillation and purification of the raw products, the following are the principal substances obtained:—

(*a.*) Light tar oils containing benzol, toluol, and xylol.
(*b.*) Phenol.
(*c.*) Naphthalene.
(*d.*) Anthracene.
(*e.*) Creosote oils.
(*f.*) Pyridene.

The first four on the list are the raw materials of the manufacture of artificial colouring matters and chemical preparations, the creosote oils are used for the pickling of railway sleepers, and pyridene finds its application in the so-called denaturation of alcohol.

(4.) The manufacture of coke with saving of the by-products. This recently established and rapidly developing industry is similar in principle to the manufacture of gas, but turns out coke for blast furnaces as a main product; the gas obtained is used as fuel for the ovens, and the vapours thrown off by the coal are condensed as in gas-making. The tar thus obtained is further worked up like gas-tar, and yields the same products. The consumption of tar distillates is so large in Germany that considerable quantities are still being introduced from England, France, and the United States.

(5.) The refining of crude petroleum, which may be looked upon as a product of dry distillation carried on in the interior of the earth. There are three petroleum districts in the German Empire, but none of them bear comparison with either the Caucasian or American districts. They are, therefore, quite unable to cover the consumption in Germany. In 1885, 41,000 barrels of crude oil were obtained from the German wells. A number of works is engaged in the purification of this material, as well as of crude oil imported from abroad.—*Chemical Trade Journal.*

Soda Industry in Germany.

The German soda industry has largely increased in recent years. Whereas in the year 1877 only 42,000 tons of soda were produced and about 27,000 tons were imported, the production in 1883 amounted even then to 115,500 tons, of which 59,100 tons were obtained by Solvay process. Since 1884 the German Empire can boast of an important export trade in soda. The excess of exports over the imports amounted in 1884 to 3,305 tons; in 1890, with a total production of 195,000, to 28,465 tons. The value of the total production varies with the price of soda. In 1883 it amounted in round numbers to 17 million marks.—*Kuhlow.*

A Borax Mine.

Nearly all the boracic deposits heretofore discovered have been found in the form of incrustations on the surface of marshlands, of nodules buried beneath the surface, or of crystals embedded in the mud at the bottom of shallow lakes. In a few instances these deposits are found interstratified with layers of earth and rock, the entire formation being in a horizontal position, as seen at several points in Death Valley. But only in the Calico district, San Bernardino county, does one of these boracic deposits occur in the form of a regular vein, so uptilted that it requires to be exploited after the manner of an ore-bearing lode.

This deposit, the property of the Pacific Coast Borax Company, is located on the northerly slope of the Calico Mountains. This lode, which outcrops at intervals for nearly 3 miles, has an east and west course and a southerly inclination. The slate walls are enclosed in sandstone, superimposed upon which is a brecciated rock, evidently of volcanic origin. The crude material here consists of that variety of the borate of lime known as Colemanite. According to the *Mining and Scientific Press*, it is of a vitreous adamantine lustre, and exceedingly rich in anhydrous boracic acid. The contents of the fissure are 6 feet thick, and at a depth of over 200 feet hold this proportion of nearly pure mineral.

The deposit has been opened by several shafts standing 100 feet apart, these being connected by drifts and levels, the mineral being easily broken down, but a small working force is required in the mine. All that is abnormal about this deposit of borax is easily accounted for. Originally it was, no doubt, deposited at the bottom of a lake, where later on great floods brought down a quantity of sediment which covered it up. In course of time this sediment having been converted into rock, the whole was then lifted up by some great convulsion of nature and left standing at its present angle, this movement having been most likely of a seismic character. In the early history of the borax industry the works put up for the manufacture of this salt were of a very crude and primitive style. Owing to the great cost of lumber this article had to be economised to the utmost, the crystallising vats and other portions of the plant being left uncovered. But in the hot and desiccated atmosphere that for two-thirds of the year prevails in that region, this was no detriment so long as the workmen could be protected in part, at least, from the sun, which here strikes down with a killing heat the whole day long.—*Chemical Trade Journal.*

A Pumice Stone Mine.

A mine of pumice stone exists on the Teneriffe Peak, of which the working was only started in 1888. The stone is found in that part of the peak called the "Canadas," at about 2,000 feet above sea-level, which has an area of some 6,000 hectares, out of the middle of which rises the highest part of the peak. The Russian Consul at St. Croix bought this property from the Spanish Government in consideration of an annual payment for the pumice stone working. The Russian Consul has associated himself with a Belgian, and they, under the firm styled Aguilar and Valcke, commenced operations in 1888, but it was only last year that exportation was really started. At the Paris Exhibition, the Consul General states, this stone obtained a silver medal, and in view of the requirements of England, France and America, he believes it will develop a trade of great importance before many years. So far, the Lipari Islands have practically furnished the world's supply of this product, exporting about 100,000 tons per annum. The Teneriffe stone being recognised as of excellent quality, and its extraction being of a much more simple matter than in the Lipari Islands, it follows that the price is much less.—*Ibid.*

Nickel Production in New Caledonia.

The *Journal des Mines,* in its issue of the 20th July, refers to a report by the Belgian Consul at Noumea, in which it is stated that large areas in New Caledonia are now being worked for nickel. The composition of the nickel ore is hydrated silicate of nickel and magnesia, without any trace of arsenic. It contains 8 to 10 per cent. of the metal, and samples have been found containing as much as 16 per cent. The average value of the ore delivered at the port of shipment is about 100 francs per ton. New Caledonia exported in 1890, 5,000 tons of nickel ore, 1,500 tons of chromate of iron, 700 tons of cobalt, and 210 tons of auriferous quartz.

Mineral Wealth of Russian Turkestan.

The *Chemiker Zeitung* states that Russian Turkestan is very rich in mineral wealth. Mines have been discovered of silver, copper, antimony, iron, zinc, manganese, and gold, as well as beds of ozokerit, naphtha, coal, sulphur, alum, and saltpetre. These treasures cannot at present be worked, owing to the lack of means of transport. It is believed that the extension of the Transcaspian Railway from Samarcand to Tashkend, which is already begun, will open out several of these mines.

Mineral Production in the Caucasus in 1892.

The French *Journal des Mines,* in its issue of the 20th July, gives the following particulars of mining production of the Caucasus in 1892:—103,559 pouds of copper (poud = 36 lb. avoirdupois), 23,700 pouds of sulphur, 1,036,793 pouds of coal, 10,314,394 pouds of manganese ores, 1,535,715 pouds of rock salt, 612,393 pouds of lake salt, and 30,000 pouds of glauber salt.

Mineral Production in New South Wales.

The following particulars of the production of minerals in New South Wales in 1892 are taken from the *British Australasian* for the 22nd June:—

The output of minerals in the Colony during 1892 was 5,305,812*l.*, which, though a decrease of 1,341,194*l.* on the yield of 1891, was greater than that of any other previous year. The output of the principal minerals in 1892 was: Gold, 156,870 oz., value 569,177*l.*; silver lead and ores, 133,354 tons, value 2,420,952*l.*; coal, 3,780,967 tons, value 1,462,388*l.*; silver 350,661 oz., value 56,884*l.*; copper, 4,834 tons, value 187,706*l.* The principal decreases as against 1891 were: Silver lead and ores, 1,063,787*l.*; coal, 280,407*l.*; and silver, 77,966*l.*

Poisoning by Fish in Russia.

The *Journal de St. Pétersbourg* for the 4th July states that the large salted fish, a considerable quantity of which is consumed in Russia, contains a poison all the more dangerous as it is not yet precisely ascertained what its nature actually is, or what means should be adopted to prevent its action. Generally, cases of poisoning by this fish have a fatal issue. The Imperial Academy of Sciences took up the subject in 1887 with a view of defining the nature of this poison and the means of combating it. No result having been attained within a specified period, the academy has just instituted a prize of 5,000 roubles for the best work on the subject, both Russian and foreign savants being eligible for the competition. Works must be written in Russian, Latin, French, English, or German.

The questions to be answered are the following:—1. To determine by chemical and physical experiments the nature of the fish poison. 2. To study experimentally the action of this poison on the heart, circulation of the blood, the digestive organs, and the nervous system. 3. To define the rapidity of the absorption of the poison by the digestive organs. 4. To study and describe the symptoms by which the non-venomous may be distinguished from the venomous fish. 5. To point out the means for preventing the development of the poisonous substances in the fish. 6. To indicate the remedies which may be effectually employed as a counter-irritant.

The works must be presented to the jury by the 1st January 1894 at the latest. Other information may be obtained from the Academy of Sciences at St. Petersburg.

Consumption of Nitrate of Soda.

According to the *Bulletin du Museé Commercial* of the 22nd July, it was in the year 1891 that the consumption of nitrate attained its maximum, 928,000 tons for the whole of the world, of which 830,000 tons were taken by Europe alone. Since this period the annual world's consumption has fallen to about 870,000 tons in 1892 and 845,000 in the year ending 30th June 1893. From 1877 to 1882 the world's consumption varied between 200,000 and 300,000 tons.

According to the order of importance the consuming European countries may be classed as follows, the figures indicating the average quantities taken during the last few years: — Germany, 330,000 tons; France, 200,000; England, 110,000; Belgium, 100,000; Holland, 40,000; Italy and Spain, 10,000; America, 100,000 tons.

The principal ports at which the consignments are received are: Hamburg, with 300,000 to 350,000 tons annually; Dunkirk, 175,000 to 200,000; Antwerp, 70,000; Liverpool, 30,000; London, 25,000; Rotterdam, 46,000. The other ports only receive relatively insignificant quantities.

A New India-rubber Tree in Madagascar.

The *Journal de Mines*, in its issue of the 6th July, states that the trade of the Island of Madagascar in 1892 received a decided stimulus by the discovery of a new india-rubber tree. The principal centres where this new product is treated are Farafangana, Vaugaindrano, Manaimbondro, Fort Dauphin, Andrahomby, and Cape St. Mary.

At first the new product realised from 3 to 6 piastres per 100 lb.; aided by competition the purchase price very soon amounted to 10 and then to 15 piastres. More than 20 piastres per 100 pounds is now paid at Fort Dauphin.

The discovery of the new india-rubber tree has come very fortunately to relieve the Madagascar market, which was at such a low ebb that the Tamatave houses were closing their agencies on the north-east coast and the Americans suppressed their Majunga houses.

BOARD OF TRADE RETURNS.

Summary of Imports.

Articles.	Month ending 31st July	
	1892.	1893.
	£	£
Metals	1,861,865	1,732,540
Chemicals and dyestuffs	412,717	421,558
Oils	534,169	620,563
Raw materials for non-textile industries.	4,311,399	4,282,287
Total value of all imports	33,497,585	33,292,273

Summary of Exports.

Articles.	Month ending 31st July	
	1892.	1893.
	£	£
Metals (other than machinery)	2,648,308	2,769,176
Chemicals and medicines	596,410	642,667
Miscellaneous articles	2,378,790	2,457,727
Total value of all exports	19,463,597	19,651,374

Imports of Oils for Month ending 31st July.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut .... Cwt.	15,882	11,109	18,128	14,801
Olive .... Tuns	1,443	769	52,840	29,676
Palm .... Cwt.	71,296	104,461	81,109	124,353
Petroleum .... Gall.	9,492,993	11,553,882	163,147	195,485
Seed .... Tons	1,012	2,023	25,190	51,138
Train, &c. .... Tuns	1,847	2,356	35,389	43,663
Turpentine .... Cwt.	68,149	76,316	81,131	82,498
Other articles .. Value £	..	..	77,235	78,949
Total value of oils ...	..	..	534,169	620,563

Imports of Metals for Month ending 31st July.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Copper :—				
Ore .... Tons	10,312	10,391	72,358	58,025
Regulus .... „	14,018	11,283	322,729	251,773
Unwrought .... „	2,959	3,140	136,202	141,190
Iron :—				
Ore .... „	319,796	350,667	229,484	236,231
Bolt, bar, &c. ... „	9,125	7,009	80,569	66,681
Steel, unwrought .. „	1,022	730	4,476	6,613
Lead, pig and sheet „	18,001	16,471	199,025	157,924
Pyrites .... „	56,783	62,041	96,017	112,567
Quicksilver .... Lb.	11,474	45,000	1,072	3,950
Silver ore .... Value £	..	..	294,179	280,624
Tin .... Cwt.	41,715	44,687	207,831	185,913
Zinc .... Tons	3,557	5,744	76,829	100,606
Other articles ... Value £	..	..	141,094	130,443
Total value of metals	..	..	1,861,865	1,732,540

Imports of Raw Material for Non-Textile Industries for Month ending 31st July.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	6,878	8,458	14,993	15,635
Bristles .... Lb.	373,917	495,065	54,298	87,662
Caoutchouc ...... Cwt.	17,673	21,636	164,859	241,489
Gum :—				
Arabic .... „	5,583	5,369	12,766	15,066
Lac, &c. .... „	12,609	6,878	49,341	32,885
Gutta-percha .... „	1,549	4,496	9,304	29,911
Hides, raw :—				
Dry .... „	27,681	36,818	80,074	102,720
Wet .... „	51,394	53,010	110,536	116,231
Ivory .... „	1,145	1,033	53,293	44,231
Manure :—				
Guano .... Tons	362	1,700	1,810	7,332
Bones .... „	2,080	2,332	8,878	9,464
Nitrate of soda. „	3,281	3,814	28,028	33,822
Phosphate of lime	26,973	37,250	57,008	64,334
Paraffin .... Cwt.	32,995	37,587	45,409	36,703
Linen rags .... Tons	2,209	960	19,787	8,347
Esparto .... „	14,341	15,054	67,008	71,639
Pulp of wood .... „	14,380	18,106	73,603	90,090
Rosin .... Cwt.	150,318	123,097	35,367	40,666
Tallow and stearin „	179,053	141,097	222,422	189,796
Tar .... Barrels	20,590	12,087	11,676	8,145

IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST JULY—*continued.*

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Wood:—				
Hewn .... Loads	286,707	250,087	622,210	494,793
Sawn .... „	785,462	809,514	1,742,339	1,652,360
Staves .... „	18,762	19,384	54,674	52,546
Mahogany ..... Tons	3,828	2,628	32,152	19,620
Other articles....Value £	..	..	739,573	816,800
Total value	..	..	4,311,399	4.282,287

Besides the above, drugs to the value of 68,482*l.* were imported, as against 45,438*l.* in July 1892.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali.............. Cwt.	1,425	8,061	2,077	6,840
Bark (tanners', &c.) „	37,508	45,513	18,247	20,298
Brimstone .... „	42,794	74,948	11,416	18,083
Chemicals...... Value £	..	..	118,902	107,524
Cochineal .... Cwt.	210	59	1,259	380
Cutch and gambier Tons	2,302	1,725	48,406	36,692
Dyes:—				
Aniline .... Value £	..	..	18,111	15,026
Alizarin ...... „	..	..	20,541	26,923
Other .... „	..	..	1,959	629
Indigo .... Cwt.	1,323	376	21,932	6,396
Nitrate of potash . „	26,495	16,388	23,347	14,136
Valonia .... Tons	1,332	3,169	18,159	41,671
Other articles... Value £	..	..	108,361	126,960
Total value of chemicals	..	..	412,717	421,558

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	363,819	352,568	136,900	120,471
Bleaching materials „	107,000	122,978	41,438	50,380
Chemical manures. Tons	29,316	32,824	148,862	173,235
Medicines....... Value £	..	..	72,339	73,507
Other articles ... „	..	..	196,871	225,074
Total value	..	..	596,410	642,667

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	9.154	11,310	37,602	42,533
Copper:—				
Unwrought ..... „	82,568	67,197	202,826	160,104
Wrought........ „	25,146	26,935	75,098	77,064
Mixed metal .... „	19,741	22,174	49,475	51,621
Hardware ..... Value £	..	..	170,557	175,184
Implements....... „	..	..	100,188	108,869
Iron and steel..... Tons	221,894	276,209	1,762,184	1,872,005
Lead .... „	5,473	3,632	63.537	38,720
Plated wares... Value £	..	..	25,736	24,264
Telegraph wires „	..	..	25,906	77,305
Tin .... Cwt.	7,196	14,651	36,067	65,517
Zinc .... „	15,114	14,552	14,558	12,527
Other articles .. Value £	..	..	84,574	63,463
Total value	..	..	2,648,308	2,769,176

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST JULY.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	513,400	662,100	14,944	15,148
Military stores.. Value £	..	..	54,199	119,611
Candles.......... Lb.	1,300,400	1,508,300	24,259	27,558
Caoutchouc ..... Value £	..	..	105,245	94,343
Cement.......... Tons	51,029	42,574	93,721	71,954
Products of coal Value £	..	..	88,187	83,789
Earthenware ... „	..	..	165,883	164,661
Stoneware ...... „	..	..	10,773	12,362
Glass:—				
Plate........... Sq. Ft.	199,498	171,830	12,050	9,642
Flint........... Cwt.	7,113	7,765	18,984	18,953
Bottles......... „	70,085	50,276	33,607	24,898
Other kinds.... „	19,965	19,768	15,824	14,024
Leather:—				
Unwrought .... „	10,868	10,574	110,133	104,047
Wrought ..... Value £	..	..	24,805	26,737
Seed oil.......... Tons	4,198	5,513	83,440	120,111
Floorcloth ..... Sq. Yds.	1,172,900	1,527,900	53,649	64,570
Painters' materials Val. £	..	..	124,777	120,401
Paper .... Cwt.	74,173	79,054	125,040	123,728
Rags............. Tons	4,194	3,533	28,210	21,969
Soap .... Cwt.	43,989	51,290	46,683	52,756
Total value	..	..	2,378,790	2,457,727

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

13,929. A. Müller. An improved valve for gases and liquids under high pressure. July 18.

13,975. T. Hydes. Improvements in apparatus for the purification of furnace gases. July 19.

14,493. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in evaporating or concentrating apparatus. July 27.

14,516. A. F. W. Kreinsen. Improvements in and connected with electric furnaces. Complete Specification. July 28.

14,698. T. G. Webb. Improvements in apparatus for the concentration of sulphuric acid and other liquids. August 1.

14,840. M. Julien. Apparatus for effecting the intimate mixture of liquids, semi-liquids, or liquefied matters. August 2.

14,900. E. C. Buik. Improvements in apparatus for absorbing gases. August 3.

14,902. J. Kremer. Actinometer and method of measuring the chemical effect of light. Complete Specification. August 3.

14,967. J. B. Tröndle. Apparatus for sterilising beer, wine, and other liquids under pressure. Complete Specification. August 4.

15,209. K. E. Ebert and J. A. Wentzel. Improvements in machines for compressing gases and the like. August 9.

Complete Specifications Accepted.*

1892.

14,672. W. McGuffin Greaves. Improved methods for supplying air to furnaces, and apparatus therefor. August 9.

16,031. G. H. Biddles and J. Hewes. A new or improved furnace for burning town or other refuse. July 26.

16,726. E. Theisen. Method of and apparatus for producing intimate frictional action between liquids and gases or vapours, by means of centrifugal force, for effecting either the evaporation of the liquids of the interchange of temperature between the liquids and gases, or the mixing of the gases with, or their separation from, other liquids. August 9

17,824. W. Mather. *See* Class VII.

1893.

10,585. C. W. Bildt. Feed device for gas producers. July 26.

10,762. H. Birkbeck.—From H. C. Michell. A new or improved heat non-conducting composition. August 16.

12,037. J. W. Mackenzie.—From J. Bengue. Improvements in the method of closing and in the construction of receptacles for the reception of chloride of ethyl or methyl, or other similar liquid. July 26.

12,120. M. Wanner. Improved process of refrigeration and improved refrigerating apparatus. July 26.

12,121. M. Wanner. Improvements in the process of refrigeration and refrigerating apparatus. August 2.

II.—FUEL, GAS, AND LIGHT.

Applications.

13,890. J. Hamer. An improved petroleum fire-lighter. Complete Specification. July 18.

14,219. S. A. Johnson. Improvements in the use or employment of hydrocarbon or other suitable oils for the purpose of burning same in firegrates, stoves, ranges, furnaces, or the like for heating, cooking, and such like or other purposes. July 22.

14,378. G. V. Priestley. Improvements in compressed fuel. July 26.

14,522. A. Farinetti and A. Parietti. Improved means and apparatus for producing air gas from liquid hydrocarbons. July 28.

14,545. J. Smith. Improvements in the production of illuminating gas. July 28.

14,782. J. Smith and W. H. R. Saunders. A new or improved method of making fuel. August 2.

14,783. F. S Cripps. Improvements in washers for the extraction of tar, ammonia, carbonic acid, and sulphuretted hydrogen from coal gas. August 2.

14,918. Brin's Oxygen Co., Lim., and K. S. Murray. Improvements in or connected with the production of oxygen from atmospheric air and apparatus to be employed therein. August 3.

14,948. J. Cuninghame and J. Addie. Improvements in the treatment of blast furnace, producer, and illuminating gas for obtaining cyanides therefrom. August 4.

15,138. J. Schlesinger. Coking chamber with entirely or partly inclined bottom-surface for furnaces with automatic feeding device. August 8.

15,174. S. W. Van Syckel. Improvements in apparatus for the manufacture of gas. Complete Specification. August 8.

15,193. H. S. Goate. A gas purifier. August 8.

15,207. W. Cunliffe. Improvements in the carburetting of gas or air, &c. August 9.

15,305. R. Middleton. An improved process of mixing materials for making blocks or briquettes for fuel, or smelting, and analogous purposes. August 11.

Complete Specifications Accepted.

1892.

15,925. J. J. Hood and A. G. Salamon. Purification of coal gas. August 9.

17,394. H. E. Newton. From R. N. Oakman, jun. Improved apparatus for the manufacture of illuminating gas. August 9.

1893.

2161. L. B. Miller and M. W. Woods. Heating liquids by electricity. August 9.

6324. A. G. Glasgow. Improvements relating to apparatus for the manufacture of water-gas. July 26.

7625. D. Westlake. Improvements in machinery or apparatus for moulding artificial fuel or other materials. July 26.

10,190. J. Lee and S. Lancaster. Apparatus for producing an atmospheric or Bunsen smokeless flame from liquid hydrocarbons as fuel. August 16.

11,103. W. L. Teter and H. L. Webster. Improvements relating to the generation of heat by the combustion of fuel, and to apparatus therefor. August 2.

12,990. G. Winstanley. Apparatus employed in the manufacture of gas. August 16.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Application.

14,189. R. G. Bennett. A new method of oxidising and chlorinating anthracene. July 22.

IV.—COLOURING MATTERS and DYES.

Applications.

13,833. C. D. Abel. From The Actien Gessellschaft für Anilin Fabrikation, Germany. Manufacture of mordant-dyeing colouring matters. July 17.

14,014. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new basic colouring matters. July 19.

14,089. H. Goebel. *See* Class XI.

14,207. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of colouring matters from meta-amidophenol-phthaleines. July 22.

14,208. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the application of phthaleine colouring matters of the eosine and rhodamine series to the printing of fabrics. July 22.

14,345. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of colouring matters derived from anthraquinone. July 25.

14,671. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of green and blueish-green colouring matters. July 31.

14,678. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new amido-sulpho acid, and of new azo dyes therefrom. July 31.

14,895. C. D. Abel. From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improvements in the manufacture of colouring matters. August 3.

14,982. A. J. Boult. From E. Fröhlich. Process for the preparation of iodo compounds of the phenol series of the aromatic oxycarbon acids with pyrrol. Complete Specification. August 4.

15,045. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs. August 5.

15,080. H. H. Lake. From Messrs. Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. August 5.

15,223. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of naphthylamine sulpho acids. August 9.

15,269. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of amido-naphtholsulpho acids and colouring matters therefrom. August 10.

15,327. O. Imray.—From The Farbwerke vormals Meister, Lucius and Brüning, Germany. Production of para-ethoxy and of para-methoxy-phenyl-succinimides. August 11.

15,328. O. Imray.—From The Farbwerke vormals Meister Lucius and Brüning, Germany. Improvements in the production of iodo-derivatives of the succinimide and of substituted succinimides. August 11.

15,404. G. Tobias. Preparation of a new β-naphthylaminesulphonic acid by means of the salts of β-naphthylamine and β-naphthylsulfamin acid. August 12.

Complete Specifications Accepted.

1892.

14,728. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. Improvements in or connected with the manufacture or production of colouring matters. August 9.

15,056. H. E. Newton. — From the Farbenfabriken vormals F. Bayer and Co. Manufacture of dyestuffs. August 9.

15,386. Read, Holliday, and Sons, and K. B. Elbell. Improvements in the manufacture of azo colouring matters and of materials for the same. August 9.

15,692. J. R. Geigy. Production of two isomeric disulpho acids of para-amidophenol and violet-black dye stuffs obtained therefrom. August 2.

16,815. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new basic colouring matters. August 2.

17,147. B. Willcox.—From F. von Heyden. Manufacture of chloro-para-oxy-benzoic acids. July 26.

17,673. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. Improvements in the manufacture or production of dyestuffs. August 9.

17,674. H. E. Newton. — From the Farbenfabriken vormals F. Bayer and Co. Improvements in the manufacture or production of colouring matters derived from anthraquinone. August 9.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

13,921. F. Walton. Improvements in apparatus for the manufacture of mosaic floor-cloth. July 18.

14,551. G. McTear. Improvements in the manufacture of flax or vegetable fibre roofing. July 28.

15,357. J. F. Coates. Improvements connected with the printing of fabrics such as oil cloths, linoleum, and other like flexible substances. August 12.

Complete Specifications Accepted.

1892.

17,055. D. Donald. Manufacture of jute yarns. August 2.

1893.

10,863. F. Devise. Improvements in and in the manufacture of waterproof felt. July 26.

14,433. R. J. Urquhart.—From E. R. Lagerie. Improvements in the method of and apparatus for extracting suint or yolk from wool. August 9.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

13,902. E. Gessler. A new or improved apparatus for the treatment of textile fabrics or yarns or the like with dyeing fluids or vapours. Complete Specification. July 18.

14,154. J. O. Obermaier. Improvements in or relating to dyeing apparatus. July 21.

14,574. J. Kristen. See Class XIV.

14,656. W. Hadfield, J. J. Sumner, and H. Hadfield. Improvements in and in apparatus for printing fabrics. July 31.

14,790. A. R. Donisthorpe and G. White. Improvements in the dyeing of yarn. August 2.

15,028. J. Clapham, J. Picard, C. Villedieu, and W. W. L. Lishman. Improvements in the means and method of preparing vegetable and animal fibres, fabrics, or piece goods for the reception of aniline black. August 5.

15,083. H. H. Lake.—From E. Michaelis & Co., Germany. An improved process for dyeing textile materials. August 5.

15,085. H. Gardner.—From C. P. Andersen, Denmark. Improved means for cleaning, mordanting, and dyeing fabrics and tissues. Complete Specification. August 5.

15,326. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the process for producing fast colours from direct dyes on cotton. August 11.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

15,310. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Improvements in dyeing wool and woollen fabrics with sulphonic acids of alizarin colouring matters. August 9.

19,359. L. Ettl. A new or improved process and apparatus for dyeing, bleaching, and boiling textile material. August 2.

1893.

729. C. D. Abel.—From O. Keferstein, sen., O. Keferstein, jun., and Simens and Halske. Improvements in bleaching yarns, piece goods, and other materials. June 28.

11,379. J. Wetter.—From J. D. Riedel & Co. Manufacture of aluminium tannico-tartaricum. August 2.

11,634. O. P. Amend. Improved process of producing a fast black colour on fibrous substances. August 2.

VII.—ACIDS, ALKALIS, AND SALTS.

APPLICATIONS.

13,842. T. Chandelon. New process for the preparation of bi-calcic phosphate soluble in ammonic citrate. July 17.

13,916. T. H. Cobley. Improvements in the manufacture of acetic acid and the recovery or utilisation of the agent employed therein. July 18.

13,927. A. Müller. An apparatus for obtaining carbonic acid. July 18.

13,928. A. Müller. A method of and apparatus for effecting the absorption of carbonic acid. July 18.

14,078. M. Schwab. Improvements in the method of dealing with noxious liquid produced in the manufacture of sulphate of ammonia, and in apparatus for that purpose. July 20.

14,407. A. K. Huntington. An improved manufacture of compounds of iron with fatty acids. July 26.

14,948. J. Cuninghane and J. Addie. *See* Class II.

15,218. Carl von Grabowski. Improvements in the process and apparatus for the recovery from sulphate lyes or liquor of sulphuric acid free from arsenic and antimony. Complete Specification. August 9.

COMPLETE SPECIFICATION ACCEPTED.

1892.

14,607. H. H. Lake. From J. H. C. Behnke and The Chemische Fabrik Billwärder. Improvements in the production of carbonic acid gas. July 26.

15,346. F. Bale. Improvements in obtaining ammonia-hydrochloric acid, and chlorine from ammonium chloride, also in obtaining chlorine from hydrochloric acid, and in the apparatus used. August 2.

16,757. J. Rice. Improvements in or relating to the manufacture of sulphuric acid. August 16.

16,873. C. L. C. Berton. Improvements in the process of precipitating oxide of tin from solutions.

16,874. C. L. C. Berton. Improved process for the precipitation of tin from acid solutions containing same with other metals. July 26.

17,824. W. Mather. Improvements in the dehydration of ammonia and other volatile liquids, vapours, or gases, and in apparatus therefor. August 2.

1893.

543. J. E. Fuller. Improvements in and relating to combined ammonia distilling and refrigerating apparatus. July 19.

544. D. Branson, R. D. Thornburg, and J. E. Starr. Improvements in and relating to a system of underground distribution and recovery of anhydrous ammonia. July 19.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

APPLICATIONS.

13,812. J. Teggin. Improved appliances for supporting china and earthenware cups whilst being fired. July 17.

13,838. W. Knapp. A process for the production of coloured pictures, writing, and the like on glass, porcelain, and enamel. Complete Specification. July 17.

15,178. R. S. Brownlow. Improvements in the manufacture of earthenware taps. August 9.

15,179. R. S. Brownlow. Improvements in the manufacture of earthenware taps. August 9.

15,365. H. Bourne and T. Garner. An improved method of decorating ceramic ware. August 12.

COMPLETE SPECIFICATION ACCEPTED.

1892.

13,355. F. Ohm. Improvements in the means or materials for decorating, colouring, and enamelling glass, earthenware, and metals. July 26.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

APPLICATIONS.

13,807. C. Musker and A. Musker. Improvements in or connected with machinery for making blocks, slabs, or articles of artificial stone and other material. July 17.

14,429. A. H. Perkins. Improvements relating to the repair of asphalt pavements, and to apparatus therefor. July 26.

14,437. J. Nash. Improvements in the manufacture of bricks and tiles, and the preparation of clay and other ingredients for same. July 27.

15,008. H. Stanton. Improvement in fire-resisting floors. Complete Specification. August 5.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

10,010. J. Hoyle. Apparatus for purifying and grinding the residue of Portland cement and other material. August 2.

10,010*a*. J. Hoyle. Improvements in apparatus for purifying and grinding the residue of Portland cement. August 2.

1893.

508. J. C. Bloomfield. Manufacture of plaster. July 26.

8142. E. A. R. Avenarius. Improvements in and connected with moulding boxes for the manufacture of artificial sandstone. August 9.

12,584. P. Bilstein. Manufacture of fireproof plates or slabs. August 9.

X.—METALLURGY, MINING, Etc.

Applications.

13,847. R. A. Hadfield. Improvements in the manufacture of what is known as manganese steel. July 17.

14,229. E. J. Ball and H. C. Jenkins. Improvements in the use of the metals of the alkaline earths, and of their compounds. July 24.

14,623. P. Becker.—From F. Oettel, Germany. Process for purifying cement copper from arsenic. July 29.

15,037. S. T. Croasdell and B. J. Hall. Improvements in the manufacture of pig-iron. August 5.

15,049. A. Reynolds. An improvement in alloying metals and metalloids. August 5.

15,075. M. Fribourg. Improvements in the treatment of ores, particularly those of the precious metals. August 5.

15,117. R. Howarth. Improvements in the manufacture of metallic alloys or compounds. August 8.

15,152. E. C. Broadwell. Improvements in processes of coating metals with aluminium or its diluent alloys. August 8.

15,184. T. Hampton. Improvements in and relating to the manufacture of armour plates. August 9.

15,189. A. Lazenby. An improved process for the manufacture of steel. August 8.

15,263. J. W. Swan. Improvements in the production of protective coatings of iron or nickel, or both, upon engraved plates or other metallic surfaces. August 10.

15,358. W. Skaife. Improvements in or relating to the removal and recovery of the fume or vapour given off from the baths used in galvanising metals. August 12.

Complete Specifications Accepted.

1892.

8467. H. R. Lewis and C. Gelstharp. Treatment of ores containing blende or zinc in association with gold, silver, lead, copper, antimony, sulphur, and other metals or metalloids, and apparatus therefor. August 9.

14,147. F. W. Durham. Extracting gold from its ores. August 9.

15,444. H. H. Lake.—From G. F. Simonds. Improvements relating to the manufacture of steel, and to furnaces therefor, said furnaces being applicable for other uses. August 2.

16,292. O. Nicolai and C. Langenbach. Soldering aluminium. August 9.

16,800. J. Strap. A process for recovering copper and nickel from ores or matters containing these metals. August 2.

16,891. E. Ruck and F. N. Raggatt. Improvements in or relating to the smelting of zinc. July 26.

16,894. J. C. Montgomerie. Improvements in the extraction of gold and silver from ores or compounds containing the same. July 26.

17,081. A. Culley. A silver-plating compound. August 2.

17,692. E. H. Saniter. Improvements in or relating to the purification of iron or steel from sulphur. August 2.

17,825. H. Imray. From La Compagnie Anonyme de Forges de Chatillon et Commentry. A process for facilitating the fusion of mild steel and other refractory metals. July 26.

1893.

9817. W. R. Ingalls and F. Wyatt. Improvements relating to the treatment of complex sulphide ores. August 9.

12,931. C. James and W. Griffiths. Improvements in the construction of metallurgical furnaces. August 9.

13,117. A. Sternberg and A. Duetsch. Improvements in and connected with the production of chromium, manganese, molybdenum, titanium, tungsten, and similar metals from their alkaline and alkaline earth compounds. August 9.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

16,335*b*. E. M. Harrison. Improvements in magneto-electric generators. Complete Specification. Filed 29 July. Date claimed 13 September 1892.

13,858. A. Heil. A galvanic element. Complete Specification. July 17.

13,911. W. P. Thompson. From C. L. Coffin, United States. An improved method of and apparatus for heating, welding, or working metals electrically. Complete Specification. July 18.

14,012. H. Bonner. Improvements in electric batteries. July 19.

14,056. W. H. Longsdorf. Improvements in electrolytes for primary batteries. July 20.

14,089. H. Goebel. Improvements relating to the manufacture of Paris blue or Berlin blue and of Berlin green by electrolysis, and to apparatus chiefly designed for use in such manufacture. Complete Specification. July 20.

14,130. J. Hargreaves and T. Bird. Improvements in the electrolysis of iodides, bromides, nitrates, and other salts. July 21.

14,131. J. Hargreaves and T. Bird. Improvements in the electrolysis of chlorides, iodides, bromides, nitrates, and other salts, and in apparatus therefor. July 21.

14,259. W. Lowrie. Improvements in dynamo-electric machines. July 24.

14,315. C. W. A. Hertel. Improvements in galvanic elements. Complete Specification. July 25.

14,505. L. Voltmer. A process and apparatus for obtaining pure metallic manganese by electrolysis. July 28.

14,534. H. C. F. Störmer. A cathode for electrolysis. July 28.

14,628. F. Hurter. Improvements in or connected with cells or batteries for use in electrolysis. July 29.

14,910. P. Jensen. From A. Sinding-Larsen, Norway. A method of and apparatus for electrolytical decomposition while using quicksilver as cathode. Complete Specification. August 3.

15,257. S. Marcus. Improvements in and connected with galvanic batteries. Complete Specification. August 10.

15,264. P. Marino. Improvements in plating metallic surfaces and also prepared surfaces of non-conducting substances by electro chemical deposition. Complete Specification. August 10.

15,355. H. S. Pyne and R. Thompson. An improved electric battery. August 12.

15,396. F. Hurter. Improvements in or connected with apparatus for the manufacture of chlorate of potash by electrolysis. August 12.

Complete Specifications Accepted.

1892.

14,658. A. J. Smith. Improvements relating to electric accumulators or secondary batteries, and to the manufacture of plates or electrodes therefor. August 9.

15,113. J. P. Roubertie, V. Lapeyse, and U. Grenier. Manufacture of caustic soda and potash, and hydrochloric acid, by electrolytic treatment of chloride of sodium and chloride of potassium, and apparatus for this purpose. July 26.

15,793. C. G. P. de Laval. Method of smelting or overheating iron or other metals by means of electricity. August 16.

16,866. A Müller. Improvements in electrode-plates for secondary batteries. August 16.

16,892. D. Tommasi. Process and apparatus for the extraction, separation, and refining of metals by electrolysis. July 26.

16,893. D. Tommasi. Process and apparatus for the extraction, separation, and refining of metals by electrolysis. July 26.

17,246. T. J. D. Rawlins. Improvements in or connected with electric primary batteries. August 2.

17,922. F. King and E. Clark. Secondary batteries. August 9.

18,037. W. C. Mountain. Improvements in electric welding apparatus. August 16.

24,127. F. King. Secondary batteries. August 9.

1893.

11,578. W. P. Thompson. From C. L. Coffin. A new or improved method of electrically welding metals. July 26.

13,408. J. H. Mason and A van Derwerken. Improvements in electric batteries. August 16.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

14,188. D. D. Brown. Grease. July 22.

15,259. J. Trabert. Improvements in the manufacture of soap. August 10.

Complete Specifications Accepted.

1892.

16,767. W. Mills. Improvements in and relating to the recovery of soap and suint from wool grease. July 26.

1893.

8740. W. J. Fraser and T. C. Palmer. Improvements in tallow melting or rendering. July 26.

12,116. E. W. Stanton. Improvements in naphtha soap and in the method of, and apparatus for, producing such a soap. July 26.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

13,925. A. Beck. An improved lacquer. Complete Specification. July 18.

14,970. H. W. Langbeck. Improvements in the manufacture of materials for indelibly marking paper and fabrics. August 4.

1892.

16,184. P. Bronner. Process for the manufacture of oxide of lead and of white lead from crude sulphate of lead. August 16.

1893.

2626. M. Becker. Process for producing a fundamental mass from which varnish and similar coatings may be made. July 26.

7500. J. W. F. Alber. An improved enamel. July 26.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

14,491. E. S. Spencer. Improvements in the manufacture of gelatine. July 28.

14,574. J. Kristen. Improvements in and connected with leather-dyeing apparatus or machines. July 29.

14,825. M. Cohen.—From Messrs. Bellack and Friedrich, Austria. An improved process for making a vegetable odourless size or glue. August 2.

14,826. M. Cohen.—From Messrs. Bellack and Friedrich, Austria. An improved process of making liquid glue free from disagreeable smell. August 2.

Complete Specification Accepted.

1892.

20,677. M. Heftler and G. Bénard. Improvements in or relating to the extraction of tanning and dyeing materials. August 9.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

14,086. J. Y. Johnson.—From J. E. Pellegrini, Spain. Improvements in the manufacture of sugar, and in the apparatus employed therein. July 20.

14,394. J. N. S. Williams. Improvements in defecating or purifying saccharine liquids, and in apparatus therefor. Complete Specification. July 26.

14,934. J. Littlewood. A new and improved process of compounding ready mixed, liquid starch for linen. Aug. 4.

15,300. W. Smith.—From H. Kidd, New South Wales. Improvements in continuous subsiding or settling apparatus for sugar-cane juice. Complete Specification. Aug 11.

15,301. W. Smith.—From H. Kidd, New South Wales. Improvements in machinery for forcibly feeding crushed or shreaded or comminuted sugar cane to crushing mills. Complete Specification. Aug. 11.

15,304. W. Smith.—From H. Kidd, New South Wales. Improvements in apparatus for treating shreaded or comminuted sugar canes preparatorily to crushing. Complete Specification. Aug. 11.

Complete Specification Accepted.

1893.

11,913. P. Lebaudy. Improvements in the artificial cooling of syrup for the manufacture of refined sugar, and apparatus therefor. July 26.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

14,120. J. E. Johnson-Johnson. Improvements in the manufacture of materials for the production of alcoholic and non-alcoholic beverages, and in apparatus therefor. Complete Specification. July 21.

14,280. W. Watson. Improvements in and relating to the treatment of hops. July 24.

14,373. R. E. Evans. Improvements in syrups, extracts, wines, beers, mineral waters, and other liquids. July 26.

14,567. W. Bruce. Improvements in the manufacture of yeast. July 29.

14,967. J. B. Tröndle. *See* Class I.

Complete Specifications Accepted.

1892.

14,118. E. Korn. A novel treatment of beers to adapt them for transport, and for preservation purposes. August 9.

1893.

8144. C. Rach. Improvements in the preparation of wort from Indian corn. August 9.

10,290. M. Wool. Process of making brandy mash and composition for same. August 16.

12,555. J. A. Tilden. Process of malting. August 9.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

14,252. F. A. Kleemann. An improved method of and apparatus for pasteurizing or sterilizing milk and other fluids. July 24.

14,292. H. V. Weyde. Improvements in the manufacture of block ice. July 24.

14,693. G. T. H. Roeske. Improvement in the method of and apparatus for purifying water. July 31.

14,894. C. Ekin and W. H. Thew. Improvements in or relating to the manufacture or preservation of condensed milk. August 3.

15,161. W. F. E. Casse. Process for preserving milk and cream for a length of time, rendering it suitable for lengthy transit. August 8.

15,169. H. L. Doulton and A. W. Manger. Improvements in and relating to the softening and purifying of water and apparatus therefor. August 8.

B.—Sanitary Chemistry.

14,245. W. Horsfall. Improvements in furnaces for the destruction of town refuse. Complete Specification. July 24.

14,285. G. J. Epstein. Improvements in making the air antizymotic, wholesome, invigorating, ozonising, for different purposes. July 24.

14,586. A. McDougall. Improvements in covering lead surfaces to protect water and other portable liquids from contamination with lead dissolved in contact therewith. July 29.

14,642. R. C. Tanner. Improvements in the treatment of sewage and other foul waters. July 31.

14,716. J. Emmett. Improvements in the treatment of sewage and other polluted waters. August 1.

14,801. C. A. Burghardt. Improvements in and in the production of compositions adapted to be used in the treatment of sewage and other foul waters. August 2.

15,036. F. A. Black. An apparatus for purifying, disinfecting, and deoderising the contents of sewers, drains, cesspools and the like. Complete Specification. August 5.

C.—Disinfectants.

14,411. I. S. McDougall and J. T. McDougall. Improvements in fumigants. July 26.

14,412. I. S. McDougall and J. T. McDougall. Improvements in the production of insecticides. July 26.

14,903. C. T. Kingzett. Improvements in sulphur candles or fumigators. August 3.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

14,651. A. J. M. Bolanachi. Improvements in or relating to the treatment of milk, cream, and various food materials and in apparatus therefor. August 16.

B.—Sanitary Chemistry.

1892.

17,302. A. P. J. Cotterell. An appliance for facilitating withdrawal of sludge or deposit in sewage tanks, applicable also to clarifying water and other liquids. August 2.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

13,837. O. Brauer. Manufacture of waterproof materials from crude cellulose or wood pulp. July 17.

14,191. J. P. Cornett. Improvements in or connected with the manufacture of pulp for paper making. Complete Specification. July 22.

14,504. H. E. Cusack. A preparation for making any paper forgery-proof. July 28.

15,038. E. R. Baller. A method of making cheques and other negotiable documents forgery-proof. August 5.

15,068. L. R. Hennig. A method of treating printed and other paper to remove printing-ink and render the material suitable for re-manufacture. August 5.

15,180. J. B. Howard.—From E. Fischer, Germany. Improvements in appliances for moulding and shaping pasteboard. Complete Specification. August 9.

15,332. W. H. Coldwell. Improvements in apparatus used in the manufacture of paper-pulp. August 11.

15,399. A. Ruffin. Improvement in the manufacture or treatment of cardboard and cards. August 12.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

14,075. H. Baum. Improvements relating to the production of halogen isodithiosalicylic acid. July 20.

Complete Specification Accepted.

1892.

14,716. O. Imray from the Farbwerke vormals Meister, Lucius, and Brüning. Improvements in the production of pyrazalone derivatives. July 26.

14,881. H. E. Newton.—Farbenfabriken vormals F. Bayer & Co. The manufacture or production of new chemical compounds containing sulphur. July 26.

16,112. H. E. Newton.—From the Farbenfabriken vormals F. Bayer & Co. The manufacture of iodine compounds. July 26.

1893.

10,769. J. Y. Johnson. From F. von Heyden. Improvements in purifying saccharine. July 24.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

14,024. F. C. D. Beacham. Improvements in or relating to colours for and colouring photographs and other articles. July 20.

15,383. O. Hellstern. An improved process and combination of ingredients for the formation and transfer of photographic images. August 12.

Complete Specifications Accepted.

1892.

17,766. R. G. Williams. Improvements in photographic developing solutions. August 9.

22,576. J. Hauff. The employment of diamido-dioxybenzol in combination with sulphides of the alkalis for developing the latent image in layers containing halogen silver for photographic purposes. July 26.

1893.

12,304. F. W. Edwards and H. Ramson. An improvement in the manufacture of sensitive plates or films for photographic purposes. July 26.

XXII.—EXPLOSIVES, MATCHES, Etc.

Application.

14,726. J. Clark. Improvements in exploder for torpedoes. Complete Specification. August 1.

Complete Specifications Accepted.

1893.

8226. G. Pinder. Improvements in or connected with ships' rockets, signal lights, Roman candles, and other fireworks. July 26.

12,168. C. M. Bowman. Manufacture of matches. July 26.

12,401. H. H. Lake.—From F. Krupp and Co. Time fuses. August 9.

PATENT UNCLASSIFIABLE.

Application.

14,274. F. Crane and J. B. B. Wellington. Improvements in or relating to the manufacture of films or bands of flexible material. Complete Specification. July 24.

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Deaths.

Heaton, Prof. C. W., Charing Cross Hospital, W.C.

Milne, Dr. J. M., Royal Infirmary School of Medicine, Glasgow.

Mumford, A., 19, St. James' Place, Plymouth.

Obituary.

JAMES M. MILNE, Ph.D.,

LECTURER IN CHEMISTRY TO THE ROYAL INFIRMARY MEDICAL SCHOOL, GLASGOW, MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

THE subject of this notice died on the 29th of August 1893, thus leaving vacant a post he has held as Lecturer in Chemistry for upwards of ten years, first in the Royal Infirmary Medical School, and then in St. Mungo's College, where the Chair of Chemistry was committed to him. James M. Milne commenced about twenty-five years ago the study of chemistry as a special subject, and he added to his Glasgow training in the Science also a subsequent continental training, ultimately taking his Ph.D. degree in Zürich. Returning home from Zürich, he fitted up a laboratory in Glasgow, and commenced practice as an analytical and consulting chemist in that city, a practice he maintained to the time of his decease. For four years Dr. Milne acted as one of the examiners in chemistry to the joint faculties of Glasgow and Edinburgh, and to this office he had been re-elected for yet another period of four years. He was also Examiner in Chemistry to the Glasgow Faculty for the Diploma in Public Health.

Dr. Milne held moreover the appointments of Public Analyst for the county of Fife, and for the Burghs of Airdrie, Ardrossan, and Irvine.—W. S.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Employment of Petroleum as a Disincrustant in Germany.
Journ. des Mines, Aug. 17, 1893.

The officials of the Prussian State railways have for several years been making use of petroleum in order to remove the incrustations in the boilers of locomotives and fixed machinery. These trials have been so satisfactory that petroleum is now used in every case where the incrustations are not too hard and impermeable. Petroleum is used after washing the boiler and after the compartments of the latter are completely dried; the petroleum is applied with the aid of brushes, or injected by means of a pump. On some occasions an attempt has been made to make use of petroleum before the water in the boiler has been removed. In this case the petroleum spreads uniformly over the whole surface of the water, and when the latter is allowed to run out slowly the petroleum fixes itself regularly in the porous incrustations, which absorb it.

A Study of the Filtration of Liquids. P. Dehérain.
Comptes rend. **116**, 1440—1441.

If porous vessels be filled with liquids and rapidly revolved the liquids filter through the pores. If the rapidity with which pure water passes through be taken as unity, then the rapidity of filtration of other liquids is as follows:—

Sodium chloride, 5 per cent. solution	1·023
Potassium chloride, 5 per cent. solution	1·043
Sodium nitrate, 5 per cent. solution	1·051
Ammonium sulphate, 5 per cent. solution	0·993
Alcohol 20°	0·590
Alcohol 40°	0·50
Alcohol 90°	0·67
Milk	0·03

The rapidity of revolution was equivalent to a pressure of 8—10 atmospheres.

If the speed of revolution be increased the co-efficients of potassium chloride and sodium nitrate solutions increase, whilst those of sodium chloride and ammonium sulphate diminish.—A. L. S.

A New System of Water Purification for Steam Boilers.
A. Gibault. Bull. de la Soc. d'encour. 7 [80], 490.

The purification of the feed-water for steam boilers may be effected in three different ways:—

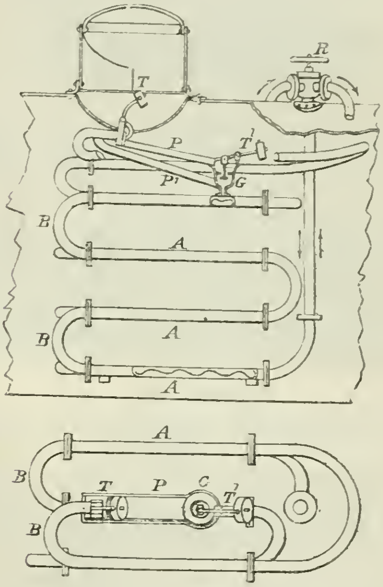
The water may be purified by chemical precipitation before entering the boiler. Very good results are obtained in this manner, but these processes involve considerable expense and careful supervision.

The water may be fed into the boiler together with such substances as prevent the formation of adherent scales.

In the boiler, vessels or reservoirs may be provided, in which the circulation of the water is reduced to a minimum, and in which consequently the deposits accumulate. The only drawback of this arrangement is the necessity for frequent stoppages in order to clean these vessels.

The new purifier is one of the last-named class. Iron tubes A of 12 cm. diameter (Fig. 1) are united horizontally and vertically by bends B. The length of these tubes is preferably proportionate to the length of the boiler. At least two or three of them ought to reach above the highest level of the water, all the others being under water. Each tube forms part of a horizontal set of three tubes, thus forming a kind of worm in which the water circulates with the greatest ease. The apparatus is introduced into the boiler through the dome and rests upon iron cross-bars. The highest of these vertical tubes terminates in an inclined trough P, the lower end of which is formed by the cup G, which rests upon the next lower tube. A counterpoise valve T¹ closes this cup during the feeding of the boiler and a similar valve T, which is then open, allows the water filling the highest horizontal tube, to run through the trough P. The tube P¹ connects the bottom of the cup G with the highest horizontal tube, just behind the valve T, and insures the perfect action of the whole arrangement. Corrugated surfaces are provided in the interior of the tubes A, in order to prevent the deposits being carried away. To set the apparatus in action a three-way tap R is provided on that part of the feed-pipe which is outside the boiler, and by means of this tap either the boiler is fed through the apparatus, or the deposit accumulated in the latter is blown off through a branch pipe. If the tap is adjusted for feeding, the water descends through the vertical tube into the lowest coil of the worm, and almost immediately

Fig. 1.



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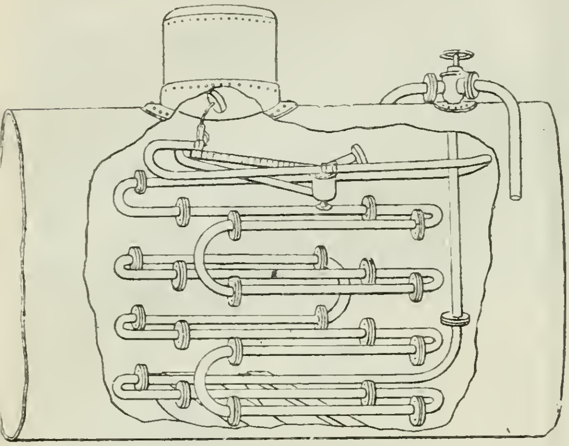
* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

takes the temperature of the water of the boiler. Rising subsequently in the worm it finally emerges at T, and flowing through P, unites with the water in the boiler without change of temperature. All incrusting matters are precipitated in the worm tubes, the finest particles being deposited in the trough P and filling the cup G, the bottom of which is closed by the valve T^1. When it is desired to clear the apparatus of accumulated deposits, the tap R is moved into the required position, whereupon the steam pressure within the boiler automatically closes valve T and opens T^1, the steam thus first traversing the inclined tube P^1, subsequently passes through the worm in exactly the opposite direction to the feed-water, carrying with it and expelling through the branch tube all the deposits, along with a small quantity of water. The apparatus is manipulated in this manner at intervals, determined by the amount of deposit-forming impurities which are contained in the feed-water.—C. O. W.

Fig. 2.



Glass Water-Gauges for Steam Boilers. M. Hervier. Comptes rend. 116, 688—690.

Glass water-gauges are usually regarded as giving the best available indications of the level of the water in the boilers to which they are attached; but, nevertheless, they are liable to give erroneous indications under certain circumstances. Defects in the position of the tube, tumultuous ebullition, presence of steam bubbles or suspended matters, obstruction of the tubes by foreign substances, and condensation of steam in the connecting pipes are the chief sources of error; the result of which is that the water level indicated in the gauge is often more or less different from the true level in the boiler, the difference being sometimes very marked. Tumultuous ebullition generally occurs when the water in the boiler has fallen below its proper level, and hence of itself suggests that something is wrong with the water supply. Obstruction by deposition of crust, or otherwise, usually prevents rapid oscillation of the water in the gauge; the blow-off cock should then be opened so as to dislodge the obstructing matter, if possible. In any case the cocks connecting the boiler and gauge ends should be closed each evening, and opened again in the morning, and not be left open, as this would facilitate deposition of obstructing matter.

The author is of opinion that the use of *two* water level indicators is indispensable, working independently of each other; but that these should not be on different systems. It is absolutely necessary that each should control the other, but they should both be on identically the same system.—C. R. A. W.

The Effect of Steam Jackets upon Multiple Expansion Engines. A. Witz. Comptes rend. 116, 370—373.

The author refers to the doubt that exists with many as to the utility of steam jackets, and states, that *à priori*, it must be greater with simple expansion than with compound or triple expansion engines.

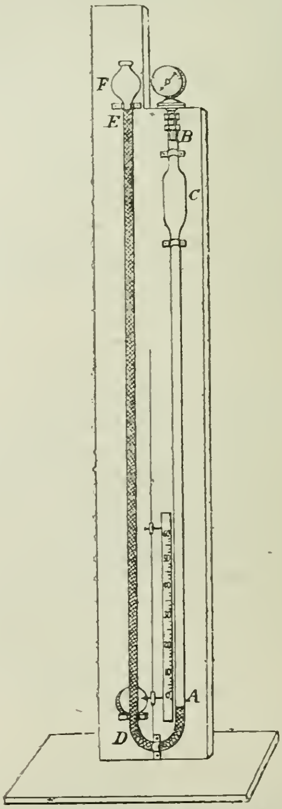
The results of a series of trials made by the author with a "Dujardin" engine of 625 n.h.p. at one eleventh cut off are given. The trials were made under the following five different conditions, viz:—steam in (1) the jackets of both cylinders and the receiver jacket; (2) in the two cylinder jackets only; (3) in the jackets of the high-pressure cylinder and the receiver; (4) in the receiver jacket only; (5) none in any of the jackets. All other conditions of the trials remained identical throughout. The results arrived at are as follows:—

The initial condensation, and therefore the re-evaporation during expansion, is much less in the high-pressure cylinder of a compound engine than in a simple expansion engine. The value of γ in the equation $p.v^{\gamma} = \text{constant}$, is nearly unity for all five conditions. When the jackets are in use the expansion line is above the hyperbolic curve, and below it when they are not. The steam consumption under conditions (5) being 3·7 per cent. greater than under conditions (1) there is a real gain, but it is of little importance.

The best results being obtained under conditions (3), makers who have discarded the use of jackets round receivers are justified in doing so. The steam consumption with the non-jacketed engine being remarkably low—6·547 kilos.—shows the superiority of compound over simple expansion engines, and, falling as it does to 6·100 kilos. with the jacketed engine, that triple expansion engines can alone give better results.—R. B. P.

Manometer for Control of Vacuum Gauge. M. Zouzal. Zeits. f. Zuckerind. Böhm, 1893, 17, 394.

The author has devised the instrument depicted below for the purpose of testing the accuracy of a vacuum gauge. It



Zouzal's Vacuum Barometer.

consists of a fairly strong glass tube A B with a wider portion at C, fixed to a wooden stand. The vacuum gauge to be tested is hermetically screwed to the upper portion of the tube. A thick caoutchouc tube D E terminating with a glass mercury reservoir F is fixed to the lower end of the glass tube. When the instrument is not in use the reservoir is placed in the upper holder. Near the lower portion of the glass tube is a movable scale which has at the zero point a metallic pointer. The level of the mercury in both arms is adjusted, the vacuum gauge screwed on, and the reservoir placed in the lower holder. It must be ascertained that the metallic pointer, *i.e.*, the zero point of the scale, is on a level with the surface of the mercury in the reservoir. Both the gauge and the manometer should give the same indications.—A. R. L.

PATENTS.

A New or Improved Method of Mixing and Dissolving Solids and Liquids and in Apparatus therefor. O. Hamilton, Northfleet. Eng. Pat. 11,249, June 15, 1892.

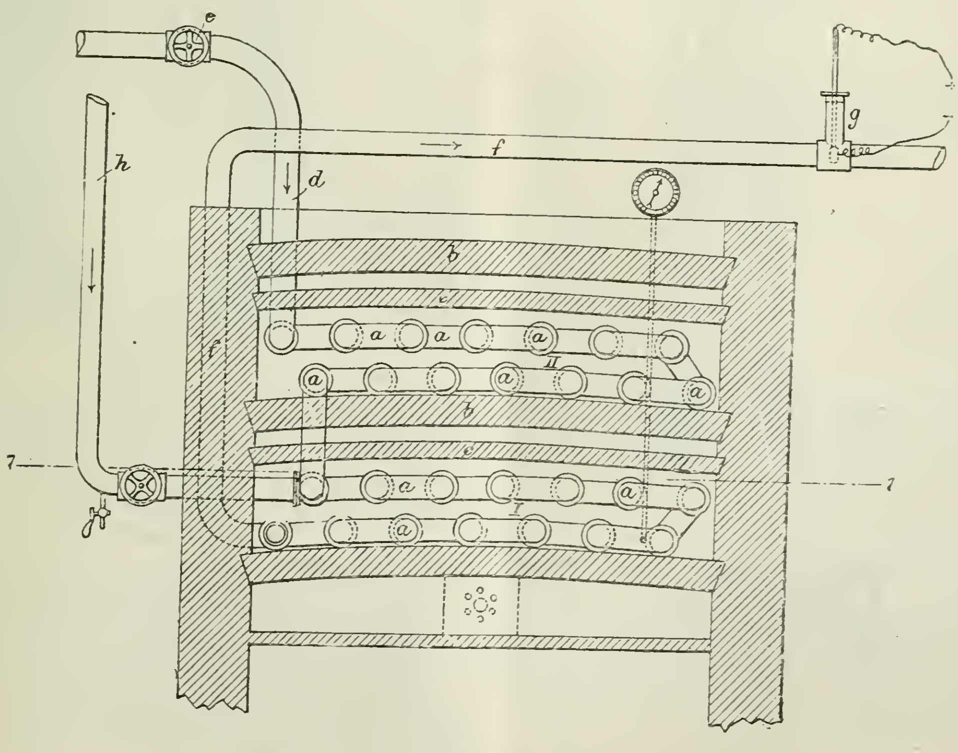
In the method patented the use of mechanical agitators is avoided, and the gas or gas and air are employed for the agitation. The apparatus and process are described more particularly for the treatment of litharge with ammonium acetate solution in the manufacture of white lead, though they are said to be more generally applicable. They are essentially as follows: A double acting air compressor continually circulates the atmosphere of a lead-lined digester, the gas being withdrawn at the top and driven in again through a distributing pipe at the bottom under the liquid to be agitated. A snifting valve connected with a tank of the liquid to be agitated allows of the automatic restoration of adequate pressure in the digester should it accidentally fall, while a relief valve communicating with the same tank, permits the escape of gas from the digester should the pressure rise unduly. The substitution of agitation with a limited supply of air for either mechanical agitation or agitation by means of an indefinite quantity of air allows on the one hand of greater freedom in the choice of structural materials, and on the other avoids the necessity of scrubbing the exit gases.—B. B.

Process and Apparatus for Separating out the Constituent Parts of Gaseous and Liquid Compounds. F. Windhausen, Berlin, Germany. Eng. Pat. 14,851, August 17, 1892.

In this invention certain constituent parts of gaseous and liquid compounds are eliminated by a cooling process which leaves the residual parts after separation has taken place, at their original or a higher temperature. The process is carried out by causing a current of a gaseous body which has previously been rendered intensely cold to meet a counter current of the compound to be treated, thereby solidifying or liquefying those parts affected by the low temperature and utilising the part not affected as a heat-absorbing agent acting on the compressed gaseous body before the latter is allowed to expand for cooling. The apparatus consists mainly of two sets of refrigerators acting together on the counter current principle, a receptacle fitted between them to catch particles eliminated in the first refrigerator, an expansion vessel through which the heat conveying agent passes, and a compression cylinder fed from the expansion vessel. The apparatus is arranged in various ways and there are coolers, strainers, and collectors and other details according to the nature of the substances acted upon whether gaseous or liquid.—B.

Improvements in the Method of and Apparatus for the Production of Superheated Steam and its Application in Steam-Engines. A. Bratsluboff, Moscow, Russia. Eng. Pat. 14,890, August 17, 1892.

The object of this invention is the superheating of steam to any desired temperature, and maintaining it thereat



Improved Apparatus for producing Superheated Steam.

without change for any length of time. This is stated to be accomplished by allowing the steam to pass through heated coils of tubes inserted in a furnace and imbedded in layers of sand or other badly conducting substances whereby a very equable temperature is maintained.

The accompanying cut gives a cross section through a heating furnace constructed in accordance with this invention. *a a* are the heating tubes, arranged in two superheating chambers I. and II. separated by thick brick arches *b b*, each being provided with a second thinner arch *c* closely covering in the tubes.

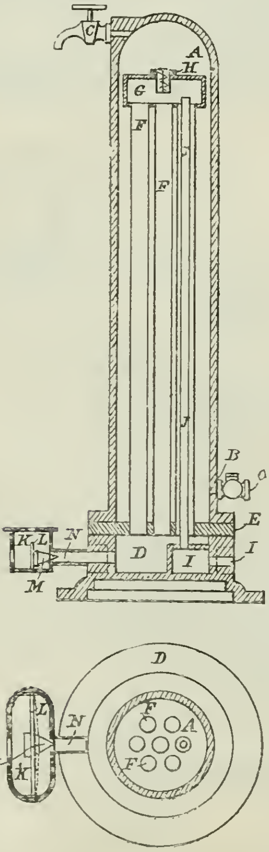
The chambers are filled with sand between the tubes, and the hot gases pass and repass through the flues both above and below them.—B.

Improvements in Apparatus for Separating Substances of Different Sizes or Specific Gravities. J. U. Askham, Sheffield. Eng. Pat. 14,926, August 18, 1892.

This invention relates to improvements in Eng. Pat., 1455, 1885, granted to T. W. B. Mumford and R. Moodie (this Journal, 1886, 94), and refers to details of construction and to the arrangement of the apparatus. It embraces a bearing for the lower end of the fan spindle with a special arrangement for lubricating the same and for keeping it free from dust, the construction of openings with doors for easy access to the casing, an arrangement of fan for facilitating the repair or renewal of the blades, and the separation of the apparatus into two for the better subdivision of the substances.—B.

Improvements in Apparatus for Heating and Cooling Liquids. G. H. Richmond, Fairfield. Eng. Pat. 15,124, August 23, 1892.

This apparatus for heating water by steam is constructed in the manner indicated in the accompanying figures.



Improved Apparatus for Heating and Cooling Liquids.

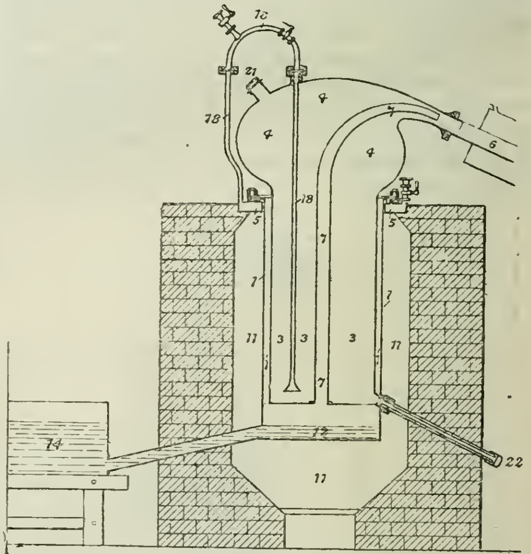
A is the casing into which the cold water enters by the cock B, which can be withdrawn hot through the tap C. The steam enters the bottom box at I, and rises by the small pipe J through one of the heating tubes F into the upper box G, thence descending by the whole of the tubes F, which it heats together with the surrounding water. The water of condensation falls into the bottom box D, and finds its way to the outlet through the conical valve M. The latter is carried on a strip of metal which, when all the water has passed, is heated and expanded by the steam following the same, thereby closing the opening against the steam and maintaining it closed until sufficient water has accumulated again behind it, when the operation is repeated.

The relief valve H on top of box C opens downwards and prevents the accumulation of pressure in the casing.—B.

An Improved Construction of Alembic. V. J. Kness and C. H. J. Donnadieu, Paris. Eng. Pat. 15,244, August 24, 1892.

The alembic, the subject of the present invention, is used for the distillation of matters by means of a steam bath and may be constructed as indicated in the illustration.

The alembic 3 is placed within the water vessel 1 in which the water level 12 is maintained constant by connection with an outside supply cistern 14. The whole is inserted in the furnace 11. The alembic carries a central vertical taper tube 7, bent in such a way as to enter the inner opening of the discharge tube which leads from the head 4 to the condenser 6. As steam is raised in the vessel 1, it not only heats the contents of the vessel 3, but escaping through the tube 7 acts as an ejector for the vapours arising from the matters to be distilled, thereby facilitating the operation. In order to further accelerate this, a second water receptacle 5 may be fitted around the alembic at the top of the furnace and the steam produced therein allowed to descend through the distillate by the pipe 18, thence escaping, together with the vapour, through the common discharge pipe.—B.



Improved Alembic.

Method of and Apparatus for Producing Intimate Frictional Action between Liquids and Gases or Vapours by Means of Centrifugal Force for effecting either the Evaporation of the Liquids or the Interchange of Temperature between the Liquids and Gases or the Mixing of the Gases with or their Separation from the Liquids. E. Theisen, Radolfzel, Baden, Germany. Eng. Pat. 16,726, September 19, 1892.

The invention relates to a method of producing intimate frictional action between liquids and gases by causing the liquids to flow in thin films or layers over the inner surfaces of rapidly-revolving cylindrical or conical drums, while at the same time air, gases, or vapours, subject also to centrifugal action are caused to flow over or in intimate contact with such thin layers of liquid at a considerable relative speed thereto. By this means is caused either a rapid interchange of temperature producing the heating or evaporation of the liquid or the cooling or condensation of the vapours or a combination of the two, or else an intimate mixture or a perfect separation of the liquid and the gas, as the case may be, according to the requirements and to the consequent arrangement and manipulation of the apparatus. The apparatus principally consists of a number of concentric drums of various shapes threaded on to a rapidly revolving spindle, provided with sundry devices for the proper guidance and direction of the gaseous and liquid fluids under treatment.—B.

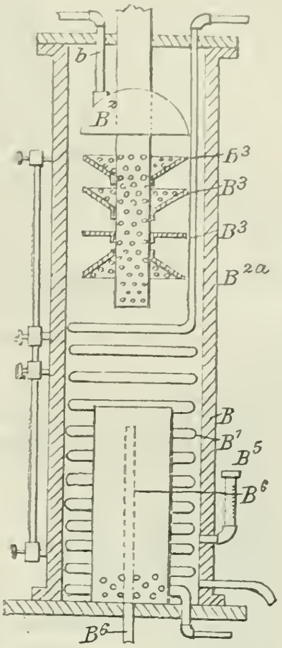
An Improved Construction of Pyrometer. H. P. J. Negretti and M. W. Zambra. Eng. Pat. 15,489, August 29, 1892.

The inventors take a thermometer tube with an elongated bulb and place it in a metal case, which is inserted in the wall of a furnace in the ordinary way, the bulb extending beyond the end of the case, and being situated at greater or less distance from the source of heat. The bulb is enclosed in a suitable sheath of fireclay, carbon, platinum, or other material capable of withstanding intense heat, secured to the inner end of the metal case, the outer part of which carries the scale. The bulb must not be in contact with the sheath at any point.—B.

Improvements in and relating to Combined Ammonia Distilling and Refrigerating Apparatus. J. E. Fuller, New York, United States of America. Eng. Pat. 543, January 10, 1893.

The invention relates to an apparatus for the production of anhydrous ammonia from the aqua ammoniæ of commerce; the anhydrous ammonia so obtained is intended for use as a refrigerating agent, and after being so used the ammonia is recovered and prepared for use over again by a continuous process. Fig. 1 (for illustration, see next page) shows a general view of the entire apparatus in which A is the still or separator, A^6 the stand-pipes or condensers, provided with internal cold-water pipes, C is the equaliser, B the absorber, A^3 the strong aqua ammoniæ supply tank, F^3 the weak ammonia tank, RRR the anhydrous ammonia reservoirs, K one of the heat absorbing coils; numerous pipes connect the various parts, and valves worked by hand open or close communication as desired. The apparatus works in the following manner:—Steam from a boiler X passes through a coil inside the separator A, and aqua ammoniæ is pumped from the tank A^3, through the equaliser C to a rose placed over the coil. The ammoniacal liquor, trickling over this coil, is vaporised and ascends into the water-jacketed chamber A^5, the vertical pipes A^6, and the coil F. The combined cooling effect of these three condenses the watery vapour, which is discharged by a drip-trap, leaving the ammonia to pass on through the condensing coil F into the receiver R, where the vapour condenses to a liquid, and may be stored in any suitable manner, or else used for refrigerating purposes by passing it through the heat absorbing coils K. The fully expanded gas is afterwards conveyed by the manifold H to the absorber B shown in section at Fig. 2. The absorber is a cylinder B, provided with a spiral coil B^1, through which water circulates from the reservoir D. Weak ammonia is fed from the reservoir F^3, into the atomiser B^2, by the pipe *b*, and is still more finely divided by the perforated distributing cones B^3 and deflecting plate B^{2a}, thereby causing the weak ammonia water to take up the ammonia gas. The aqua ammoniæ, cooled by its descent over the coil B^1, falls to the bottom of the absorber, and collects in the cylinder B^5, perforated at its base, and from thence a pipe B^6 conveys the strong surface liquid back to the reservoir, to be used over again. With this apparatus it is found that some ammonia is always left in the water at the bottom of the still A. In order to remove this ammonia, the liquid ammonia is expelled into the reservoir F^3, by opening suitable valves, the pressure in the still being sufficient to force the liquid into F^3. All the principal parts of the apparatus are provided with pressure gauges and level indicators.—E. G. C.

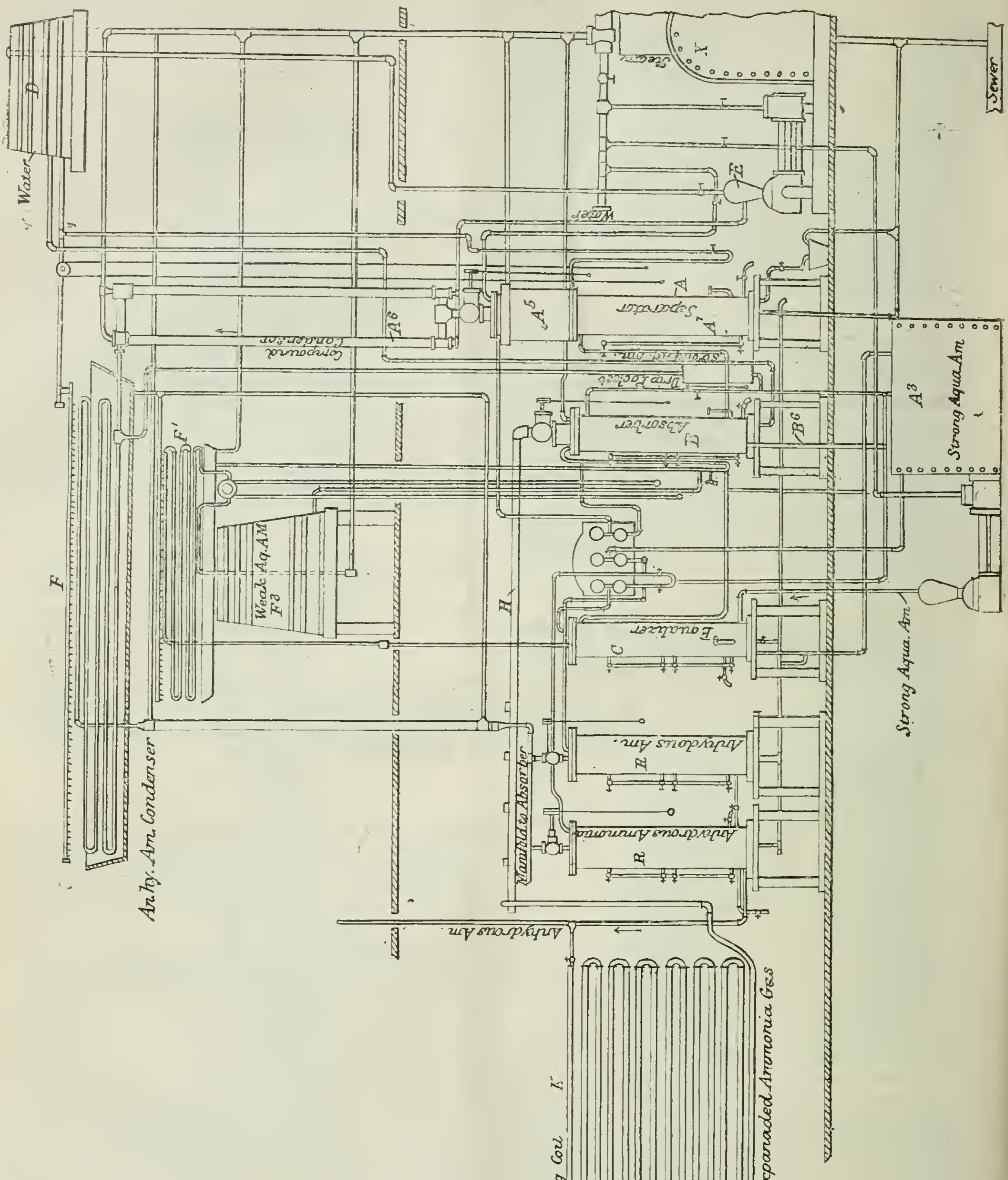
Fig. 2.



Improvements in and Relating to a System of Underground Distribution and Recovery of Anhydrous Ammonia when Employed as a Refrigerating Agent. D. Branson, Philadelphia; R. D. Thornburgh, St. Louis; and J. E. Starr, St. Louis; all of the United States of America. Eng. Pat. 544, January 10, 1893.

Anhydrous ammonia is generated at a central station, in any suitable manner, and distributed by means of underground pipes, laid in a conduit, and following the levels of the streets. The ammonia, after use in refrigerators, boxes, or rooms along the line of route, is returned by another larger pipe to the absorber at the central station, there to be recovered and concentrated for use over again. Traps are placed at suitable points for the collection of any aqueous fluid, and to keep the pipes clear; scale traps are also provided to collect the scale, disengaged from the iron pipes by the action of the strong ammonia. To provide for making repairs or changes in the refrigerators, without any loss or escape of gas, a vacuum pipe is laid alongside the flow and return pipes, so that by shutting suitable cocks, any part of the circuit can be cut off, and exhausted by the vacuum pipe. By keeping the vacuum pump constantly running, refrigerator boxes may be repaired without disturbing the other parts of the system. A pressure-reducer is placed upon the main outflow pipe, in electrical connexion with an alarm bell, so that if the pressure rises much above the normal, the ringing of the bell at once announces the change at the central station. The valves for supplying ammonia to the cooling coils may be operated either by hand or by thermostats.—E. G. C.

Fig 1.



General Arrangement of Combined Ammonia Distilling and Refrigerating Apparatus.
(*See page* 743, *Eng. Pat.* 543.)

Improvements in Filter Films, and in the Method of Making the Same. E. M. Knight, New York, United States of America. Eng. Pat. 6560, March 28, 1893.

The filter films are formed by strewing a quantity of dry and comminuted asbestos over the wire gauze bottom of a vessel partly submerged in water, whereby the fibres of asbestos are held in a state of flotation. The fibres are then arranged to run in all directions, by gently stroking with a brush or with the finger.

The vessel is now lifted from the water and tamped to drive out any surplus water, after which the film is transferred to a flat plate, by introducing the latter into a holder and turning the vessel bottom upwards. The film is afterwards finished by thoroughly drying upon a heater. The film so made has fibres interlocking in all directions, with a surface which, although pervious to water, is of sufficient density to hold back impurities in water that has passed the preliminary screening point. The films being of asbestos do not dissolve or decompose, and are applicable to any form of portable or other filters.—E. G. C.

Improvements in and Connected with the Direct Indication of the Weight or Volume, or both, of Gases, and Apparatus therefor. A. Longsdon, London. From the firm of Fried. Krupp, Essen, Germany. Eng. Pat. 9518, May 12, 1893.

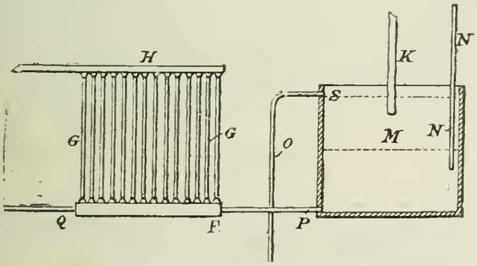
The object of the invention is to find the volume or weight of a gas, at any pressure or temperature, without any calculation. A volume of absolutely dry air or other gas is enclosed in an air-tight spring case, or in a "Bourdon's ring," and the alteration in volume of this enclosed gas, produced under different temperatures and pressures, is transferred by a dial train to an index finger, travelling over two concentric scales. Scale I. is constructed to read volumes, while scale II. indicates the weights, the latter scale being of course a different one for each gas.—E. G. C.

Improvements in Evaporating Apparatus. S. M. Lillie, Philadelphia, United States of America. Eng. Pat. 11,104, June 6, 1893.

The invention has for its object the separation of suspended liquid particles from the vapours evolved during the evaporation of liquids. By means of perforated plates, the liquid is distributed over a series of horizontal pipes arranged in a closed chamber. Steam is caused to circulate through the pipes, by means of a main, causing the liquid to evaporate. The vapour so formed passes through and around baffle plates, into a prolongation of the evaporating chamber, called the subsiding chamber. The baffle plates cause the suspended particles to separate and fall to the bottom of the subsiding chamber, from whence they are drawn off by means of a pipe below. The vapour passes off in a dry state by means of an outlet pipe, placed at the upper part of the subsiding chamber.—E. G. C.

Improvements in the Process of Refrigeration and Refrigerating Apparatus. M. Wanner, Denver, Colorado. Eng. Pat. 12,121, June 20, 1893.

The invention relates to improvements in refrigerating apparatus in which carbon disulphide is the refrigerating agent; the process is especially intended for use in abbattoirs, breweries, cold storage warehouses, and for the manufacture of ice. The figure shows an elevation of the essential parts of the apparatus: M is the reservoir, F and H evaporating pans connected by pipes G to form the refrigerating apparatus. All the upper and lower pans H and F are respectively connected together by piping, the upper connecting pipe being finally led away to the exhaust chamber of the vacuum pump. The reservoirs, pans and tubes are partly filled with carbon bisulphide, which is evaporated by the action of the vacuum pump and the vapour is drawn through the pump and forced by the return system of tubes K back into the reservoir M, being partly liquefied in its passage back through the tubes and partly by means of water entering the reservoir by the pipe N. The surplus water is drawn off by the outlet pipe O, leaving the carbon bisulphide in the bottom of the reservoir for use over again. The refrigerators are arranged in independent sets, so that in case of failure the affected apparatus can be shut off, without interfering with the remainder. For use in making ice the evaporators are immersed in the brine tank, in which is the vessel containing the water to be frozen.—E. G. C.



Refrigerating Apparatus.

II.—FUEL, GAS, AND LIGHT.

Explosions of Petroleum Lamps. J. für Gasbeleuchtung, 1893 [20], 397.

The German Imperial Commission from a copious collection of evidence, elicits evidence in support of the conclusion that scarcely 1 per cent. of the total lamp explosions have been occasioned by attempting to extinguish the lamps by blowing down the chimney. The majority of the explosions were occasioned by special circumstances, such as knocking over, or letting fall the lamps, rapid movements, or holding aslant whereby frequently ignition of the vapours in the interior of the oil reservoir or chamber, is occasioned. For prevention of explosions the following rules are to be observed :—

1. The lamp must have a heavy foot with a base as broad as possible, so that it cannot tip over.
2. The oil reservoir ought preferably to be of metal, rather than of glass or porcelain.
3. The well-fitting chimney must be adjusted so that no side draughts of air can reach the flame.
4. The burner-ring must be firmly fixed.
5. The wick ought to be soft and not too thick, also of a width such that it can be easily drawn into the holder.
6. The reservoir ought to be filled up completely, before using the lamp; during the filling up no flame ought to be in the immediate neighbourhood.
7. The lamp must always be kept clean.
8. The extinguishing of the lamp ought to be effected, after lowering the flame to the level of the burner, by blowing down the cylinder not directly but from one side, a kind of side-blast. The direct blowing into the cylinder is to be avoided.
9. The burning lamp ought not to be exposed to a draught. If this cannot be avoided though, since the lamp must be carried about, then it must be protected from the draught by interposing a piece of paper or cardboard, &c.

PATENTS.

Improvements in the Purification of Coal Gas. J. J. Hood and A. G. Salamon, both of London. Eng. Pat. 15,925, September 5, 1892.

This invention deals with the elimination of "carbonic acid," "sulphuretted hydrogen," and "a class of sulphur compounds, of which the chief is carbon bisulphide" from coal gas. It is claimed that by the use of hot lime the carbon dioxide and the hydrogen sulphide are absorbed more readily than if cold lime be used, that the carbon dioxide more readily replaces the hydrogen sulphide, and that calcium sulphide prepared from hot lime is more active in absorbing sulphur compounds than if prepared from cold lime.

Within the purifying vessels is deposited "hot hydrated slaked lime," or unhydrated lime, or partially hydrated lime, in lumps or ground. In the two latter cases the hydration is completed in the vessel itself, by the introduction of steam, or water, or both, and the heat maintained by admitting steam, or heating a portion of the gas. By these means a larger amount of carbon dioxide is arrested and a longer continued stream of hydrogen sulphide, free from carbon dioxide, sent forward, either to form hot calcium sulphide, for the absorption of sulphur compounds, or to be absorbed in "Weldon mud" or iron oxide.

Hot slaked lime for the formation of calcium sulphide is introduced into the vessels at such a time as the former vessel, known as the carbonate vessel, is becoming foul; the hydrogen sulphide driven out by the carbon dioxide is collected in the hot lime, and a very active "sulphide vessel" formed. The temperature of these vessels is maintained in the same manner as in the purifying vessels.

By the use of hot slaked lime the action between ammonia, carbon bisulphide, and lime, resulting in the formation of calcium sulphocyanide, is accelerated.

For the removal of the last traces of ammonia from coal-gas by means of lime in the purifiers, the addition of calcium chloride to the water used for slaking this lime is claimed as of great assistance in the process.—R. B. P.

Improvements in or connected with Jet Apparatus for Lime and other Lights. A. Kershaw, Leeds. Eng. Pat. 16,026, September 7, 1893.

The object of the invention is to construct jet burners so that they may be efficiently adjusted, whilst the cost of manufacture is much reduced.

In this apparatus the burner for producing the light is carried on the two gas-supply tubes. These are supported on an L-shaped bracket hinged at its upper end to a bracket projecting from a vertical tube. This tube can be rotated round a vertical rod passing through it by means of a thumb-screw; this motion moves the burner to the right or left horizontally. To raise or lower this burner there is another thumb-screw, which, by pressing on the heel of the L bracket, tilts the gas-supply tubes up or down, and with them the burner.—R. B. P.

Improvements in making Gas, and a Compound therefor. H. Collet, London, and M. Merichenski, Tottenham. Eng. Pat. 17,067, September 24, 1892.

In this invention the use of a mixture of cocoanut-oil and gasoline is claimed for making illuminating or explosive gas, by passing air, a mixture of air and gas, or water-gas, through it. Either commercial cocoanut-oil or fat may be used. It is dissolved in gasoline not exceeding 0·7 in specific gravity in the proportion of one and a half pounds of cocoanut-oil to one gallon of gasoline.

This compound is specially intended for use in the carburettor described in Eng. Pat. 6909, 1892, but may be used also for enriching coal-, water-, or any other gas.

—R. B. P.

Improved Apparatus for the Manufacture of Illuminating Gas. H. E. Newton, London. From R. N. Oakman, jun., Greenfield, Mass., U.S.A. Eng. Pat. 17,394, September 29, 1892.

This invention relates to the manufacture and carburetting of water-gas. With this plant pressure is not required, the steam and air being alternately drawn down through the incandescent fuel by an exhauster. In this manner the water-gas can be made slowly, and the fuel bed kept from cooling down too quickly. It is claimed that by using an exhauster in place of a blast a more uniform temperature can be maintained in the carburettor, and thereby a gas more uniform in quality obtained. For details of construction and arrangement of the various parts of the apparatus, the specification, which is illustrated with eight figures, must be consulted.—R. B. P.

Improvements in or relating to Coke Ovens. A. J. Boult, London. From F. J. Collin, Dortmund, Germany. Eng. Pat. 4205, February 25, 1893.

The object of this arrangement of coke ovens is to provide a passage for the gases in which a very high temperature is maintained, and to adapt the oven for coking coal containing but small quantities of gas and incapable of satisfactory "baking"; the process also comprises the extraction of by-products from suitable coals.

Fig. 1 is a section through the flue between two adjacent ovens, and Fig. 2 a section through an oven itself. The gases from the ovens pass out through vertical ports in the crown into the flue C, and out of C through lateral ports into the flue C^1. The latter has a cross partition at its centre, which divides the gases into two parts, one going to each end of the flue, and then through the dampers S into the flues C^2, and out through the ports O O into the hearth channel S C. The necessary air is admitted through P *f* from the cooling channel K C. When by-products are to be recovered the gases are exhausted direct from the ovens, or from C and C^1, the dampers S being shut. After treatment the gases are admitted under S into the flues C^2.

—R. B. P.

Fig. 1.

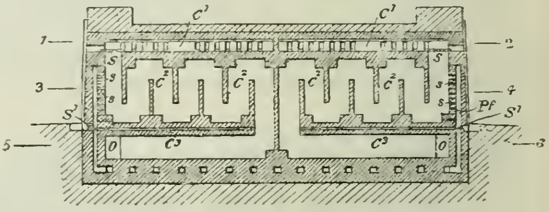
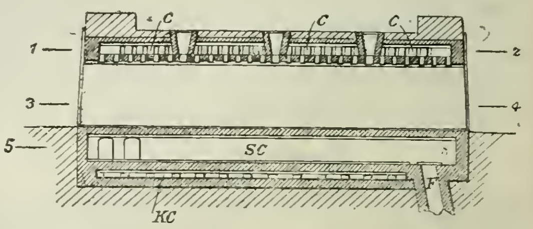
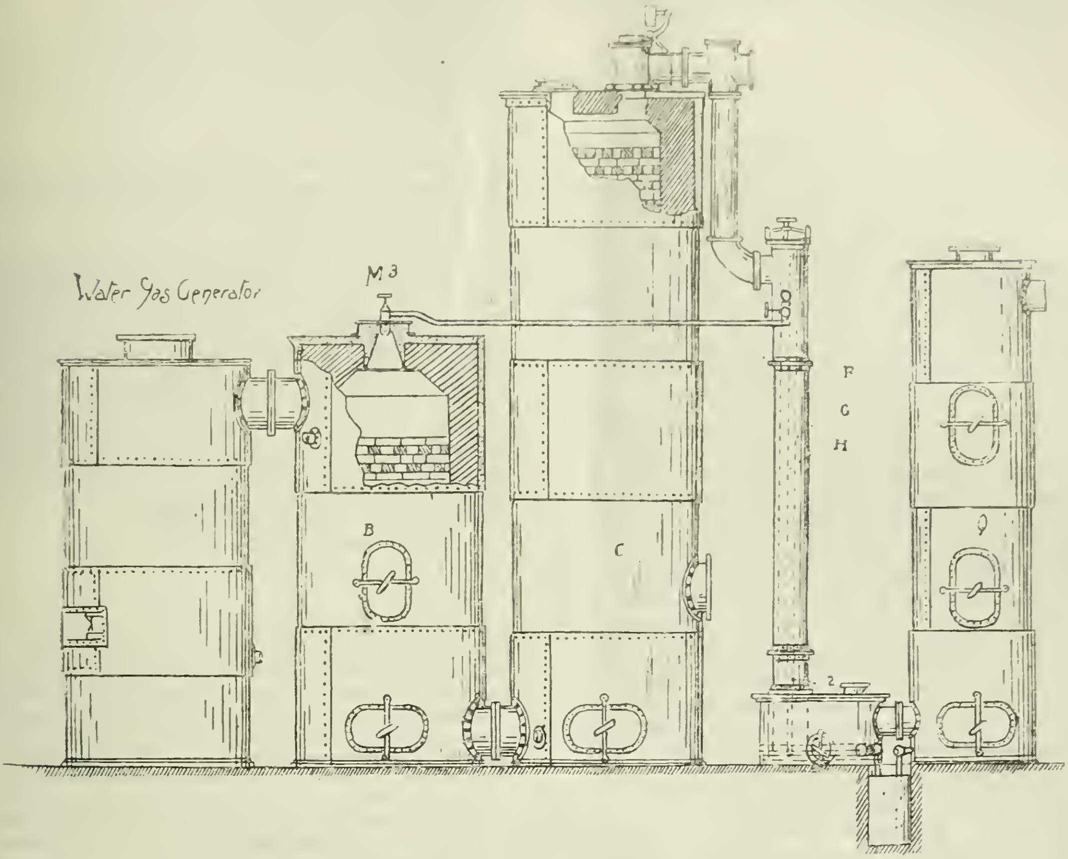


Fig. 2



Improvements relating to Apparatus for the Manufacture of Water-Gas. A. G. Glasgow, Westminster. Eng. Pat. 6324, March 24, 1893.

This invention relates to an oil heater for water-gas apparatus. In the gas conduit F, between the superheaters B and C and the purifying chamber Q, is placed an oil heating tube G. Along the centre line of this is a rod H (or a tube closed at both ends) welded to the top of the tube, which is there closed. The rod is kept concentric with the tube by means of lugs on it. The object of this rod is to cause the oil, which enters the lower end of the tube, to ascend in the form of a hollow cylinder to the outlet at the top thereof, whence it passes to the oil nozzle M^3 in the superheater B. The oil is heated through the walls of the tube by the hot gases passing along the conduit.



Improved Apparatus for the Manufacture of Water Gas. —R. B. P.

Feed Device for Gas Producers. C. W. Bildt, Worcester, Mass., U.S.A. Eng. Pat. 10,585, May 30, 1893.

This invention relates to improvements upon the apparatus described in Eng. Pat. 20,462, 1890, and consists of an apparatus for feeding in the fuel and evenly distributing it.

Attached centrally to the producer cover is a hopper, in the form of a truncated cone, and below this is a horizontal disc, carried by a sleeve which is continuously rotated, by suitable gearing, round a central shaft.

To the lower end of the latter are attached two distributing blades, one of which converges spirally towards, and the other diverges spirally away from, the shaft carrying them, one curve finishing where the other commences, both being in the same horizontal plane. The coal falls from the hopper on the rotating horizontal disc, and from this on to the distributing blades, whence it is thrown on to the bed in spiral lines, and in a uniform and even layer. The gearing for rotating, raising, and lowering the disc and blades is described.—R. B. P.

A Gas Light Intensifier by the use of which any Ordinary Gas Burner will give a Greater Amount of Light. J. T. Guthrie, Leith. Eng. Pat. 15,213, August 24, 1893.

A marked increase in the amount of light given off by the same quantity of gas in any ordinary burner is claimed to be effected by use of a metal cylinder fitting over the burner, and having projecting wings or sides. A burner with these permanently attached is also described.—R. B. P.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Asphalt Mines in Syria. Reports from the Consuls of the United States, 42 [153], June 1893, 228—230.

Of the four asphalt mines known to exist in Syria, the one situated in the vicinity of Hasbaya, about 40 miles south-east of Beirut, is the most important. It yields a product little inferior if not equal to that derived from that well-known source, the Dead Sea, and is the only mine in Syria from which asphalt is at present obtained. The working of the three other mines, situated at Sohmor (30 miles south of Beirut), Ain-Ettineh village (70 miles east of Beirut), and in the valley of the Dead Sea, respectively, is strictly interdicted by the local Turkish authorities. Until 1860 these mines were almost completely neglected, small quantities of asphalt only being dug, free of tax, by the natives and applied by them to their vines as an insecticide. In 1864 the working of the Hasbaya mine (the Sultan's private property) was placed upon a commercial basis and is now carried on with marked success by the firm Absy & Co., who have held the mine since 1888, the condition of the lease being that 65½ per cent. of the asphalt extracted should go to the agents of the imperial private treasury. The amount of asphalt obtained by this firm during the last five years is estimated at 5,400 tons, the price of the product in the foreign markets being at present from 8·69 dolls. to 9·65 dolls. per 100 kilos., whilst at the commencement of the working of this mine it was 19·30 dolls. The Syrian asphalt, which is invariably exported in its natural state, is subjected to an export duty of 1 per cent., but this is expected to be shortly abolished Large quantities of asphalt being obtainable from all the Syrian mines, the output might be increased considerably if the local authorities would grant permission for more extensive operations.—K. E. M.

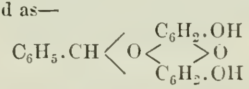
IV.—COLOURING MATTERS AND DYES.

Some Colouring Matters of the Triphenylmethane Group.

K. Hofmann. Ber. **26**, 1893, 1139—1146.

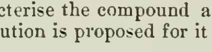
By the action of benzaldehyde on pyrogallol in the presence of hydrochloric acid, Baeyer (Ber. **5**, 280) obtained a colourless body to which he assigned the formula $C_{26}H_{22}O_7$. The compound was subsequently prepared and examined by Michael (Ber. **19**, 1389), who gave it the formula $C_{26}H_{20}O_6$. Being formed by the condensation of 2 mols. of pyrogallol with 2 mols. of benzaldehyde, this body is evidently not a triphenylmethane derivative.

The author has succeeded in preparing such a compound by varying the conditions of action between the two substances, taking a different proportion of them and a different condensing agent from those employed by Baeyer; the best results being obtained by heating a mixture of 20 grms. of pyrogallol, 35 grms. of zinc chloride, and 12 grms. of benzaldehyde for six hours at 130°—135°. The compound was isolated from the mass produced by extracting successively with dilute hydrochloric acid and hot acetic acid, and precipitating from its solution in the latter, with water. Its properties are as follows:—Alcohol and dilute alkalis dissolve it with a red-brown colour, concentrated sulphuric acid with an orange colour; chloranil does not affect the colour of its alcoholic solution, showing that it is not a leuco compound of the ordinary type; sulphur dioxide, potassium cyanide, and caustic soda and zinc dust, are without action upon it, proving it not to be an aurin; it has no affinity for mordants, but dyes unmordanted wool colours similar to those yielded by galloflavin on the chrome mordant; silk is dyed by it pale olive to dark brown, according to the proportion of dyestuff employed. The molecular weight of its diacetyl derivative, determined by Raoult's method (using acetic acid as a solvent), is 320. The empirical formula of the compound is, it would seem, $C_{19}H_{12}O_4$, and its constitution may be expressed as—



By prolonged treatment, however, with acetic anhydride and anhydrous sodium acetate a triacetyl compound is formed, the production of which is only explicable by this formula on the assumption that the methane hydrogen atom is replaced.

Another colouring matter, the formation of which was observed by Baeyer (*loc. cit.*), is prepared by heating pyrogallol and benzaldehyde in an open vessel with concentrated hydrochloric acid (15 parts) for two hours at 100° C. This dissolves in alcohol with a deep red, and in caustic soda solution with a blue colour, which on dilution turns pink. The alcoholic solution is decolourised by zinc and hydrochloric acid, as is also the alkaline solution by zinc dust. From the decolourised solutions a leuco compound may be separated in the form of a white, flocculent precipitate, which rapidly reddens on exposure to air. The alcoholic solution of the colouring matter is also nearly decolourised by sulphur dioxide. These properties characterise the compound as an aurin, and the following constitution is proposed for it:—



On drying some time at 90° C. 2 mols. of this body split off the elements of a molecule of H_2O and form the compound, $C_{38}H_{22}O_9$.

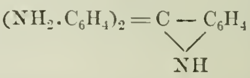
In the above reactions it is considered that the pyrogallol first undergoes condensation to a compound of the formula $C_{12}H_8O_4$, which then interacts with benzaldehyde, yielding triphenylmethane derivatives; such a compound being formed by the action of zinc chloride (15 grms.) on pyrogallol (5) at 110°—130° in an atmosphere of hydrogen. This body appears to be distinct from Böttinger's pyrogallol anhydride (Ann. **202**, 280) to which the formula $C_{24}H_{14}O_7$, is ascribed.—E. B.

Researches on the Constitution of Magenta and of analogous Colouring Matters through the investigation of their Acid Salts.

A. Rosenstiehl. Bull. Soc. ind. de Mulhouse, May, 1893, 195.

Through E. and O. Fischer's researches the constitution of the fundamental hydrocarbon of rosaniline and of the rosaniline base itself are well established. The constitution of the colouring matters themselves is still in some respects more or less a matter of hypothesis, and this remark applies particularly to magenta. An investigation of the acid salts of this colouring matter led to the following results:—

Hofmann's Rosaniline tri-hydrochloride, $C_{20}H_{19}N_3.3HCl$, possesses the empirical formula $C_{20}H_{23}N_3Cl_4$, therefore as a matter of fact it does not exist and the hypotheses based upon it must be abandoned, especially—(1.) The formula $C_{20}H_{19}N_3$ for rosaniline anhydride. (2.) E. and O. Fischer's formula for its lower homologue—



(3.) The existence of a double bond between one of the nitrogen atoms and the carbon of the methane and phenylene. (4.) This double bond not existing, it can no longer be considered the cause of dyeing power in magenta and similar dyes. Accordingly the formula of magenta must be $Cl—C\equiv(C_6H_4.NH_2)_3$, and magenta must be considered as the hydrochloric ester of a tri-amido alcohol. In combination with acids this alcoholic function of magenta first comes into play. It is invariably modified in the presence of amido groups, the basic nature of which is superadded to the feebly basic $\equiv COH$ group and imparts to the OH group of the rosaniline, or to the Cl of magenta, as great a capacity for ready chemical interchange as is observable in any metallic salt. The hydrochloric ester of rosaniline, *i.e.* magenta, being formed, any excess of acid is fixed by the amido-groups and the molecule is saturated when all the amido-groups have become neutralised—

$$Cl—C\equiv(C_6H_4.NH_2)_3.3HCl.$$

The presence of the acid radicle in the methane carbon also explains the lack of stability observable in the acid salts of magenta. An analogous decrease of the basic properties is noticeable in chlorinated, brominated, or nitrated aniline. A glance at the formulæ of leucaniline and magenta at once explains now why the former yields stable salts while the salts of the latter decompose so easily—

$$H—C\equiv(C_6H_4.NH_2)_3,\ Cl—C\equiv(C_6H_4.NH_2)_3$$

The hydrogen atom preserves the basicity of the molecule, whereas the chlorine atom of the magenta weakens it. The relation existing between the colourless and the coloured derivatives of triphenylmethane is clearly explained in the following formulæ:—

$Cl—C\equiv H_3$	$Cl—C\equiv(C_6H_5)_3$
Methyl chloride.	Triphenylmethane chloride.

These two compounds are colourless.

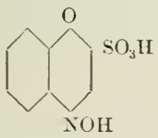
Triamidotriphenylmethane chloride (magenta)—

$$Cl—C\equiv(C_6H_4.NH_2)_3$$

Without going so far as to ascribe the dyeing power to the presence of the amido groups, it may be said that the colouring matters in question are the esters of aromatic amido alcohols.—C. O. W.

Investigations on the Sulphonic Acids of α-Naphthol. M. Conrad and W. Fischer. Annalen, **273**, 102–117.

The literature of the products obtained by the direct sulphonation of α-naphthol contains numerous contradictory statements as to the number and properties of the sulphonic acids obtained. While Claus and Oehler by treating one part of α-naphthol with two parts of sulphuric acid on the water-bath only obtained one single sulphonic acid, Witt and also Baum obtained two acids simultaneously, one being the long-known α-naphtholsulphonic acid of Schaeffer, yielding but very poor azo colouring matters by combination with diazo compounds, and the difficultly soluble nitroso compound of this acid does not yield a green coloration with ferrous sulphate, while the second of these acids produces excellent azo dyes and its nitroso compound yields a green coloration with ferrous sulphate. On repeating Schaeffer's experiments by heating one part of α-naphthol with two parts of sulphuric acid on the water-bath for two hours, a mixture was obtained which was found to contain chiefly 1-2-4-naphtholdisulphonic acid, 1-2-naphthol-monosulphonic acid being formed in small quantities only. From this it follows that in order to obtain good yields of the monosulphonic acid, excess of sulphuric acid ought to be avoided as much as possible. For this purpose the naphthol is best treated for one hour with a mixture of one part of sulphuric acid and one-half part of glacial acetic acid at a temperature not exceeding 55° C. Operating in this way 100 grms. of naphthol yielded 52 grms. of the potassium salt of 1-2-naphtholsulphonic acid and 70 grms. of 1-4-naphtholsulphonic acid. At the same time about one-half of the naphthol is converted into oxy-naphthyl-methyl-ketone. The 1-2-naphtholsulphonic acid gives a dark blue coloration with ferric chloride; it forms with diazoxylene an orange azo-dye and its nitroso compound does not give a green reaction with ferrous chloride. This acid is therefore evidently identical with Schaeffer's 1-2-naphtholsulphonic acid, and with Clève's acid. The same acid is obtained by heating the potassium salt of 1-2-4-naphtholdisulphonic acid for several hours at a temperature of 180° C. By treating this acid with nitrous acid, nitroso-1-2-naphtholsulphonic acid—



is obtained, which, on gently heating with dilute nitric acid, is quantitatively converted into dinitronaphthol. On treating the above nitroso acid with stannous chloride and hydrochloric acid the corresponding amido-naphthol-sulphonic acid is obtained.

The salts of the 1-4-naphtholsulphonic acid are easily soluble in water and produce a deep blue coloration with ferric chloride which does not turn purple on diluting the solution, but excess of the iron salt causes a dirty green coloration. The nitroso compound yields a dark green coloration with ferrous sulphate and a dark red one with nitrate of cobalt. All these reactions prove that on sulphonating α-naphthol in the manner described, besides 1-2-naphthol-sulphonic acid, a considerable quantity of 1-4-naphthol-sulphonic acid is also formed.—C. O. W.

Amidonaphthol Sulphonic Acids. F. Reverdin and Ch. de la Harpe. Ber. **26**, 1279—1284.

The authors in their first paper (Ber. **25**, 1400; this Journal, 1892, 997) on the oxidation of amido-naphthol sulphonic acids concluded, that only those derivatives of α-naphthol which contained the amido group ortho to the hydroxyl were capable of giving violet-black colouring matters on oxidation. The β-naphthol derivatives, all of which contained the amido group ortho to the hydroxyl, gave true colouring matters which dyed wool reddish-violet from an acid-bath and mordanted cotton, grey to greyish-green shades. To this rule there are three exceptions, the amidonaphthol sulphonic acid—

$$[2.1.5]\ C_{10}H_5.OH.NH_2.SO_3H$$

and the disulphonic acids—

$$[2.1.3.6] \text{ and } [2.1.6.8]\ C_{10}H_4.OH.NH_2.(SO_3H)_2$$

The preparation and properties of certain other α-naphthol derivatives are now described.

$$[1.2.4] \text{ or } [1.2.5]\ C_{10}H_5.OH.NH_2.SO_3H.$$

Formed by sulphonating amido-naphthol from nitroso-naphthol, which is best obtained by the action of nitrous acid on α-hydroxy-naphthoic acid. The acid shows a great similarity to the [1.2.4] acid already described, but in view of the fact that in sulphonating β-naphthylamine the sulphonic acid group enters the ring heteronucleal to the amido group there is a possibility that the acid has the constitution [1·2·5].

[1.4.3] $C_{10}H_5.OH.NH_2.SO_3H$. Obtained from the nitroso derivative of the [1.3] α-naphthol sulphonic acid or from the azo-dyestuff of this acid, in both cases by reduction. The colouring matters formed by oxidation are of no value.

Amidonaphthol disulphonic acids—

$$[1.2.4.6]\ C_{10}H_4.OH.NH_2.(SO_3H)_2$$

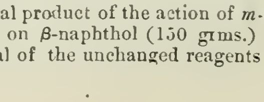
By converting [1.4.6] α-naphthylamine disulphonic acid (Dahl's acid II.) by means of the diazo reaction into the corresponding α-naphthol disulphonic acid, combining this with diazobenzene chloride and reducing the resulting azo-compound, on oxidation of the solution of this acid in sodium carbonate, it is converted into a colouring matter which dyes wool violet-black.

[1.2.4.7] $C_{10}H_4.OH.NH_2.(SO_3H)_2$. Obtained in a similar way from [1.4.7] α-naphthylamine disulphonic acid (Dahl's acid III.). This separates in white needles dissolving in sodium carbonate with a yellow colour. The oxidation product is of no particular value.

[1.2.4.8] $C_{10}H_4.OH.NH_2.(SO_3H)_2$. By reduction of the azo colouring matter from [1.4.8] α-naphthol disulphonic acid S obtained by sulphonating naphthosultone. The acid crystallises from concentrated solutions in presence of hydrochloric acid, and dissolves in sodium carbonate to a brown solution giving on oxidation a small quantity of colouring matter which dyes wool greenish-black. The position of the second sulphonic acid group thus affects the formation and shade of the dyestuff produced, and although none of them from these disulphonic acids are of practical importance, the reaction is useful as a means of identifying a particular derivative. In the course of the investigation it was found that these three amidonaphthol disulphonic acids could be readily diazotised, and the combinations of these bodies with resorcinol, β-naphthol, and β-hydroxynaphthoic acid melting at 216° C. give colouring matters which dye mordanted and unmordanted wool. With respect to the shades produced, the [1.2.4.6] and the [1.2.4.7] acids when diazotised and combined with β-hydroxynaphthoic acid dye bluish-violet on unmordanted wool and bluer shades on chromed wool, whilst the [1.2.4.8] acid gives greener shades. As regards the solubilities, the first acid is easily soluble, whilst the last is so insoluble that it precipitates from a 1 per cent. solution, the remaining acid having a solubility intermediate between the other two.—T. A. L.

The Condensation Derivatives of m-Phenylenediamine and β-Naphthol. F. Gaess and E. Elsaesser. Ber. **26**, 976—981.

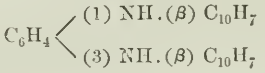
Mono-β-naphthyl-m-phenylenediamine—



$$C_6H_4 \begin{cases} (1)\ NH.(\beta)\ C_{10}H_7 \\ (3)\ NH_2 \end{cases}$$

is the principal product of the action of *m*-phenylenediamine (110 grms.) on β-naphthol (150 grms.) at 250°—260° C. After removal of the unchanged reagents by hot water and dilute caustic soda solution respectively, it was separated from the greater part of the intermixed di-β-naphthyl compound by means of hot alcohol, in which it freely dissolves. It was then purified by crystallisation from alcohol or benzene, by distillation under reduced pressure, and recrystallisation again from alcohol. Thus obtained, it forms long, colourless needles, melting at 128° C., and boiling, under a pressure of 45 mm., at about 320°. It is sparingly soluble in hot water, readily so in acetone, ether, chloroform, hot alcohol, and carbon bisulphide, its solutions exhibiting a green-blue fluorescence. It dissolves on heating with dilute hydrochloric acid, and, on cooling, deposits in small, colourless needles of the monohydrochloride, which turns red on exposure to air. Its dihydrochloride is obtained by passing hydrochloric acid gas into an ethereal solution of the base. The monoacetyl derivative melts at 135°, the diacetyl derivative at 147°—148°.

Di-β-naphthyl-m-phenylenediamine—



$$C_6H_4\begin{cases}(1)\ NH.(\beta)\ C_{10}H_7\\(3)\ NH.(\beta)\ C_{10}H_7\end{cases}$$

is chiefly obtained when 2 mols. of β-naphthol and 1 mol. of *m*-phenylenediamine are heated together at about 330°. It constitutes nearly the whole of the residue left after the extraction of the mono-naphthyl compound as described, and may be easily obtained in a pure state by dissolving this in a mixture of aniline and benzene and crystallising. It forms long, colourless needles, melting at 192° and distilling, under a pressure of 45 mm., at above 460°, with partial decomposition. It is almost insoluble in alcohol, slightly soluble in ether, moderately in hot benzene, acetone, and chloroform, and readily so in hot aniline, its solutions showing a purple fluorescence. Its dihydrochloride is produced, in the form of a white powder, by passing hydrochloric acid gas into a solution of the base in chloroform. It is distinguished from the mono-naphthyl derivative by its inability to combine with picric acid. Its diacetyl compound forms well-defined, colourless plates of melting point 175°.

From the above account of the properties of the two β-naphthyl derivatives of *m*-phenylenediamine it appears that the compound prepared by Ruhemann (Ber. **14**, 2654) and described by him as β-dinaphthyl-*m*-phenylenediamine, is not that body, but is the mono-β-naphthyl compound.

—E. B.

p-Amido-alkyl-o-toluidine II. A. Weinberg. Ber. **26**, 307—308.

In his first communication (Ber. **25**, 1610) the author showed that methylene-blue dyestuffs were obtainable from mono-alkyl-*o*-toluidines, but not from the dialkyl products, and this behaviour he ascribes to the pseudo-tertiary character of the former and to the quarternary character of the latter compounds. These views are objected to by Rosenstichl (Comptes. rend. **115**, 180) and by Bernthsen (Ber. **25**, 3128 and 3366; this Journal, 1893, 139). In the present paper, replies are made to the objections, and the author finds in support of his theory that *o*-methoxydimethyl aniline and *o*-methoxy-monomethyl aniline behave similarly to dimethyl- and monomethyl-*o*-toluidine respectively. On repeating Bernthsen's experiments, *p*-amidodiethyl-*o*-toluidine was obtained identical with that already prepared, and Friedländer observes that the pure base forms large colourless crystals melting at 24°. This substance only gives a thiosulphonic acid with difficulty. The reaction proceeds somewhat more smoothly with the dimethyl derivative, and this gives a blue colouring matter with dimethyl-aniline, but not with dimethyl-*o*-toluidine. The author considers from his experiments that he is still justified in upholding the view that *p*-amido-dialkyl-*o*-toluidine has essentially different properties from *p*-amidodialkyl aniline, since it cannot be converted into the tetra-alkylditoluthionine corresponding to methylene-blue.

—T. A. L.

The Convertibility of m-Amidodialkyl-o-toluidines— (1.2.5) $C_6H_3.CH_3.NR_2.NH_2$ *into Methylene-Blue Colouring Matters.* A. Bernthsen. Ber. **26**, 992—993.

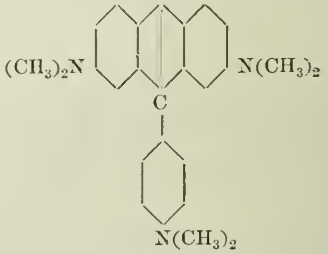
A reply to Weinberg, who, in contradistinction to the author, asserts that the above bases are widely differentiated in properties from the similarly constituted *p*-amidodimethylaniline (Ber. **25**, 1610, and **26**, 307; see preceding abstract). In support of his view Weinberg has cited the fact that *m*-amidodialkyl-o-toluidines cannot be converted into dyes analogous to methylene-blue by joint oxidation with dialkyl-*o*-toluidines, but he has overlooked the generally inactive character of the latter bases, which are incapable of employment under any conditions as second (monamine) components in the manufacture of thionine dyes.

The chief point of disagreement, however, between Weinberg and the author, is in regard to the convertibility of *m*-amidodimethyl- and diethyl-*o*-toluidines into thionines by the thiosulphonic acid process, the author declaring that they are so convertible, and, consequently, do not in this respect essentially differ from *p*-amidodimethylaniline. (See also this Journal, 1893, 139.)—E. B.

A New Method of Formation of Acridine Dyes. R. Möhlau and E. Fritzsche. Ber. **26**, 1034—1044.

The action of nitrosodimethylaniline on dimethylaniline in the presence of concentrated hydrochloric acid has been studied by Möhlau (Ber. **16**, 2729), who obtained thereby the hydrochloride of a colour-base of the apparent formula $C_{16}H_{19}N_3$, which he termed Rubifuscine. The present research has been undertaken to determine the nature of this colouring matter.

It is found that the colour-base as formerly obtained was contaminated by the presence of a small quantity of a second colour-base, which can be separated by crystallisation from dimethylaniline. The formula previously assigned to the principal base is consequently incorrect. In the pure state this base has a composition represented by the formula $C_{25}H_{28}N_4$, and is considered to be a *hexamethyltriamidophenylacridine*, of the formula—



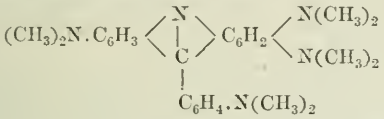
The assignment of such a constitution is based on the following grounds:—When heated with concentrated hydrochloric acid at 150° the base decomposes into a number of substances, the principal of which are: *p*-phenylenediamine, and a pale yellow mixture of what is believed to be tetra-methyl-*m*-*p*-diamidobenzophenone and its hydrol, as it yields an auramine on heating with zinc and ammonium chlorides, but an auramine of a more reddish shade than the ordinary one, and, further, it dissolves in acetic acid with a blue colour (Ber. **9**, 1900); secondly, the colour-base, when submitted to energetic reduction with zinc and hydrochloric acid, is broken up into dimethyl-*p*-toluidine, *p*-phenylenediamine, and traces of aniline, with an indifferent oil, probably benzene.

The base is precipitated from the aqueous solution or suspension of its salts in the form of yellow flocks or powder. It is insoluble in most menstrua, but dissolves in phenol with a red colour, and readily in hot dimethylaniline, from the latter of which it crystallises in needles or plates melting at 270°. Its dihydrochloride, $C_{25}H_{28}N_4.2HCl$, crystallises with both one and five mols. of water.

The mechanism of the reaction is apparently analogous to that of the formation of methyl-violet by the oxidation of dimethylaniline, a methyl group being detached and oxidised to formic acid, in the present instance by a nitroso-group (dichlor-*p*-phenylenediamine being among the products of the action), and the formic acid then undergoing condensation with the dimethylphenylene-green intermediately produced, and dimethylaniline, to form the colour-base. This view is to some extent confirmed by the production of the base in a condition of greater purity, although not in greater amount, by heating together to a temperature of 70° paraformaldehyde (10 grms.), concentrated hydrochloric acid (150), dimethylaniline (50), and nitrosodimethylaniline hydrochloride (100); a yield of 20 grms. being thus obtained.

By employing a larger proportion of formaldehyde than the above, the yield of hexamethyltriamidophenylacridine is diminished, but the accompanying colouring matter is formed in larger amount. A maximum of this (70 grms.) is obtained with 50 grms. of paraformaldehyde, 300 of hydrochloric acid of sp. gr. 1·17, 50 of dimethylaniline, and 100 of nitrosodimethylaniline hydrochloride.

This second base has the formula $C_{27}H_{33}N_5$, thus containing $N(CH_3)_2$ more and H less than the base first described. It melts at 229°, is insoluble in water, ether, and cold alcohol, but slightly soluble in hot alcohol, from which it crystallises in yellow plates. Zinc and hydrochloric acid decompose it into dimethyl-*p*-toluidine, *p*-amidodimethylaniline, and a basic oil which is presumed to be a tetramethylphenylenediamine. The formula and products of decomposition of this compound accord with those of an *octomethyltetramidophenylacridine*—



The dimethylamine which takes part in the formation of this latter base is produced by the decomposition of part of the nitrosodimethylaniline by concentrated hydrochloric acid, *p*-amidophenol and its chlorine substitution compounds being simultaneously formed. The interesting substitution of hydrogen in the benzene ring by the dimethylamine residue which takes place, has already been observed (this Journal, 1892, 25).—E. B.

The Action of Formaldehyde on Nitrosodimethylaniline. J. Pinnow and G. Pistor. Ber. 26, 1313—1315.

A preliminary note published in consequence of the appearance of a paper on a kindred subject by Möhlau and Fritzsche (see preceding abstract).

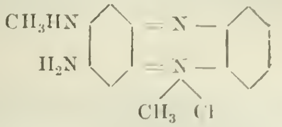
The principal products of the action of formaldehyde (two parts of 40 per cent. solution) on nitrosodimethylaniline (one part) are tetramethyldiamido-azoxybenzene—

$$O\left\{N.C_6H_4.N(CH_3)_2\right\}_2$$

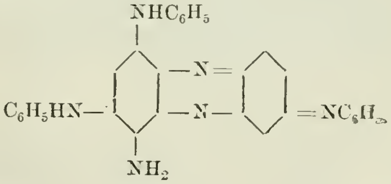
(Schraube, Ber. 8, 619), and *form-p-amidodimethylaniline*, $HCO.NH.C_6H_4.N(CH_3)_2$, a compound crystallising from water in lustrous, colourless plates of melting-point 108° C. —E. B.

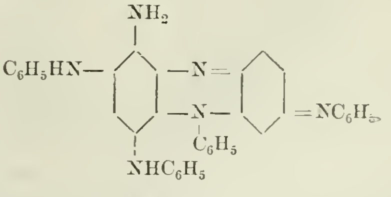
Oxidation Products of Orthodiamines. O. Fischer and O. Heiler. Ber. 26, 378—386.

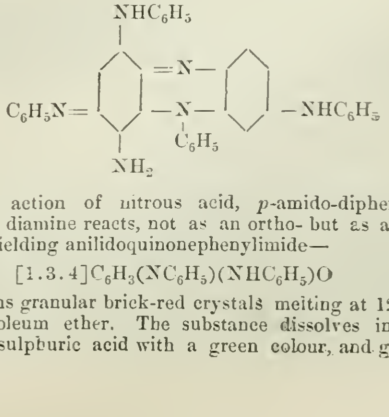
By oxidising *m-p*-tolylene diamine and *o*-amido-ditolylamine, O. Fischer and L. Sieder (Ber. 23, 3798) found that red compounds containing oxygen were obtained, and also that methyl-phenylene diamine on oxidation with ferric chloride gave a substance crystallising in dark red metallic needles. Kehrmann and Messinger (J. Prakt. Chem. 46, 566) on oxidising *o*-ethyl-phenylene diamine and *o*-amidodiphenylamine, state that ammonia is given off and azonium bases are produced. The oxidation of these substances is the subject-matter of the present paper, and the authors state that the reaction in contra-distinction to Kehrmann's statement, proceeds in the same way as in the case of *o*-phenylene diamine, when diamido-phenazine is produced. By oxidising methyl-*o*-phenylene diamine with ferric chloride in an alcoholic solution the hydrochloride of an azonium base is obtained having the constitution—



This salt crystallises from alcohol in green metallic needles dissolving in water and alcohol with a red and in sulphuric acid with a rose colour. The base cannot be separated by ammonia, but is precipitated by caustic soda as a greenish-black oil, which solidifies and gives a red powder. On oxidising *o*-diphenylamine with ferric chloride BI anilidophenylinduline is produced, which forms brownish-red plates, melting above 240° C., and crystallising from benzene or alcohol. The base dissolves in concentrated sulphuric acid with a violet-red colour, which does not disappear on dilution and is non-fluorescent. It dissolves with a brown colour in alcohol, benzene, or ether, and is insoluble in water. On heating under pressure with sulphuric acid it is converted into BI anilidobenzene indone and BI hydroxybenzene indone, according as to whether the reaction is carried on for a short or long period. By carefully distilling *o*-amidodiphenylamine with lead oxide it yields phenazine melting at 171° C. When *p*-amidodiphenyl-*m*-phenylene diamine is oxidised with ferric chloride it forms a blue colouring matter. If lead peroxide be employed, an intermediate compound, anilido-phenylquinone di-imide is obtained, which crystallises from petroleum ether in orange-red concentric needles, melting at 98° C. On warming this substance with glacial acetic acid or by direct oxidation as above, the blue colouring matter is obtained, which crystallises from benzene in bronzy prisms melting at 235° C. It dissolves in alcohol with a blue colour and in concentrated sulphuric acid with a violet-red colour, which on dilution with water becomes bluer, and the sulphate separates as a flocculent precipitate. The nitrate is also a sparingly soluble salt, and can be obtained directly by oxidising the triamine with dilute nitric acid. Three possible formulæ are given for the substance—







By the action of nitrous acid, *p*-amido-diphenyl-*m*-phenylene diamine reacts, not as an ortho- but as a para-diamine, yielding anilidoquinonephenylimide—

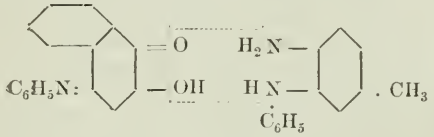
$$[1.3.4]C_6H_3(NC_6H_5)(NHC_6H_5)O$$

which forms granular brick-red crystals melting at 125° C., from petroleum ether. The substance dissolves in concentrated sulphuric acid with a green colour, and gives a

violet solution on dilution. On dissolving in glacial acetic acid a blue dyestuff is formed. With reference to the nomenclature of the indulines, see Fischer and Hepp, Annalen. **272** [3], 306; this Journal, also 1893, 669.
—T. A. L.

Iso-p-tolylrosinduline. C. Schraube and E. Romig. Ber. **26**, 575—582.

Attempts to prepare a homologue of azocarmine (the sulphonic acid of the induline obtained by heating benzene-azo-α-naphthylamine with aniline and aniline hydrochloride) by the use of benzene-azo-*p*-tolyl-α-naphthylamine, resulted in the production of an induline identical with unsulphonated azocarmine. Fischer and Hepp (Ber. **21**, 2621; this Journal, 1888, 743) claim to have produced iso-*p*-tolyl-rosinduline by heating benzene-azo-*p*-tolyl-α naphthylamine with aniline and alcohol under pressure. In the present communication the authors describe the synthesis of iso-*p*-tolyl-rosinduline by condensing β-hydroxy-α-naphthoquinone-anil with phenyl-*o*-tolylene diamine. The latter substance was obtained from *m*-chloro-toluene, which on nitration and sulphonation yields chloro-nitro-toluene sulphonic acid [1.3.4.6] $C_6H_3.CH_3.CL.NO_2.SO_3H$. On heating this substance with aniline and subsequent hydrolysis, nitrotolylphenylamine [1.3.4] $C_6H_3.CH_3.NHC_6H_5.NO_2$ is formed, which on reduction gives phenyl-o-tolylene diamine [1.3.4] $C_6H_3.CH_3.NHC_6H_5.NH_2$. The condensation with β-hydroxy-α-naphthoquinone-anil, which is effected by means of hydrochloric acid in an alcoholic solution, takes place according to the following scheme:—



The iso-*p*-tolylrosinduline so obtained crystallises from alcohol in dark brown needles melting at 224·5° C., and dissolves in sulphuric acid with a green colour. It dyes cotton mordanted with tannin a yellowish-red and the authors conclude that the iso-*p*-tolylrosinduline of Fischer and Hepp was impure phenylrosinduline.—T. A. L.

Synthetical Reactions of Formaldehyde. New Colouring Matters. A. Trillat. Comptes rend. **116**, 1382—1385.

It may be concluded from the author's investigations—(1) that formaldehyde reacts readily with aromatic amines of the form XNH_2, X.Y.NH; (2) that colouring matters of such constitution are by this reaction more or less profoundly changed in hue, the modification being expressed in terms of the spectrum as a movement from left to right. The following reactions have been studied:—

(1.) With *rosaniline.* The product is the analogue of Lauth's Aldehyde violet. (2.) With *safranine.* 100 grms. of the colouring matter are dissolved in excess of hydrochloric acid at 40° C., and to the solution 35 grms. of formaldehyde solution (40 per cent.) added. Reaction ensues according to the equation—

$$2CH_2O + C_{18}H_{15}N_4Cl =$$
$$2H_2O + [CH_2:NC_6H_3N_2Cl\ (C_6H_4)_2N:CH_2]$$

The product is easily purified by crystallisation. It dyes cotton and wool without mordant, and the colours will stand hot soaping. (3.) With *diamido-phenyl-acridine* $C_{19}H_{15}N_3$. The phosphine is changed from yellow to an orange colouring matter of the composition $C_{19}H_{11}N_3\ (CH_2)_2$ and resembling in dyeing properties, chrysaniline. (4.) With α- and-β-*amido-alizarine.* The products are more violet in tone.

Similar reactions are obtained with the azo derivatives of monamines and diamines.—C. F. C.

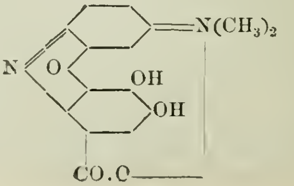
Note on the Ponceau Red of the Japanese. A. Scheurer. Bull. Soc. ind. de Mulhouse, May 1893, 206.

The author received from Messrs. Siber and Brennwald, Yokohama, samples and a description of the use of this dye, which essentially consists of a red powder prepared from safflower, and is chiefly imported from China, there being only one place in the interior of Japan where the same preparation is made in small quantities. No information as to the way in which this substance is prepared could be obtained. The preparation is first treated with cold water for a whole day, and when sufficiently dissolved the solution is rubbed between the hands with rice bran. After this process, plums and a yellow powder are added to the same solution, which is then well stirred. Hemp fibre is now added to the solution and the whole left standing for several hours. Another solution of the ashes of rice straw in water is prepared in the meantime, and subsequently the hemp is withdrawn from the first solution, transferred to the second solution, and well washed and rubbed in it until it has recovered its natural colour. The hemp is then altogether removed, the colouring matter derived from it remaining in the solution. After some time the whole of the colouring matter will have settled down to the bottom of the vessel. The supernatant liquor is now decanted, and the colour, remaining behind as a pasty mass, is used by the Japanese for the production of ponceau (scarlet) shades upon textile fabrics.

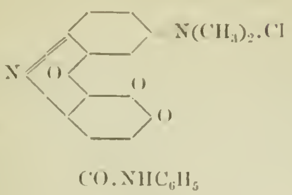
This description of the process is not very clear, but it is an interesting example of the purification of a colouring matter by means of a dyeing process. Probably the alkaline liquor in which the dye is stripped from the hemp is acidulated before the precipitation of the dye takes place. A process for the preparation of carthamine red given by J. Hein (The Industry of Japan, London, 1889, 176) differs essentially from the above. According to this process the florets of commercial safflower are macerated with a small quantity of water during one night. On the following day the soaked mass is poured into a bucket with addition of chopped rice-straw to prevent agglutination. A thick paste is thus formed, which is pressed into a bag. The dirty yellow liquid which escapes is not utilised. The pressed mass is then mixed with a solution of wood-ash and left standing over night. The next day the whole is filtered and pressed, when a brown-red solution is obtained, which is precipitated with plum vinegar. The precipitate thus obtained is subsequently dissolved in vinegar, and this solution is employed to dye silk red. By addition of turmeric to this solution the Turkey-reds are obtained which are found on Chinese and Japanese silks.—C. O. W.

The Constitution of Gallanilic Blue. P. Cazeneuve. Comptes rend. **116**, 884—887.

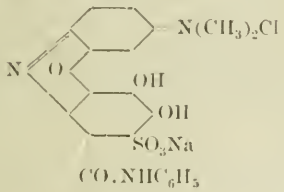
By the action of gallanilide on nitrosodimethylaniline hydrochloride, Durand and Huguenin (Eng. Pat. 15,360 of 1889; this Journal, 1889, 981) have obtained an olive-green colouring matter, which is transformed by heating with sodium bisulphite or sulphuric acid (24 per cent.) into a valuable blue dye ("Bleu gallique ou indigo du tannin.") Being, from its manner of formation, evidently closely related to gallocyanine, the constitutional formula of which is—



the intermediate, green colouring matter probably has the formula—



and the blue dye, the formula—



—E. B.

PATENTS.

An Improved Ecru or Yellow Tint for Laundry Purposes. C. Brown, Peckham, Surrey. Eng. Pat. 13,684, July 27, 1892.

The patented preparation is made "by thoroughly beating up and mixing with water, yellow ochre, or other substitute for this colour such as chrome yellow, imperial yellow, and turmeric to a required thickness or consistency." The mixture is moulded into any suitable shape and used in the same manner as laundry blue.—B. B.

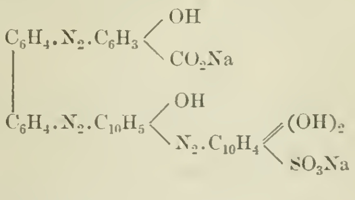
Improvements in or Connected with the Manufacture of New Colouring Matters. H. E. Newton, London. From "The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 14,728, August 15, 1892.

This is an extension of Eng. Pat. 19,062 of 1891 (this Journal, 1892, 1000), and refers to the production of colouring matters by condensation of tetra-alkyldiamidobenzhydrols with the dibenzyl derivatives of metasulphanilic acid or orthotoluidine metasulphonic acid and convertion of the leuco compounds thus obtained with or without further sulphonation, into dyestuffs by oxidation. The colouring matters thus obtained dye wool from an acid-bath blue shades, which are very fast to alkalis. The following example is given as an illustration of the method of production of these colouring matters.

A mixture of 17 parts of metasulphanilic acid, 30 parts of benzyl chloride, 10 parts of caustic soda, and 100 parts of water is heated to boiling under an inverted condenser until the benzyl chloride has disappeared. The dibenzylmetasulphanilic acid is precipitated by the addition of acid, filtered off, dried, and ground. 35 parts of this dibenzylmetasulphanilic acid are added to a solution of 27 parts of tetramethyldiamidobenzhydrol in 270 parts of acetic acid of 75 per cent., and the mixture is heated on the water-bath until the reaction is complete. After pouring into water and neutralisation with sodium carbonate the leuco compound is obtained as a greyish-blue precipitate, sparingly soluble in alkalis or acids. This leuco sulphonic acid is then further sulphonated by dissolving it in 5 times its weight of fuming sulphuric acid (20 per cent. anhydride) in the cold. The product is poured into water, limed, and the calcium salt converted into sodium salt. The solution of the latter is oxidised to the colouring matter by means of lead peroxide and acetic acid, the lead removed as sulphate and the filtrate evaporated. The product dyes wool from an acid-bath a blue similar to that of "Cotton Blue R," which resists the action of alkalis to a remarkable extent.—T. A. L.

Improvements in the Manufacture of Dye-Stuffs. H. E. Newton, London. From "The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 15,056, August 20, 1892.

An extension of Eng. Pats. 13,235, of 1890, and 3,439 of 1891 (this Journal, 1891, 760 and 1892, 158) by employment of amidonaphthols, amidonaphthol sulphonic acids, amidonaphthol ether sulphonic acids, amidonaphthoxyacetic acid or amidonaphthoxyacetic sulphonic acid, in place of the α-naphthylamine or amidonaphthol ether there mentioned. The claim covers a large number of colouring matters, which are obtained by combination of the tetrazo compounds derived from benzidine, tolidine, dianisidine, methoxybenzidine, diamidoazobenzene, diamidoazoxylene, paraphenylene diamine, diamidonaphthalene, diamidostilbene, diamidocarbazol, diamidodiphenic acid, diamidodiphenylene oxide, &c. with—(*a*) 1 mol. of the amidonaphthol, amidonaphthol sulphonic acid, &c., above mentioned, and 1 mol. of salicylic acid or other analogous phenol carboxylic acid; or with (*b*) 1 or 2 mols. of the said amidonaphthol, amidonaphthol sulphonic acids, &c.: the intermediate products thus obtained being rediazotised, and the diazo compounds combined with 1 or 2 mols. of the usual dyestuff components, more especially the dihydroxynaphthalenes, amidonaphthols, &c. For example, a dyestuff dyeing unmordanted cotton green shades from an alkaline or neutral bath, is obtained in the following manner. A solution of tetrazodiphenyl chloride from 18·4 parts of benzidine is allowed to run into an aqueous solution of 13·8 parts of salicylic acid containing a slight excess of sodium carbonate. A solution of 15·9 parts of (1.5)-amidonaphthol in dilute hydrochloric acid is then added, and after standing for several hours the reaction is completed by heating for a short time to 90° C. The intermediate compound thus obtained is filtered off, mixed with water containing 7 parts of sodium nitrite, and dilute hydrochloric acid is allowed to slowly run in. After standing for 24 hours the diazotisation is complete, and the diazo compound is filtered off and introduced into an aqueous solution containing 26·2 parts of the sodium salt of (1.8.4)-dihydroxynaphthalene sulphonic acid, 50 parts of sodium acetate, and a little acetic acid. After 24 hours standing the mixture is rendered alkaline, and the dyestuff which has the constitution—

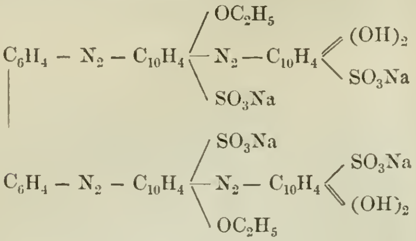


$$\begin{array}{l} C_6H_4.N_2.C_6H_3\left\langle\begin{array}{l}OH\\CO_2Na\end{array}\right.\\ \Big|\\ C_6H_4.N_2.C_{10}H_5\left\langle\begin{array}{l}OH\\N_2.C_{10}H_4\left\langle\begin{array}{l}(OH)_2\\SO_3Na\end{array}\right.\end{array}\right.\end{array}$$

is salted out, filtered off, and dried.

A colouring matter dyeing unmordanted cotton a pure green is obtained as follows:—

A solution of tetrazodiphenyl chloride from 18·4 parts of benzidine is mixed with a moderately acid or alkaline solution of 53·4 parts of α-amido-β-naphthol-ether-β-sulphonic acid (from β-naphthol 2.6 sulphonic acid by ethylation, nitration, and reduction). The mixture is kept at 50° C. for several days, and finally heated for a short time to 90° C. After rendering alkaline the intermediate compound is salted out and filtered off. It is then stirred up with a solution of 14 parts of sodium nitrite, and hydrochloric acid is allowed to run in slowly. After 24 hours the tetrazochloride is filtered off and introduced into a solution of 52·4 parts of (1.8.4)-dihydroxynaphthalene sulphonic acid and 100 parts of sodium acetate. After heating to 90° C. to complete the reaction the solution is made alkaline and the colouring matter is filtered off and dried. It has the constitution—



$$\begin{array}{l} C_6H_4 - N_2 - C_{10}H_4 \left\langle \begin{array}{l} OC_2H_5 \\ N_2 - C_{10}H_4 \left\langle \begin{array}{l} (OH)_2 \\ SO_3Na \end{array} \right. \\ SO_3Na \end{array} \right. \\ | \\ C_6H_4 - N_2 - C_{10}H_4 \left\langle \begin{array}{l} SO_3Na \\ N_2 - C_{10}H_4 \left\langle \begin{array}{l} SO_3Na \\ (OH)_2 \end{array} \right. \\ OC_2H_5 \end{array} \right. \end{array}$$

—T. A. L.

Improvements in the Manufacture of Azo Colouring Matters and of Materials for the Same. Read Holliday and Sons, Limited, and K. B. Elbel, Ph.D., Huddersfield. Eng. Pat. 15,386, August 26, 1892.

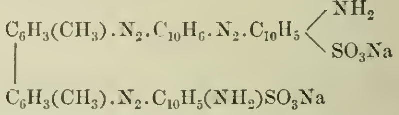
By the action of methylal, formaldehyde, acetaldehyde, or acroleïn upon a mixture of two aromatic amines, mixed methane derivatives are obtained, which can be employed for the preparation of colouring matters, either by combination with diazo or tetrazo compounds, or by diazotisation and combination of the diazo compounds with the usual dyestuff components.

For example, a dimethyldiamidophenyl-α-naphthylmethane is obtained by agitating 50 lb. of α-naphthylamine with 30 lb. of formaldehyde solution (40 per cent.) and 15 gals. of water at 50°, drawing off the water and heating the product with 300 lb. of dimethylaniline and ½ gal. of hydrochloric acid (20° Bé.) at 100° for 2 or 3 hours. The new base remains behind after making alkaline and driving off the excess of dimethylaniline with steam. It is purified by solution in dilute sulphuric acid and precipitation with an alkali. In a similar manner diamido-*o*-tolyl-α-naphthylmethane is prepared by the action of formic aldehyde upon a mixture of α-naphthylamine and *o*-toluidine. The new bases can be converted into sulphonic acids by warming with fuming sulphuric acid. The employment of these methane derivatives for the preparation of azo colours is illustrated by the following examples :—A solution of 35 lb. of sodium α-naphthylamine-disulphonate (1.3.6) in 100 gals. of water is diazotised by addition of 20 lb. of hydrochloric acid and 7 lb. of sodium nitrite. The diazo solution is mixed with a cold solution of 28 lb. of dimethyl-diamidophenyl-α-naphthyl-methane and 25 lb. of hydrochloric acid in 100 gals. of water. After standing for 24 hours the intermediate product is rediazotised by addition of 7 lb. of nitrite, and the diazo compound run into a solution of 40 lb. of sodium β-naphthol-disulphonate R and 30 lb. of dry sodium carbonate in 100 gals. of water. The colour produced dyes wool a bluish black from an acid bath. By combination of the methane derivatives with tetrazo compounds, substantive cotton colouring matters are obtained. For example, a solution of tetrazoditolyl chloride from 21½ lb. of tolidine is mixed with a solution of 28 lb. of dimethyldiamidophenyl-α-naphthyl methane and 25 lb. of hydrochloric acid in 50 gals. of water. The intermediate product is rediazotised by the addition of 7 lb. of sodium nitrite and is run into a solution of 90 lb. of amido-hydroxynaphthalene disulphonate of sodium and 50 lb. of dry sodium carbonate in 100 gals. of water. The colouring matter thus obtained dyes unmordanted cotton greenish-blue shades from an alkaline bath, which can be diazotised upon the fibre yielding dark " ingrain colours."—T. A. L.

Improvements in the Production of Black Azo Colours upon Fibres. H. E. Newton, London. From " The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 15,439, August 27, 1892.

This specification is an extension of Eng. Pats. 8530 of 1890, 9636 of 1891, 22,641a of 1891, and 11,395 of 1892 (this Journal, 1893, 258, and 1893, 593). It claims the production of fast black " ingrain " colours of still greater intensity than those which have been yet described in the above-mentioned patents. These colours are produced upon the fibre in the usual way from certain " diskis-azo " " triskis-azo," and " tetrakis-azo " dyestuffs which are specified in the patent. Such dyestuffs are those obtained by combining the tetrazo-compounds derived from benzidine, tolidine, dianisidine, methoxybenzidine, diamidoazobenzene, diamidoazotoluene, paraphenylenediamine, diamidonaphthalene, diamidostilbene, diamidocarbazol, diamidodiphenic acid, diamidodiphenylene oxide, &c., with 1 or 2 mols. of α-naphthylamine, α-naphthylamine-β-sulphonic acids, α-amidonaphthol-ether sulphonic acid, amidonaphthoxyacetic acid or amidonaphthoxyacetic sulphonic acid as " middle component," or with 1 mol. of one of these " middle components " and 1 mol. of another, and then rediazotising the intermediate compound thus formed and combining it with 1 or 2 mols. of amidonaphthol sulphonic acid, α-naphthylamine-β-sulphonic acid, amidonaphthol-ether sulphonic acid, amido-naphthol, amidonaphthol-ether, amidonaphthoxyacetic acid or amidonaphthoxyacetic sulphonic acid, or with 1 mol. of one of these and 1 mol. of another dyestuff component.

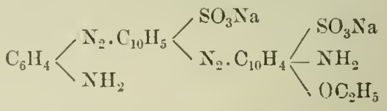
For instance, a blue black colour is obtained upon the fibre by diazotisation and development with β-naphthol, after having been previously dyed with the colouring matter of the formula—



$$\begin{array}{l} C_6H_3(CH_3).N_2.C_{10}H_6.N_2.C_{10}H_5 \left\langle \begin{array}{l} NH_2 \\ SO_3Na \end{array} \right. \\ | \\ C_6H_3(CH_3).N_2.C_{10}H_5(NH_2)SO_3Na \end{array}$$

which is obtained by combining tetrazo-ditolyl chloride with 1 mol. of α-naphthylamine, rediazotising and coupling with α-naphthylamine sulphonic acid (1.6).

In a similar manner a beautiful bluish-black is obtained by dyeing and development with the colouring matter of the constitution—



$$C_6H_4 \left\langle \begin{array}{l} N_2.C_{10}H_5 \left\langle \begin{array}{l} SO_3Na \\ N_2.C_{10}H_4 \left\langle \begin{array}{l} SO_3Na \\ NH_2 \\ OC_2H_5 \end{array} \right. \end{array} \right. \\ NH_2 \end{array} \right.$$

which is prepared by combining diazotised acetyl-paraphenylene diamine with 1 mol. of α-naphthylamine sulphonic acid (1.7), rediazotisation of the product, combination with α-amido-β-naphthol-ether-β-sulphonic acid, and finally splitting off the acetyl-group by saponification.—T. A. L.

The Manufacture or Production of New Azo Colouring Matters, and Processes for Dyeing and Printing therewith. H. E. Newton, London. From " The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 15,636, August 31, 1892.

In the specification of Eng. Pat. 5112 of 1892 (this Journal, 1893, 259), a series of mordant dyeing amido azo colouring matters is described, which when fixed upon cotton by means of chromium salts can be diazotised and combined with phenols and amines with production of fast " ingrain colours." According to the present specification a similar result is obtained by employing the amidoazo colouring matters formed by combination of paraxylidine with the diazo compounds of amidocarboxylic acids such as *o*-amidobenzoic acid, *p*-amidobenzoic acid, amidosulphobenzoic acid, *o*-amidosalicylic acid, *p*-amidosalicylic acid, amido-*p*-hydroxybenzoic acid, *o*-amido-*m*-cresol-carboxylic acid, *p*-amido-*o*-cresolcarboxylic acid, amidoanisic acid, amidophthalic acid, and their sulphonic acids. The dyestuffs so obtained give yellow to red shades, when dyed upon chrome mordanted wool, or when printed upon cotton with a chromium mordant. The colouring matters thus fixed upon the fibre can be diazotised by treatment with nitrous acid and converted into fast " ingrain colours " ranging in shade from yellowish-brown to violet by immersion in solutions of naphthols, dihydroxynaphthalenes, amidonaphthols, naphthylamines, diamines, &c.

The following is an example of the preparation and use of these colouring matters:—A solution of 21·7 parts of amidosulphobenzoic acid and 36 parts of hydrochloric acid (20 per cent. HCl) in 400 parts of water is diazotised by addition of 6·9 parts of sodium nitrite dissolved in 20 parts of water. The diazo solution is then mixed with a solution of 16 parts of paraxylidine hydrochloride in 100 parts of water, and after addition of 67 parts of sodium acetate the mixture is heated to 35°—40° C., and then allowed to stand for 24 hours. The colouring matter is filtered off, dissolved in sodium carbonate, and reprecipitated by acetic acid. It can then be directly employed for dyeing and printing. For instance, cotton cloth is printed with a mixture composed of 100 parts of the 20 per cent. dyestuff paste thus prepared, 200 parts of water, 640 parts of acetic acid starch tragacanth thickening, and 60 parts of chromium acetate solution of 20° Bé.

After steaming, chalking, treating with malt, scraping, and washing, the printed cloth is passed through a bath of nitrous acid, and then after washing through an alkaline solution of β-naphthol: the printed parts then assume a red colour. Instead of printing with the colouring matter, the cloth may be printed with the chrome mordant, then dyed, and subsequently diazotised and developed as before, the pattern only appearing on the mordanted parts.

—T. A. L.

Production of Two Isomeric Disulpho Acids of Para-amidophenol and Violet-Black Dye-Stuffs obtained therefrom. J. R. Geigy, Basle, Switzerland. Eng. Pat. 15,692, September 1, 1892.

By the action of sodium bisulphite upon nitrosodimethylaniline, two isomeric disulphonic acids of *p*-amidophenol are obtained, whilst dimethylamine is split off.

The α-acid is prepared by adding 5 kiios. of nitrosodimethylaniline hydrochloride to 15 kilos. of a solution of sodium bisulphite of 38° Bé. filtering the solution, adding 23 kilos. of hydrochloric acid, and boiling for two or three hours. On cooling, the sodium salt of the α-disulphonic acid crystallises out in long thin needles. The β-acid is prepared by evaporating the above sodium bisulphite solution until it shows a temperature of 115° C. After cooling, it is mixed with some water and hydrochloric acid, and on standing the sodium salt of the β-acid crystallises out in small prisms. Both sulphonic acids are employed for the preparation of violet-black diazo colouring matters by combination of their diazo compounds with α-naphthylamine, rediazotisation, and combination with β-naphthol. The preparation of the colouring matters is performed in the usual manner.

—T. A. L.

Improvements in the Production of Azo Colouring Matters. C. D. Abel, London. From "The Actiengesellschaft für Anilinfabrikation," Berlin, Germany. Eng. Pat. 15,789, September 2, 1822.

By combining the tetrazo compounds derived from paradiamines with 1 mol. of γ-amidonaphthol monosulphonic acid and 1 mol. of α- or β-hydroxynaphthoic acid, colouring matters are obtained which dye unmordanted cotton direct from an alkaline or neutral bath, indigo blue to brownish violet shades. Tha latter are distinguished by great intensity and fastness against light, air, and washing. For example, 24·4 kilos. of dianisidine are diazotised, and combined with 26 kilos. of γ-amidonaphthol-sulphonic acid in a solution kept alkaline with sodium carbonate. The black insoluble precipitate of the intermediate compound is then combined with 19 kilos, of β-hydroxynaphthoic acid (of m.p. 216° C.) in a solution rendered alkaline with caustic soda. When the combination is complete the dyestuff is salted out, pressed, and dried. It dyes unmordanted cotton a deep indigo-blue.

—T. A. L.

The Manufacture or Production of New Basic Colouring Matters. H. E. Newton, London. From "The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 16,815, September 20, 1892.

The specification describes the preparation of a large number of soluble basic colouring matters belonging to the azine class, by the reaction of the hydrochlorides of various amido-azo compounds upon a variety of amines and diamines The reaction is best performed by heating the constituents together in alcoholic, glycerol, or acetic acid solution. The amidoazo compound employed may be amido-azobenzene or one of its homologues or alkyl derivatives more especially dimethyl or diethyl-amido-azobenzene. The amine may be one of the following:—Aniline, orthotoluidine, diphenylamine, α and β-naphthylamine and their alkyl derivatives, *m*-phenylene and *m*-tolylene-diamine and their alkyl derivatives, (2.6) and (2.7)—naphthylene diamines and their phenyl and tolyl derivatives. The colouring matters thus obtained yield blue and green shades upon cotton mordanted with tannin and possess a high degree of fastness to light and alkalis. Their preparation is illustrated by the following example. A mixture of 28·9 parts of dimethyl-amido-azobenzene hydrochloride and 15·5 parts of diphenyl-naphthylene diamine (2.6) is heated with 100 parts of alcohol in a vessel provided with an inverted condenser until the colour of the solution changes from brown to green. It is then poured into a large quantity of hot water filtered and the dyestuff salted out. The product dyes tannined cotton a bluish green.—T. A. L.

Improvement in the Manufacture or Production of Dyestuffs. H. E. Newton, London. From "The Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 17,673, October 4, 1892.

The ordinary method of preparing naphthazarine by heating dinitronaphthalene (1.5) with concentrated sulphuric acid at 200°—300° is very defective, as only small yields are obtained. The inventors find that this difficulty is entirely obviated by employing fuming sulphuric acid containing sulphur sesquioxide (S_2O_3) by which dinitronaphthalene (1.5) is readily converted into naphthazarine even at ordinary temperatures, 10 parts of finely-powdered dinitronaphthalene are stirred into 200 parts of 100 per cent. sulphuric acid and a solution of sulphur sesquioxide, obtained by adding 5 parts of flowers of sulphur to 50 parts of fuming sulphuric acid (40 per cent. anhydride) is slowly added keeping the temperature below 40° C. The reaction is complete almost at once. The product is poured into water filtered from sulphur and the solution boiled until the blue colour of the intermediate product has changed to bluish-red. On cooling, naphthazarine separates in a pure state and is filtered off and washed with cold water.—T. A. L.

Improvements in the Manufacture or Production of Colouring Matters derived from Anthraquinone. H. G. Newton, London. From "Farbenfabriken vormals Fr. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 17,674, October 4, 1892.

In the specifications of German Patents 6,526 and 67,102 the preparation of colouring matters is described, which dye chrome mordanted wool reddish to greenish blue shades and which are obtained by the action of concentrated or fuming sulphuric acid upon *oo*-dinitroanthraquinone. The inventors find that this reaction can be much more readily effected by employing a sulphuric acid solution of sulphur sesquioxide. The reaction then proceeds at a much lower temperature and the products are distinguished by greater purity and brightness of shade.

For example, 10 parts of dinitro-anthraquinone are dissolved in 200 parts of fuming sulphuric acid (20 per cent. anhydride) and 2·5 parts of flowers of sulphur are slowly stirred into the mixture. The reaction begins in the cold and the temperature rises spontaneously but must not be allowed to exceed 45°—50°. The mixture is kept at 40°—50° for 6 hours with constant stirring and is then poured into water and boiled. The dark violet precipitate of the colouring matter is filtered off and washed with cold water. It dyes chromed wool greenish-blue shades which are fast to fulling and light.—T. A. L.

Manufacture of New Colouring Matters derived from Dioxydiphenylmethane. J. C. L. Durand, D. E. Huguenin, and A. J. J. D'Andiran, Basle, Switzerland. Eng. Pat. 9182, May 8, 1893. Date under International Convention, December 2, 1892.

The patent relates to the preparation of mixed azo colouring matters, obtained by combination of tetrazo compounds with sulphanilic or naphthionic acid, and dihydroxydiphenylmethane (from phenol and formaldehyde). They are prepared by reacting with 1 mol. of dihydroxydiphenylmethane upon 1 or 2 mols. of the intermediate compounds from 1 mol. of diazotised benzidine, tolidine, or dianisidine, and 1 mol. of sulphanilic or naphthionic acid; or upon 1 mol. of one of these intermediate products and 1 mol. of another; or upon 1 mol. of one of these intermediate products and 1 mol. of an ordinary diazo compound. They dye unmordanted cotton from an alkaline bath, those derived from sulphanilic acid and dihydroxydiphenylmethane giving yellow shades, and those having naphthionic acid in their composition giving red shades. They differ considerably in properties from the corresponding mixed phenol colours. —T. A. L.

Manufacture of New Colouring Matters derived from the Condensation Products of Formic Aldehyde with Benzidine, Tolidine, or Dianisidine. J. C. L. Durand, D. E. Huguenin, and A. J. J. D'Andiran, Basle, Switzerland. Eng. Pat. 9183, May 8, 1893. Date under International Convention, January 27, 1893.

In the English patent 9360 of 1892 (this Journal, 1892, 809), condensation products obtained by the action of formaldehyde upon benzidine, tolidine, and dianisidine have been described. The present specification relates to the preparation of substantive cotton colouring matters from these condensation products by combining their diazo compounds with the sulphonic acids of naphthols or naphthylamines or with phenolcarboxylic acids.

For example, a colouring matter which dyes unmordanted cotton red is prepared by diazotising 4·3 kilos. of the condensation products of formaldehyde and tolidine, with 8 kilos. of hydrochloric acid (21° Bé.), and 1·4 kilos. of sodium nitrite, and pouring the product into a solution containing 4·9 kilos. of sodium naphthionate and 8 kilos. of sodium acetate. After allowing it to stand for 12 hours the mixture is made alkaline, heated to boiling, and the colouring matter salted out. The colouring matters obtained by combining the condensation products with salicylic acid dye yellow to brown shades, those with α-naphthol-α-sulphonic acid violet to blue.—T. A. L.

Improvements in and in the Method of Obtaining Dyestuffs from Petroleum. H. A. Frasch, Cleveland, Ohio, U.S.A. Eng. Pat. 10,320, May 25, 1893.

The patent relates to the production of a brown dyestuff by treating petroleum or crude mineral oil with a mixture of sulphuric and nitric acids as long as the oil discolours fresh acid. The acid is then drawn off and heated or allowed to stand for a long time, after which the dyestuff is precipitated by dilution or neutralisation, dissolved in hot water, filtered and converted into calcium salt and thence into sodium salt.—T A. L.

Sulpho Acid and Process of Producing the same. H. A. Frasch, Cleveland, Ohio, U.S.A. Eng. Pat. 10,321, May 25, 1893.

Crude petroleum, petroleum residues, &c. is agitated with concentrated sulphuric acid until a sample of the oil no longer discolours fresh acid. The acid layer is then drawn off, and heated or allowed to stand for a long time. It is then diluted or neutralised and the precipitate is extracted with boiling water. The solution of the sulphonated products thus obtained is neutralised with lime and the precipitate of insoluble calcium salts is separated from the soluble calcium salts which remain in solution. The acid corresponding to the former is claimed in this specification.—T. A. L.

Art of Manufacturing Sulpho Acid from Petroleum. H. A. Frasch, Cleveland, Ohio, U.S.A. Eng. Pat. 10,322, May 25, 1893.

This specification claims the sulphonic acid corresponding to the soluble calcium salt, the preparation of which is described in the previous abstract.—T. A. L.

Art of Producing Dyestuffs from Natural Mineral Oils by Sulphonation. H. A. Frasch, Cleveland, Ohio, U.S.A. Eng. Pat. 10,323, May 25, 1893.

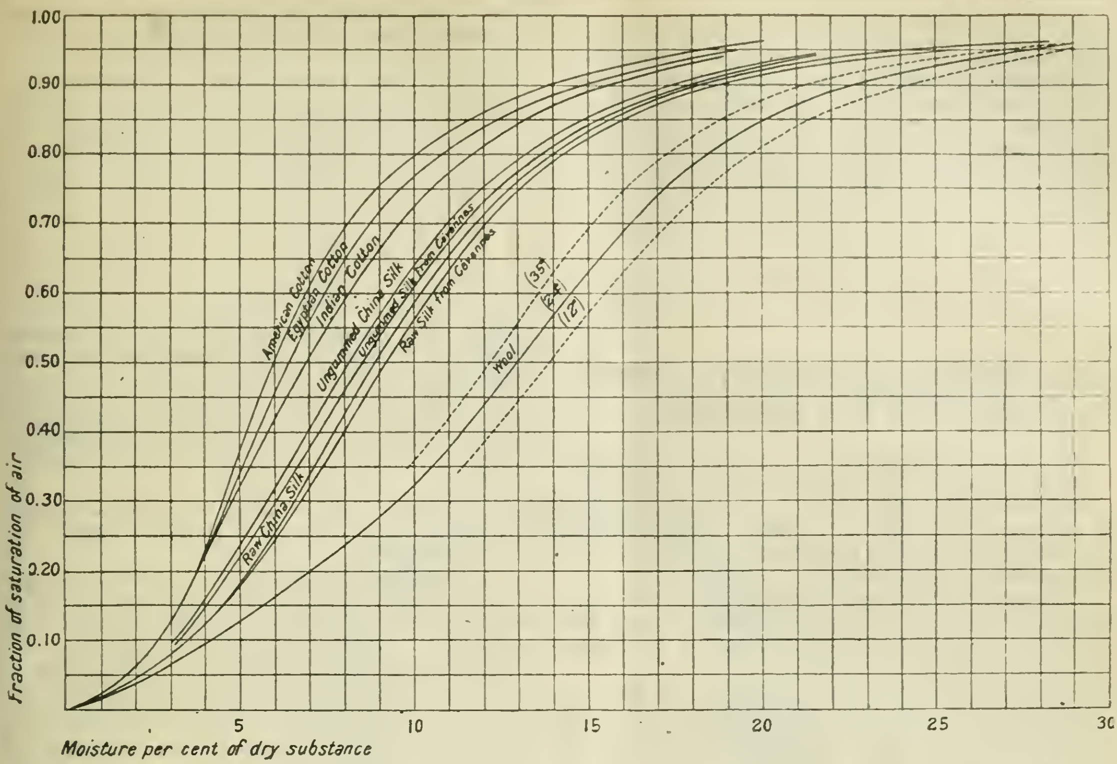
The patent claims the preparation of a yellow dyestuff by adding salt to the soluble calcium salts obtained as described in the abstract of English Patent 10,321 (see above). —T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Hygrometric Properties of Textile Materials. Th. Schloesing, jun. Comptes rend. **116**, 808—812.

Textile materials in general possess very marked hygroscopic characters, the quantity of moisture absorbed depending on the temperature and the proportionate saturation of the atmosphere with humidity; when equilibrium subsists between the material and the surrounding atmosphere there is for each temperature a relation between the amount of hygroscopic moisture taken up and the fraction of saturation of the air. The author has studied these relations in two ways: *firstly*, by passing air through a relatively large bulk of the material examined so that the air and the material assumed the humidity relationship appropriate to the particular temperature; and *secondly*, by exposing a small quantity of material to air containing a known amount of moisture, this latter being maintained constant by enclosing in the experimental chamber a vessel of diluted sulphuric acid of known strength. This second method was principally used as an occasional check upon the values obtained in the first way; satisfactory concordance was observed between the two different valuations thus obtained. Experiments were made with cotton (American, Egyptian, and Indian), woollen (Buenos Ayres and Port Philippe), and silken (Cevennes and Chinese) goods, at the temperatures 12°, 24°, and 35°.

The annexed cut illustrates the results obtained, the three curves for different temperatures being given for wool, but only those obtained at 24° for the other textiles; in all cases the general character of the curve was the same. Obviously, the total amount of moisture taken up when in contact with an approaching saturation with humidity is very considerable, being greatest with wool and least with cotton.



—C. R. A. W.

PATENTS.

Improvements in and in the Manufacture of Waterproof Felt. F. Devise, Paris. Eng. Pat. 10,863, June 5, 1893.

In carrying out this invention, the waterproof coating is applied in the ordinary manner on the surface of the felt. Then the two coated faces of two similar pieces of fabric are placed one upon the other and passed under a roller which forces the coating into the material for about half its thickness. The surfaces thus coated are given a suitable polish by applying a layer of solution in the usual manner, and they are then allowed to dry. A plate of felt is thus obtained impregnated for half its thickness and having a coating on one of its surfaces. It may be used for the making of soles of boots, saddle-cloths, and any other articles in which it is useful to have one face porous and the other impervious.—E. G. P. T.

Improvements in Machines or Apparatus for Decorticating or Treating Fibrous Leaves, Stems, and the like, for the purpose of Obtaining the Fibre therefrom. E. N. B. and H. St. J. K. Donisthorpe and T. Burrows, London. Eng. Pat. 13,301, July 20, 1892.

The fibres in the leaves or stems of the American agave, sisal hemp, pita, pineapple, yucca, New Zealand flax, musa, and other fibrous plants are, it is averred, separated more effectually and expeditiously than hitherto by means of the apparatus which forms the subject of this invention. This consists essentially of a pair of heavy-pressure feed-rollers, revolving in front of two longitudinally-fluted rollers which are so geared that the raised surfaces on the one dip into the grooves on the other, the crushed leaves and stems being thus divested of their pulp and prepared for the succeeding operations of combing, &c.—E. B.

A Detergent Composition for Laundry, Washing, or other Purposes. B. Pitt, Bristol. Eng. Pat. 14,896, August 18, 1892.

See under XII., *page* 771.

An Improved Écru or Yellow Tint for Laundry Purposes. C. Brown, Peckham, Surrey. Eng. Pat. 13,684, July 27, 1892.

See under IV., *page* 753.

Improvements in Machinery or Apparatus for Softening and Cleaning Textile Fabrics. A. Monforts, München-Gladbach, Germany. Eng. Pat. 15,486, August 29, 1892.

The modified apparatus in question consists essentially of a cloth-shearing machine of the ordinary type, constructed with brushes and shearing-rollers. The spiral blades on the latter have, however, sinuous instead of even edges. An undulatory motion is by this means imparted to the fabric passing through the machine, which is thus rendered more supple and elastic as well as freed from knots and projecting filaments.—E. B.

Improvements in the Manufacture of Iridescent Fabrics and Papers. F. Voland, Lyons, France. Eng. Pat. 5528, March 14, 1893.

Iridescent fabrics have been hitherto manufactured by weaving differently-coloured warp threads with a light weft and passing through rollers grooved in the direction of the warp. The present inventor improves upon this by printing narrow parallel lines or stripes of colours (generally in groups of three or four) parallel, transversely, or obliquely to the length of the fabric, and either continuously or in the form of patterns, such as squares, ovals, flowers, &c. After being thus printed, the fabric (or paper) is goffered by rollers with grooves corresponding in width and direction with the line-groups. The advantages of this method over the older one are: superiority of effect; the production of stronger fabrics, the employment of a weft of similar thickness to the warp being permissible; and, finally, less cost.—E. B.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

A Determination of the Amount of Tartar Emetic required to fix the Tannic Acid Mordant on Cotton. H. Falke. Färber Zeit. 1893, 226—229.

The author shows that the amount of tartar emetic required for the fixation of tannic acid on cotton is less than that commonly recommended.

The quantity of tartar emetic necessary for the precipitation from solution of 100 parts of tannic acid was first ascertained (volumetrically in the presence of sodium acetate) and found to be 45 parts.

Experiments were then made on cotton which had been mordanted with tannic acid in the following manner:—Six lots of 80 grms. each of cotton yarn (previously scoured and washed) were placed in separate baths (each of 1,600 cc.) of tannic acid, containing respectively of that substance from 2 up to 6 per cent. of the weight of the cotton under treatment in each, and at a temperature of 60°. The baths were thereupon allowed to cool and at the end of four hours the skeins of cotton were withdrawn and divided into 10 grm. portions.

These were now severally moved about for half-an-hour in solutions of tartar emetic containing from 0·25 to 1·2 per cent. (of the weight of the cotton portions) of the same. Finally, portions of each residual fixing-bath were tested respectively with hydrogen sulphide and ferrous sulphate, the baths which showed the presence of the least tannic acid and tartar emetic being adjudged to have contained the nearest approximation to the amount of tartar emetic needed to fix the amounts of tannic acid on the cotton immersed therein. Thus, in the experiment in which 3 per cent. of tannic acid was applied, the results of the tests were—

No. of Bath.	Tartar Emetic Employed.	Hydrogen Sulphide Test.	Ferrous Sulphate Test.
	Per Cent.		
1	0·3	.. ..	Blue colouration.
2	0·4	.. ..	„ „
3	0·5	.. ..	Faint colouration.
4	0·6	Faint colouration	.. ..
5	0·7	Orange colouration	.. ..
6	0·8	„ „	.. ..
7	0·9	„ „	.. ..
8	1·0	„ „	.. ..

from which it is inferred that 0·6 per cent. is approximately the quantity of tartar emetic required to fix the tannic acid absorbed in this case, under the conditions mentioned.

Similar experiments were made with cotton mordanted with sumac-tannic acid.

The results obtained indicate that the proper relative proportions of tannic acid and tartar emetic to employ are—

Tannic Acid.	Sumac Extract at 30° B.	Tartar Emetic.
	Per Cent.	Per Cent.
2	or 6—8	0·45—0·5
3	„ 9—12	0·6
4	„ 12—16	0·7
5	„ 16—20	0·8
6	„ 20—25	0·9—1·0

The results were confirmed by dye-tests, no advantage being found in the employment of a larger amount of tartar emetic than is needed to fix the tannic acid.

Where calcareous water is used for the preparation of the fixing-bath, the proportion of tartar emetic to be used will have to be increased to allow for that which is precipitated.
—E. B.

The Theory of the Chromic Acid Indigo-Discharge Process. J. Mullerus and J. Margulies. Färber Zeit. 1893, 284—286.

In the discharging of indigo-dyed cotton fabrics by means of chromic acid, the material printed with an alkaline chromate is drawn through a mixed bath of sulphuric and oxalic acids. A remarkable fact regarding the action which occurs is that if the oxalic acid be omitted from the bath the destruction of the colouring matter takes place more slowly and to a less extent, notwithstanding that the oxalic acid might *a priori* be expected to exercise a reducing action, and thus counteract rather than assist the oxidation of the indigo. The effect may be observed by immersing, at a temperature of 95°, swatches of indigo-dyed cloth in separate portions of a solution of chromic acid of suitable concentration, to which are added: in one case (*b*), oxalic acid; in another (*c*), sulphuric acid; and in a third (*d*), both acids; the cloth being slowly and imperfectly decolourised by the solution of chromic acid alone, and by solutions *b* and *c*, but being rapidly and entirely decolourised by *d*.

The part of the oxalic acid in the destruction of the indigo is indicated by the equations—

I.

$$2C_2H_2O_4 + 2K_2CrO_4 = 2K_2C_2O_4 + 2H_2O + 2CrO_3$$

II.

$$2C_2H_2O_4 + 2CrO_3 = 4CO_2 + 2H_2O + 2CrO_2$$

the chromium dioxide thus formed immediately oxidising the indigo—

III.

$$2CrO_2 = Cr_2O_3 + O$$

That chromic acid is liberated from an alkaline chromate by oxalic acid, as expressed by the first of these equations, is shown by the change of colour, from yellow to red, undergone by dilute and moderately concentrated solutions of alkaline chromates on the addition of oxalic acid to them. (Concentrated solutions give only a momentary red coloration, secondary changes rapidly ensuing.) The sulphuric acid present in the acid-bath with the oxalic acid may, however, be looked upon as for the most part determining this change, as it acts more energetically and rapidly to this end than oxalic acid.

The chromic acid liberated in the first phase of the reaction is at once acted upon by the oxalic acid, as indicated in the second equation. As evidence of the probable formation of chromium dioxide in this manner, an observation of E. Wild's is referred to. This is that while iodine separates only after long standing, from a mixture of carbon bisulphide, potassium dichromate and potassium iodide, it is immediately liberated by the addition of a trace of oxalic acid to the mixture. Again, it is known that whereas chloric acid does not at once act upon indigo, the addition of a sulphite to it produces a lower chlorine oxide which does so instantly. In similar manner the chromium trioxide yields by the action of the oxalic acid the unstable dioxide, which more actively oxidises the indigo, with the ultimate formation of isatin and a salt of chromium sesquioxide.

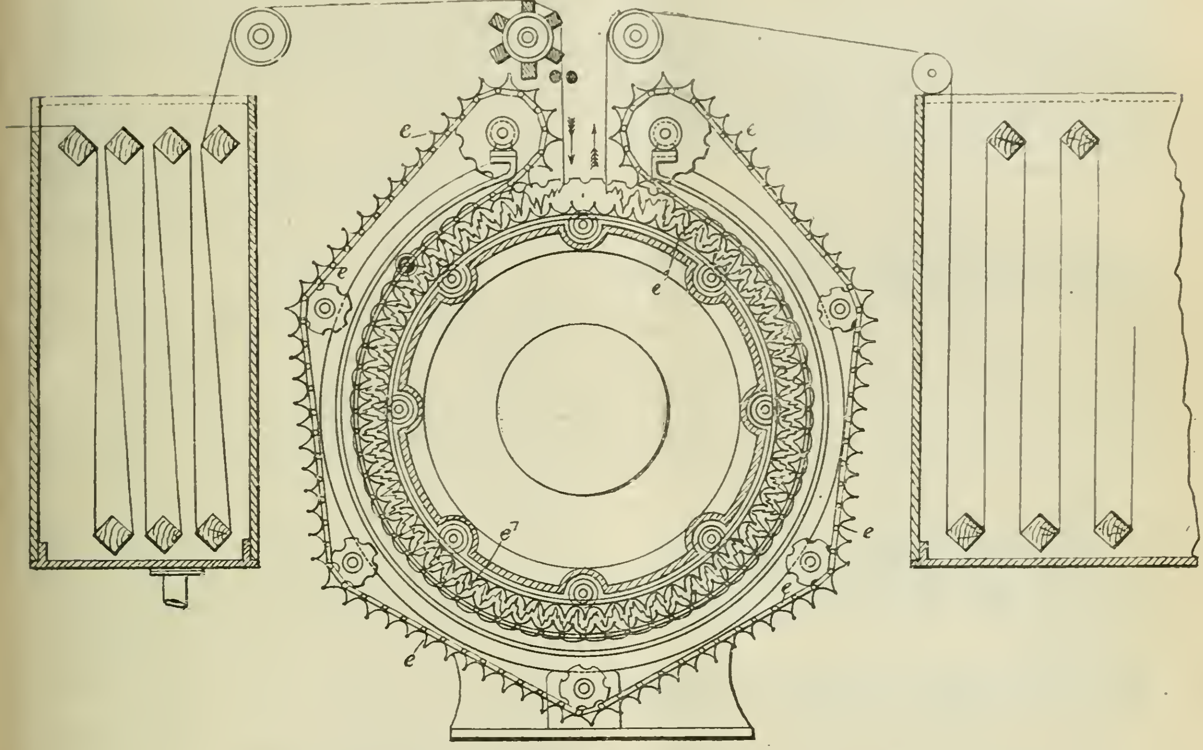
The production of carbonic anhydride in the discharge process (equation II.) was experimentally proved.

It is interesting that formic, citric, and tartaric acids cannot replace the oxalic acid in the above reaction.—E. B.

PATENTS.

Improvements in Certain Machines for Washing, Soaping, Bleaching, Dyeing, and similarly Treating Textile Fabrics. J. Schmidlin, Bradley Fold. Eng. Pat. 14,421, August 10, 1892.

This invention relates to mechanism for soaping, &c. textile fabrics at full width, and in particular to the arrangement known as "Hawthorn's Patent Open Washing and Soaping Machine." The inventor declares that the mere carrying round of the fabric by the revolving wheel in this apparatus is inadequate for its thorough cleansing or colouring, as the case may be. He, accordingly, imparts to the wheel an axially reciprocating or rocking motion, and receives the cloth in folds between two endless chains of perforated plates *e* and e^1 (see figure), thus creating a sufficient agitation of the liquor to produce the requisite action on the fabric.—E. B.



Improved Machine for Washing, Bleaching, Dyeing, &c. Textiles.

An Improved Method of Printing Fabrics. H. H. Lake, London. From E. Cousin, Lyons, France. Eng. Pat. 14,885, August 17, 1892.

A process of stencil printing. "One or more forms, blanks or the like of paper, cardboard, metal, celluloid, or other suitable material" are prepared, each "with openings according to the outlines of the design of each colour to be printed." These are placed upon the fabric and the colour or colours printed on by "brushes, pads, rollers, or the like." The principal advantages of the method are stated to be "rapidity and small cost of engraving, and employment of unskilled labour for doing work ordinarily executed by skilled workmen."—E. B.

Improvements in Cleansing, Bleaching, and Dyeing Textile Materials and Fabrics, and in Apparatus therefor. D. Stewart and T. Lambert, Glasgow. Eng. Pat. 15,726, September 2, 1892.

The materials are operated upon in the gas-tight keir described in Eng. Pat. 16,463 of 1891 (this Journal, 1892, 745).

For the purpose of scouring, a volatile hydrocarbon or mixture of hydrocarbons, such as solvent naphtha, is used. A suitable quantity of this is forced from a store-tank into the vessel containing the goods, and then air is blown in until a pressure of about 80 lbs. per square inch is reached. After a time the solvent is discharged, its lower portion, which contains most of the impurities from the goods, being received in a still for the recovery of the hydrocarbons, and its upper portion returned to the store-tank. High-pressure steam is next passed into the keir to completely remove the solvent from the goods, which, along with the steam, is condensed in a connected vessel.

The materials, after having thus been scoured, may, further, be bleached, mordanted, and dyed in the keir, solutions of the requisite agents being to this end forced into them, together with steam or compressed air, if advantageous or necessary.—E. B.

Improvements in Bleaching Yarns, Piece Goods, and other Materials. C. D. Abel, London. From O. Keferstein and O. Keferstein, jun., and "Siemens and Halske," Berlin, Germany. Eng. Pat. 729, January 12, 1893.

The bleaching process, described in Eng. Pat. 629 of 1893 (this Journal, 1893, 600), is rendered more efficacious by soaking the materials to be bleached in either ammonia solution (1 part of 30 per cent. solution to 100 parts of water), ammonia-turpentine emulsion, ammonia-resin soap solution, or "ammoniacal indigo," previous to treating them with ozone. The materials are afterwards "treated for nearly 10 hours in a solution of chloride of lime containing 0·0007 per cent. of chlorine," and the whole process repeated if necessary.

An alternative method is to place the ammoniacal liquids in the ozone chamber and to cause a strong current of the gas to impinge on them. Fumes are so produced of "hydrogen peroxide, nitrate of ammonia, and ammonia-turpentine oxidation compounds," which condense upon the textile materials, forming "salt-precipitates that increase the ozone action" and "render more effectual the ensuing weak bleaching salt solutions."—E. B.

Improvements in the Manufacture of Iridescent Fabrics and Papers. F. Voland, Lyons, France. Eng. Pat. 5528, March 14, 1893.

See under V., page 757.

VII.—ACIDS, ALKALIS, AND SALTS.

The Relative Affinities of Hydrochloric and Oxalic Acids for Ferric Oxide. G. Lemoine. Comptes rend. **116**, 880—882.

Thermochemical observations show that oxalic acid has the power of displacing hydrochloric acid from ferric chloride to a considerable extent.—E. B.

Decomposition of Oxalic Acid by Ferric Salts under the Influence of Heat. G. Lemoine. Comptes rend. **116**, 981—983.

Ferric oxalate solution is partially decomposed at 100°; ferric oxide is liberated and reduced by the oxalic acid with evolution of CO_2. Presence of excess of oxalic acid impedes the reaction.

Ferric chloride and oxalic acid solutions for the most part form ferric oxalate and hydrochloric acid; the latter impedes the decomposition of the oxalate, so that by adding excess of hydrochloric acid the action is mostly stopped.

—C. R. A. W.

The Manufacture of Bichromates. C. Häussermann. Dingl. Polyt. J. **288**, 93—96, 111—113, and 161—162.

The raw material employed in this manufacture is chrome ore which is chiefly obtained from Turkey or Asia Minor. The analysis of a sample of such an ore gave the following figures :—Cr_2O_3, 51·20; Al_2O_3, 12·80; Fe_2O_3, 1·45; FeO, 13·32; MgO, 12·55; CaO, 3·15; SiO_2, 4·95; CO_2, 0·20; loss, 0·38 per cent.

To start with, the ore must be ground to an almost impalpable powder, and for this purpose roller mills have been found to give the best results. The powdered ore is then mixed with lime and sodium carbonate, which latter ingredients must also be very finely ground. The mixture is then submitted to an oxidising roasting process. The reaction taking place is expressed by the formula—

$$2FeCr_2O_4 + 4Na_2CO_3 + 7O = Fe_2O_3 + 4Na_2CrO_4 + 4CO_2$$

In practical working the addition of lime is indispensable, conferring porosity on the mass and preventing the sodium carbonate from fusing, which would lead to incomplete oxidation. The proportions in which the above ingredients are to be used, are in England, according to Atcherley, 4·5 parts of ore, 7 parts of burnt lime, and 2·25 parts of alkaline carbonate. In Russia, according to Walberg, there are used 6 parts of ore, 3 parts of chalk, and 3 parts of soda-ash. Generally, mixtures containing more lime than soda, give the best results as regards the percentage of chromium rendered soluble. Even less sodium carbonate, as required according to the above equation, may be employed, in which case a corresponding quantity of chromate of lime is formed. The roasting operation is carried out in reverberatory furnaces so constructed as to heat the air up to a temperature of about 400° C. before it enters the furnace proper. A furnace consuming 4 tons of coal in 24 hours will roast during the same period 2 tons of ore. The working space of the furnace is divided into three beds, each succeeding bed being slightly higher than the one nearest to the entrance of the flame. One-third of the daily charge is first introduced into the furnace through a hopper over the third and highest bed of the furnace, after 8 hours it is raked down on to the second bed, whilst the third or top bed receives a fresh charge. After another 8 hours the two first charges are worked down to the first and second beds respectively, of the furnace, the top bed again receiving a fresh charge. The temperature of the first bed close to the furnace bridge ought to approach that of melting gold, the last bed that of melting aluminium. The yield of roasted material is about 5 per cent. less than the weight of the unroasted charge. Scarcely more than 1 per cent. of the ore escapes oxidation into chromic acid. The roasted mixture, together with about twice its weight of water and sufficient soda-ash to leave an excess of 5 per cent. over and above the quantity required for the formation of the normal chromate, is then transferred into iron cylinders provided with agitators and heated to from 120° to 130° C. for about 2 hours. The solution is eventually separated from the insoluble residue by filter-pressing. The composition of the residue is exhibited in the following analysis :—

Na_2O, 0·2 per cent.; CaO, 46·5; MgO, 12·2; Fe_2O_3, 7·5; Al_2O_3, 5·4; Cr_2O_3, 1·0 soluble in HCl; CrO_3, 1·8; SiO_2, 1·4; CO_2, 5·2; H_2O, 16·0; insoluble 1·2 per cent.

The solutions obtained from the filter-presses are concentrated until they attain a specific gravity of 1·5. They receive then the addition of such a quantity of sulphuric acid (containing 80 per cent. H_2SO_4) as will suffice to neutralise the excess of alkali present and to convert the whole of the monochromate into bichromate. The largest quantity of the sulphate thus formed at once precipitates in its anhydrous form, the bichromate remaining in solution. This operation is carried out in lead-lined iron pans which are provided with a steam jacket. The solution of the bichromate is separated from the precipitated sulphate by first siphoning off the clear solution of bichromate and hydro-extracting the residue. The bichromate solution is further concentrated in iron pans. Considerable quantities of sulphate crystallise out, but as soon as a specific gravity of 1·7 is reached the hot solution is filtered and allowed to stand and crystallise. If the crystallisation proceeds undisturbed large crystals of $Na_2Cr_2O_7 + 2H_2O$ are obtained, but if during crystallisation the solution be agitated, the salt crystallises in the form of small orange needles. The specific gravity of the large crystals is 2·6. Bichromate of soda is very deliquescent and imparts to absolute alcohol a yellow colour; the corresponding potassium salt does not give this reaction. The yield amounts to about 90 per cent. of that calculated. To convert the sodium salt into the potassium salt, solutions are used containing respectively 1,500 grms. of $Na_2Cr_2O_7 + 2H_2O$ and 300 grms. of KCl per litre, the latter solution being added to the former. The bulk of the bichromate of potash is at once precipitated and recrystallised, large crystals being obtained from solutions containing 570 grms. $K_2Cr_2O_7$ in one litre. The mother-liquors are used for the crystallisation of fresh quantities of the crude salt. The mother and wash liquors obtained in this manufacture which are too much contaminated with foreign salts, are treated with reducing agents and the chromium oxide precipitated, and subsequently filter-pressed. The chromium oxide cakes thus resulting are mixed with lime in the proportion of $1Cr_2O_3$ to 1·5 CaO. The mixture is dried and heated to redness, until the mass possesses a homogeneous yellow appearance and contains about 36 per cent. of CrO_3. The roasted mass is then extracted with carbonate of soda. In the same manner the chromium may be recovered from the waste liquors of alizarin works. The hurtful effects of chromates upon the health of the workpeople can be considerably minimised by adopting the necessary precautions. No workmen ought to be allowed to work whilst suffering from abrasions or wounds on exposed parts of the body, as upon these, on contamination with chromates, ulcerated sores, healing but slowly, are formed. The hands ought to be rubbed with vaseline and no food or drink allowed in the work sheds.

The conversion of chromite of soda into chromate can be effected by means of the electric current. On submitting a solution of chromic oxide in caustic soda to electrolysis, using platinum as anode and iron as cathode, the following reaction takes place:—

$$= \underbrace{3Na + 3H}_{\text{Cathode.}} \overset{Na_2Cr_2O_4}{\longleftrightarrow} \underbrace{2Na_2CrO_4 + H_2O}_{\text{Anode.}}$$

A current of 2 ampères was employed, and it was found that one hour-ampère converted 0·563 grm. of the chromite into chromate. One hour-ampère yielding theoretically 0·298 grm. of oxygen, which would oxidise 1·336 grms. of $Na_2Cr_2O_4$, it follows that—

$$Na_2Cr_2O_4 + 2NaOH + 3O = 2Na_2CrO_4 + H_2O$$

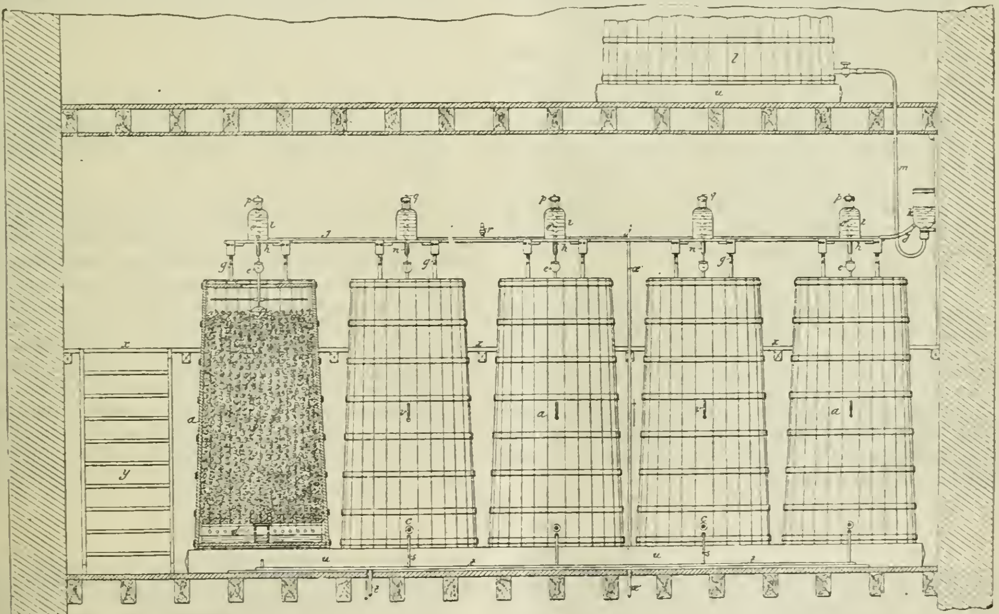
and the useful effect represented by $\frac{100 \times 0·563}{1·336} = 42$ per cent. is attained.

By placing the anode in a solution of 58 grms. Na_2CrO_4 in 0·5 litre of water and electrolysing this solution, the resistance was at first very high, but fell in the course of a quarter of an hour to eight volts, and eventually to six volts, where it remained stationary during the rest of the experiment. A current of from 2 to 3·5 ampères was used. The liquid at the cathode contained 14 grms. of caustic soda and 0·4 grm. of monochromate. The liquid at the anode yielded after concentration a crystallisation of over 40 grms. of $Na_2Cr_2O_7 + 2H_2O$. As in this manner the bichromate is obtained with caustic soda as a by-product (instead of sodium sulphate), it appears that the conversion of monochromate into bichromate by means of the electrolytic process indicates an important step in the progress of the manufacture of bichromates.—C. O. W.

An Automatic Process for the Manufacture of Vinegar.

E. Barbe. Bull. de la Soc. d'encour. 1892, 500.

In this process for the manufacture of vinegar all manual labour is dispensed with, and the alcoholic liquids are delivered into the generators continuously. The generators, which are placed side by side in rows, are 2·25 m. high, and their width is 1·15 m. at the bottom, and 0·85 m. at the top. Their capacity is about 15 hectolitres, and they are charged each with 260 kilos. of oak shavings of spiral form, presenting a total surface of about 34 square metres. At the lower part of the generator the air required for the acetification is introduced through fine apertures, a great



a. Generators filled with oak shavings.
b. Spiral shavings of oak in *a.*
c. Air valves of the generators.
d. Perforated boxes (see lower part of *a*) for distributing the air evenly in the generator.
e,f. Arrangement for distributing the alcohol evenly in the generator.
h. Bottle shelf.
i. Distributing bottles.
j. Pipes from ball-tap reservoir to bottles.
k. Ball-tap reservoir.
l Main alcohol reservoir.
m. Pipe to ball-tap reservoir.
n. Pipes conducting alcohol into bottles.
o. Siphons.
p. India-rubber stoppers.
q. Air pipes.
r. Air valve.
o, e. Pipe from the hydrostatic balance, connected with *g.*
s. Discharge pipes for vinegar.
t. Pipes carrying vinegar into storage cellar.
u. Supports for generators.
v. Thermometer indicating the temperature in the generator.
x. Stage.
y. Steps to stage.

E. Barbe's Process of Manufacturing Vinegar.

number of which are contained in each box, the front of which has a single hole only. These boxes are arranged crosswise in each generator. The apertures in the front of these boxes are provided with concentric valves, through which the necessary amount of air passing into the generator is regulated according to the temperature inside the apparatus and the progress of acetification. Above the generators, bottles of about one litre capacity each are provided, all standing on the same level. The necks of these bottles are connected with one common branch of air-pipe, a special valve in which leaves it either in connection with the atmosphere, or connects it with a reservoir containing compressed air. Two openings on the bottom of the bottles connect them on the one hand with the general alcohol reservoir, and on the other with the interior of the generators. By means of a hydrostatic balance, about every 15 minutes the air branch is automatically connected with the reservoir containing the compressed air, whereby a certain quantity of the contents of the bottles is discharged into the generator by the aid of a rotating distributor. The vinegar formed leaves the generator through pipes provided at its lowest part, and then runs into barrels to cool and clarify.—C. O. W.

PATENTS.

Improvements in the Production of Carbonic Acid Gas. H. H. Lake, London. From J. H. C. Behnke and "The Chemische Fabrik," Billwärder-on-the-Bille, Germany. Eng. Pat. 14,607, August 12, 1892.

The improvements refer to the production of pure carbonic acid gas from lime-kiln or furnace gases, by absorption in a sodium carbonate solution to form a solution of bicarbonate, which is subsequently steamed in a separate vessel, so as to produce sodium carbonate and pure carbonic acid gas.

The absorber consists of a tower provided with a number of superposed perforated trays. The sodium carbonate solution is fed in on the top and flows downwards through central or lateral overflow pipes, which dip into the solution on the next lower tray. The weak gases are forced in at the bottom, and, rising through the perforations, come into intimate contact with the solution and give up their carbonic acid; the inert gases escape at the top. The pressure will be greatest on the bottom tray, *i.e.*, equal to the sum of the heights of liquid layers, thus ensuring better saturation of the sodium carbonate liquor.

The decomposer consists of a horizontal boiler provided with a tower similar in construction to the absorbing tower. The bicarbonate solution is fed in at the top and meets in its downward course with the steam given up from the monocarbonate solution in the boiler, and being gradually heated up, looses an equivalent of carbonic acid, which is led into a gasholder. The monocarbonate solution is drawn off when required, agitated for the separation of the dissolved carbonic acid, cooled, and pumped on to the absorber for use over again.—H. A.

Manufacture of Caustic Soda and Potash and Hydrochloric Acid by Electrolytic Treatment of Chloride of Sodium and Chloride of Potassium, and Apparatus for this Purpose. J. P. Roubertie, Bordeaux; V. Lapeyre, Paris; and U. Grenier, Ponyand, France. Eng. Pat. 15,113, August 22, 1892.

The object of this invention is to cause the chlorine liberated in the electrolysis of sodium or potassium chloride solutions to combine with the hydrogen simultaneously liberated, thereby forming hydrochloric acid and avoiding the formation of oxygen compounds. The apparatus employed consists essentially of two chambers separated from each other at the upper part and resting upon a bottom vessel containing the chloride of sodium, with which they both communicate, the chambers being either rectangular and formed in one piece with an intervening partition, or they may be separate vessels, either of cylindrical or other form. Both chambers are charged with the solution to be electrolysed; that containing the negative electrodes, which are iron plates arranged vertically, is hermetically sealed so as to force the hydrogen given off to bubble through the positive chamber, which is preferably exposed to strong light so as to facilitate the formation of hydrochloric acid. The positive electrodes may be formed of any suitable metal silvered, or of lead, or of silvered glass, and are arranged in a slanting position.—G. H. R.

An Improved Process of and Apparatus for the Electrolytic Decomposition of Alkaline Salts. H. Y. Castner, London. Eng. Pat. 16,046, September 7, 1892.

See under XI., *page* 763.

Improvements in the Process of Precipitating Oxide of Tin from Solutions. C. L. C. Bertou, Paris, France. Eng. Pat. 16,873, September 21, 1892.

The object of this invention is the recovery of tin from solutions obtained according to a previous patent (this Journal, 1891, 775), in which scrap-tin is treated in a bath containing hydrochloric acid and a nitrate, at about 50° C., the temperature being raised in proportion as the bath gets richer in tin and weaker in nitrate. It is proposed to precipitate the tin at the boiling temperature as oxychloride, by addition of calcium carbonate in presence of air. When the evolution of carbonic acid ceases, the bath is allowed to cool, the precipitate collected, washed, suspended in hot water, and treated with sodium carbonate to alkaline reaction for conversion into tin oxide.—H. A.

Improved Process for the Precipitation of Tin from Acid Solutions containing same with other Metals. C. L. C. Bertou, Paris, France. Eng. Pat. 16,874, September 21, 1892.

The solution of tin chloride resulting from the treatment of waste tin in a bath, "of which hydrochloric acid is the base," contains as a rule more or less iron and lead as impurities. The separation of the tin has hitherto been effected by the addition of calcium carbonate—a slow process, because of the slow and tedious settling of the froth, the copious formation of which is due to the escape of carbonic acid. The inventor replaces calcium carbonate by quicklime or an equivalent base, adding the same slowly and in small quantities until no more tin remains in solution. The insoluble tin oxychloride is separated from the solution containing the iron; it is suspended in water and converted into tin oxide by addition of milk of lime or soda to alkaline reaction. In both cases the precipitation is best conducted at about 60°—70° C.
H. A.

Improvements in the Dehydration of Ammonia and other Volatile Liquids, Vapours, or Gases, and in Apparatus therefor. W. Mather, Manchester. Eng. Pat. 17,824, October 6, 1892.

The improvements refer to the construction of an ammonia still in which (1) the cold ammoniacal feed liquor is utilised for cooling down and thus dehydrating the ammonia vapours passing from the still, (2) the residual ammonia in the spent still liquors is extracted by the application of a vacuum.

The apparatus consists of a horizontal boiler provided on its upper part with a vertical pipe for feeding in the weak liquor. In the upper part of the pipe there is a chamber provided with a number of small tubes for carrying away the ammoniacal vapours. These tubes are surrounded with the cold feed-liquor, which overflows into a central tube leading down through the chamber and terminating in a rose; the liquor descends in a shower and causes the separation of some water from the ammonia vapours.

The ammonia abstracted from the spent liquors by means of the vacuum is used for enriching the ammoniacal feed-liquor.—H. A.

Improvements in and Connected with the Manufacture of Iron Salts. P. Hart, Manchester. Eng. Pat. 6815, April 1, 1893.

A new product, capable of utilisation in the treatment of sewage, may be obtained by heating together a mixture of ferrous sulphate or chloride (6 mols.), sodium nitrate (2 mols.), and sulphuric acid (one mol.). The treatment is effected either in externally heated retorts, cylinders, &c., or in the potting ovens of the pyrites kilns as used in the manufacture of sulphuric acid. In either case nitrous fumes are evolved, which may be utilised in the manufacture of sulphuric acid, or condensed in separate towers to produce nitric acid. The residue in the pot consists of a mixture of iron, alum, and ferric sulphate, which may be run out into drums and allowed to set.—H. A.

Improvements relating to the Treatment of Complex Sulphide Ores. W. R. Ingalls and F. Wyatt, New York, U.S.A. Eng. Pat. 9817, May 16, 1893.

See under X., *page* 767.

Improvements in or relating to the Manufacture of Chlorates. A. J. Boult, London. From A. Nieske, Dresden, Germany. Eng. Pat. 10,053, May 19, 1893.

In the old process for manufacturing potassium chlorate, 15 per cent. of this salt is "completely lost" in the lyes. As an improvement on this process it is proposed to treat the octagon liquors with sufficient potassium chloride for conversion of the calcium chlorate into the potassium salt, then to add sufficient sodium sulphate to precipitate the whole of the lime as gypsum. The remaining solution is evaporated, the common salt fished out, and the liquor run into crystallising pans. The crystals so obtained are intended for sale.

For the manufacture of sodium chlorate the addition of potassium chloride to the octagon liquors is omitted; otherwise the process is carried on as described.

As an alternative way of working, strontium or barium hydrate are treated with chlorine, and the barium or strontium chlorate so produced is converted into the potassium salt, from which the chlorides of the alkaline earths may be separated by means of sodium sulphate.
—H. A.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Athermanous Glass. R. Zsigmondy. Dingl. polyt. J. **287**, 17—22; 68—71; 108—111.

The use of glass capable of filtering off the ultra-red rays on which the chief heating effect of a ray of light from the sun or an artificial source depends, presents several advantages for purposes such as the maintenance of a moderate temperature in living rooms, the protection of the eyes of workmen at metallurgical and glass furnaces, and the screening of delicate plants from the full power of the sun. The method of investigation adopted in order to ascertain the best method of preparing glass possessing these properties, consisted in trying the effect of dissolving various metallic oxides whose salts are athermanous in aqueous solution, in glass of composition similar to that commonly used. As alum is generally used to cut off heat rays in physical experiments, the first attempt to prepare a glass with the same property consisted in the use of alumina as the essential constituent. The glass was prepared by fusing 70 parts by weight of sand with 25 of kaolin and 34 of sodium carbonate, the product having the composition, silica 74·6, alumina 8·4, soda 15·4, and lime 0·9 parts per cent. respectively. A trace of iron was also present. The glass made by this prescription transmitted only about one-third the amount of heat that was allowed to pass by a sample of ordinary mirror glass of similar thickness, and it was at first supposed that this difference was due to the high content of alumina. Further trial with a sample containing 12 per cent. of alumina and another with 17 per cent., showed that this assumption was erroneous, as the latter glasses, which were free from iron, were not more impervious to the ultra-red rays than ordinary mirror glass. In short, the effectiveness of the glass first made, was traced to the small amount of iron it contained, which appeared to be present as ferrous oxide. As a side issue of this matter the author examined the behaviour of aqueous solutions of alum, and found that their effect in cutting off heat rays is more properly to be ascribed to the water than the alum, and that such power as they possess does not appear to be characteristic of aluminium salts, but rather to the complexity of the alum molecule. On the other hand, aqueous solutions of ferrous salts had a considerable absorptive power, while ferric salts were less vigorous in their action. Three glasses were then made containing respectively 1, 2, and 4 per cent. of ferrous oxide, and it was found that even the first of these cut off the heat rays from an argand or batswing burner almost completely, provided a thickness of about 8 millimetres was used. The colour of this glass is bluish, with a slight green tint, but the intensity of the coloration was comparatively slight, and its power of cutting off heat rays could not be attributed merely to the colour, as a chromium glass of deeper tint was considerably more diathermanous. The author having given a lengthy account of his speculations concerning the possible uses of athermanous glass, records the result of such practical tests as he has made. The upshot of these experiments is less satisfactory than might have been expected. In the first place, trials with lamp glasses were made and the percentage of heat passing the glass found higher than when the glass was tested in the form of small trial plates. This the author attributes to some error in the manufacture of the lamp glasses. Another factor disturbing his original calculations of the efficiency of the glass also came into play. It was found that though the glass certainly hindered the direct transmission of radiant heat, yet that it had a higher power of emission than common glass, and when heated by the lamp radiated heat so freely that its advantage was largely diminished. The application of athermanous glass for lamp chimneys cannot therefore be recommended. Another possible use for the glass is its application for the construction of glass roofs and skylights. Those at present in use have the two-fold disadvantage that they allow the sun's rays to heat the rooms beneath unduly, and that they may act as burning glasses on occasion, should they contain any lense-shaped irregularity. Athermanous glass has not, however, been prepared in sheets sufficiently large to put the matter to the proof, so that it remains considerably a subject for conjecture.—B. B.

Diminution of the Coefficient of Expansion of Glass. L. C. Baudin. Comptes rend. **116**, 971.

See under XXIII., *page* 786.

PATENT.

Improvements in Treating Vitreous Substances for Making Metallic Connections thereto. H. Doulton, Lambeth, and J. Slater, Burslem. Eng. Pat. 12,939, July 14, 1892.

One drachm of "bichloride of platinum well washed to eliminate free acid," is dried by heat, and while warm mixed with "one ounce of balsam of sulphur and three ounces of spirit of turpentine," prepared "by boiling the same to the consistency of cream in a sand-bath." Oil of turpentine is added until the mixture can be used with a camel hair brush, when it is applied to the vitreous surface to be treated and fired in an enamel kiln at a suitable temperature. Oxide of gold, silver, or platinum sponge may be used in a similar manner. The prepared surface is suitable for making plumbers' joints between stoneware and metal by soldering instead of by the use of cement, and can be employed for sinks, urinals, &c., as well as for attaching metal mounts to glass and china, and handles to jugs capable of easy renewal, as well as for sealing the lids of jars containing preserved foods and for electrical fittings.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

PATENTS.

Improvements in Purifying and Grinding the Residue of Portland Cement. J. Hoyle, Swanscombe. Eng. Pat. 10,010, May 26, 1892.

The residue left by the ordinary grinding of Portland cement is passed through a coarse sieve to remove foreign matter accidentally present, then between permanent magnets, from which particles of iron that may be separated are removed by a revolving brush, and then through a series of coned grinding rings made of emery or similar suitable material, between which sieves or separators may be placed if desired, the product being cement of good quality.—B. B.

Improvements in Apparatus for Purifying and Grinding the Residue of Portland Cement. J. Hoyle, Swanscombe. Eng. Pat. 10,010a, May 26, 1892.

The patent is identical with Eng. Pat. 10,010, 1892, save that the claims are amended, the combination of the various parts of the apparatus described, and the plant as a whole being claimed.—B. B.

Improvements in Separating and Concentrating Apparatus. B. J. Atterbury and P. Ewens, both of London. Eng. Pat. 10,580, May 30, 1893.

The apparatus is intended for the grading and collecting in a dry state such materals as cement, and also for concentrating, collecting and depositing gold, tin or other metals, from the "slime" in which they are held after disintegration. The apparatus consists of a series of concentric tanks each having a zone or belt of wire gauze. The material enters the outer tank by means of an inclined feed pipe, and afterwards passes through the various gratings to the centre. At the bottoms of each tank, material is deposited according to size and density, the lighter material being deposited at the centre and vice versa, thus separating the heavy precious material from its vehicle or matrix. The gratings or screens are kept clear by means of brushes on revolving arms, to which latter are also attached scrapers, for the removal of the material deposited upon the bottoms of the tanks, through valves attached to the undersides. A series of india-rubber flaps are hung round the upper rims of the tanks, to prevent the material from flowing over into the next inner tank, and at the same time to permit the passage of the cross bar carrying the scrapers and brushes.—E. G. C.

Improvements in the Manufacture of Plaster. J. C. Bloomfield, Leggs. Eng. Pat. 508, January 10, 1893.

Finely ground raw shale, hydraulic lime, and barium sulphate, are mixed together for the production of a plaster, said to dry with a polished surface. When the plaster is to have a blue tint, more or less of the shale is used, and when it is to be white the shale is omitted. Colouring matters may be added, and the plaster is mixed with water and applied as a finishing coat in the ordinary manner.
—B. B.

An Improved Composition for Preserving Vegetable Fibre. H. H. Lake, London. Eng. Pat. 9816, May 16, 1893. From W. A. Gayle, Montgomery, U.S.A.

Equal parts of common ochre and crude cotton-seed oil are mixed together, and any common resin to the extent of $\frac{1}{16}$th of the weight of the mixture added, the whole being gently heated to "liquefy the resin." Kerosene or coal oil may be added as cheaper ingredients than those already mentioned. "This composition is best applied to articles made of vegetable fibre by immersing them in it." The composition is said to act as a preservative against many destructive influences, including the attacks of insects, more especially in the case of wood in the form of piles, &c.
—B. B.

X.—METALLURGY.

Volatility of Manganese. S. Jordan. Comptes rend. **116**, 752—753.

The author has previously found that manganese is volatile at the temperature of metallurgical furnaces; his results have been confirmed by R. Lorenz and F. Heusler, who have shown that whilst manganese does not form a volatile compound with carbon monoxide, it nevertheless slowly volatilizes and sublimes at a white heat in a current of either carbon dioxide, carbon monoxide, hydrogen, or nitrogen. With the first gas the metal brings about partial reduction; no indications of the formation of a nitride are obtained with nitrogen. The issuing gases passed through a flame give spectroscopic indications of the presence of manganese.—C. R. A. W.

Nitro-Copper. P. Sabatier and J. B. Senderens. Comptes rend. **116**, 756.

Spongy copper is prepared by reducing the oxide by means of hydrogen or carbon monoxide. Nitrogen peroxide vapours are then led over the sponge at 25°—30°. The metal becomes brown and heat is evolved. The compound produced is decomposed at temperatures above 90°, peroxide of nitrogen being evolved, with more or less admixture of lower oxides. With water it reacts vigorously, producing pure nitric oxide, a solution of nitrate and nitrite of copper, and a residue of nearly pure metallic copper. By taking up about 1,000 volumes of gas at 30° the resulting product has approximately the composition Cu_2NO_2. Hydrogen has no action in the cold; but at near 180° ammonium nitrite and free ammonia are abundantly formed when a rapid current of hydrogen is passed over the compound. Carbon monoxide has no action in the cold, but on heating nitrogen peroxide is evolved and metallic copper left. Sulphurous anhydride does not react with the compound in the cold, but on heating the usual product of the action of sulphur dioxide and nitrogen peroxide is formed, *viz.* "chamber crystals." The residual copper contains some oxide and a little anhydrous sulphate. Chlorine at about 200° evolves nitrogen peroxide and produces a mixture of cuprous and cupric chlorides. Ammonia gas acts in the cold, forming fumes of nitrate and nitrite, also water vapour. By and bye the mass incandesces, and much more water and ammoniacal salts are formed. Copper and copper oxide containing ammonia are left. Sulphuretted hydrogen reacts at the ordinary temperature evolving heat; water and sulphur are liberated and finally a bright blue mass of cuprous sulphide is left. Apparently the action is in each case substantially that which would take place with copper and nitrogen peroxide simply lying side by side; so that the compound may be conveniently used instead of nitrogen peroxide itself. Cobalt and nickel give similar compounds, and probably also iron, manganese, and other metals.

—C. R. A. W.

Smelting Processes for the Extraction of Silver and Gold from their Ores. H. F. Collins. Proc. Inst. Civil Eng. **112**, 1892–93, Part II. 3—51.

The author points out the novel conditions which confronted the early metallurgists of North America, and drove them to adopt processes widely differing from those generally used in Europe; the water-jacketed blast-furnace, of great dimensions and capacity, being used for smelting all classes of gold or silver bearing ores, whether the precious metals are to be concentrated into lead, copper, or matte for final treatment.

Lead is the concentration agent most generally in use; lead bullion to the value of over 6,000,000*l.* having been produced during the year 1891 by nine of the largest lead smelters of Colorado State alone. The paper describes in detail, with drawings, the type of furnace at present adopted at the largest smelting works; and discusses the relative advantages of wrought-iron and cast-iron water-jackets, and of the different modes of charging, and carrying off the waste fumes, in general use. The fuel used is commonly a mixture of coke and charcoal, about three or four parts of the former to one of the latter; but the increasing scarcity and price of charcoal have led to many experiments in the direction of replacing it by an equivalent amount of anthracite or other coal; and there can be little doubt that its abandonment is only a question of time, at any rate in the case of the Colorado smelter. The coke used is friable, and has a high percentage of ash; even the best yielding from 11 to 14 per cent., while that from the coalfields of Southern Colorado and New Mexico yields on an average 19 per cent. of ash. In spite of this inferior quality, it is relatively cheaper at all Western smelting centres than the superior coke from the Eastern States.

The method of charging and working the furnace is described in detail. The precautions taken to ensure a proper separation of matte and slag, and to protect the workmen from the evil effects of the poisonous lead fumes, being specially noticed. Of the ore smelted, an average of 85 per cent. of the lead contents, and 92 per cent. of the precious metals, is obtained directly in the first instance, as lead bullion and argentiferous matte: by far the larger portion of the remainder being irretrievably lost in the slag, in intractable speiss, and in uncondensed fumes. Flues and condensing chambers are provided for the collection of the flue-dust, which is bricked with lime or clay and re-smelted; but much of the real "fume" *i.e.*, volatilized oxides, sulphates, &c., of lead, zinc, and other metals, is lost owing to difficulties of proper condensation and handling.

The main difficulties which have to be encountered by nearly all the great smelting works of the Western States are the fineness of a large proportion of the ore offered; the increasing amount of sulphides in the ores from most great mines, as the workings get beyond the influence of atmospheric oxidation; the enormous preponderance of siliceous "dry" ores over the other kinds, and the corresponding scarcity of ores rich in lead; and the large quantity of zinc carried by most of the sulphide ores, which makes the slags both more pasty and more infusible, and causes "scaffolds" or accretions in the upper parts of the furnace, which seriously disturb its regular working.

The sulphide ores all need calcination before they can be rendered available. As regards the lump ore, consisting largely of iron pyrites, and poor in lead, this is often affected in heaps in the open air; but the loss of silver is considerable when the ore is at all rich, and also during wet weather. The fine ores, and those containing large amounts of galena or blende, are roasted in a reverberatory calciner of the Swansea type, with its hearth lengthened so as to obtain the full benefit of the combustion of the sulphur contained in the ore, as well as of the fuel. The most approved type of "roaster," as it is called in America, has a hearth roughly four times as long as it is wide, and will put through eight to ten tons of ore per day. These furnaces are sometimes provided with a fusion-hearth next to the fire-bridge, where the charge is "slagged" or agglomerated before withdrawal from the furnace; the object being to obtain a fused mass in lumps that can be handled without loss, and will help to keep the furnace open. But the loss of both lead and silver is so considerable that only ores poor in lead, free from chlorides, and so fine as to be otherwise troublesome, are generally fused. In ordinary careful roasting, the average loss of lead is found not to exceed 5 per cent. of the amount present, one-half of which can probably be recovered in well-designed flues; while the loss of silver is mostly mechanical, and unless the ore contain chlorides, it does not exceed 1 per cent. of the amount present. In fusion, on the other hand, a loss of from 15 per cent. to 20 per cent. of the lead, and 3 per cent. of the silver may be anticipated.

The different kinds of ore available are carefully mixed so as to obtain uniformly fusible slags, this being the most important point of the whole smelting business. The rules generally observed are: (1) That the slag must never average above 40 per cent. of silica, only 32 per cent. being generally more satisfactory; (2) the total charge must contain enough lead to yield at least 10 per cent. of its weight as lead bullion; and (3) the bullion should not contain much more than 300 oz. of silver to the ton. Examples are given of the methods used in calculating the amounts of different sorts of ore which have to be mixed to produce a slag of the required composition, and of the modes by which the buying value is ascertained.

As illustrations of the lead concentration process, detailed descriptions are given of the El Paso Smelting Works in Texas, and of those of the Michoacan Company at Las Trojes, Mexico. The former works purchases any silver or lead ores offered by the public; but depends largely upon a supply of low-grade carbonates with considerable basic excess, from Sierra Mojada, Mexico; so that comparatively little of the ore requires roasting. The arrangements for sampling, and for the storage and mixing of the various types of ore bought, are very complete; but both labour and fuel are dear, so that the cost of smelting per ton of charge, amounts to 1*l.* 2*s.* 7*d.* The flue-dust is mixed with 5 per cent. of plastic clay, bricked, and resmelted, the cost of pugging and making the bricks being only 3 dols. per 1,000. At these works a novel flux has been introduced, in old tin cans, costing about 9 dols. per ton at the works. These not only provide a certain amount of iron which helps to clean the slags, but are of value in keeping the charge more open, and enabling more fine ore to be smelted. At Las Trojes the ore from the mines of the Michoacan Company is alone smelted; and being very pyritous, it has first to be roasted in open heaps or in stalls. As it is poor in lead, the direct cupellation process is adopted for treating the bullion, and the litharge so obtained is returned to the raw smelting furnace. Fuel costs about the same price as at El Paso, but labour is much cheaper, and water-power is available for producing a blast; the cost of smelting being 1*l.* 10*s.* 8*d.* per ton of ore, or 16*s.* 5*d.* per ton of charge, including a large amount of slag resmelted.

The extraction of silver and gold from their ores by the action of metallic copper has been hitherto little described, though in principle long known to metallurgists. The paper describes the process at present in use at the Torreon Mines, Chihuahua, Mexico, where self-fluxing oxidised ores containing as little as 5 or 6 per cent. of copper are smelted in one operation to pig-copper of 96 or 97 per cent., carrying practically the whole of the gold and silver; these being subsequently separated, and the copper refined by the electrolytic process. The furnace used is the ordinary 36 in. round water-jacket, such as is used for smelting the much richer copper ores of Arizona; and there being no loss of copper from volatilization, condensing-flues are not used. The slag contains normally about 40 per cent. of silica, and $1\frac{3}{4}$ per cent. of copper, which the author concludes is practically all in an oxidised and combined state. The relatively small amount of bullion produced makes the danger of "freezing" in the bottom of the furnace much greater, and the tapping more difficult, but does not seem to have any other evil influence. The fuel used for smelting is exclusively coke; charcoal being prohibitive in price, while experiments with coal have not proved encouraging, Notwithstanding its inferior quality and high price, (2*l*. 17*s*. 6*d*. per ton of 2,000 lb.) and the absence of water-power, the cost of smelting is only 1*l*. per ton of ore, or 18*s*. 6*d*. per ton of charge smelted.

In comparing the copper and lead concentraction processes, the former seems to have several advantages: the high rate of concentration possible, about 20 to 1 as opposed to 10 to 1 in the lead process, and the absence of loss in fumes, being the most important. But far fewer ores are suitable for it, 4 or 5 per cent. of sulphur being sufficient to "throw back" the whole product into the less valuable form of matte, while 1 per cent. of lead will damage the quality of the pig-copper produced. Moreover, the loss of copper in the slags is more serious than the corresponding loss of lead, owing to the greater value of the former metal.

The increasingly important process of concentrating the precious metals into a matte is left to be dealt with in a future paper.—J. H. C.

The Erection of Silver-lead Smelting-works in Mexico. J. W. Malcolmson, Proc. Inst., Civil. Eng., **112**, 1892–93, Part ii., 55–62.

The paper describes the erection of two rectangular water-jacket lead furnaces, of American make, at Las Trojes, Michoacan State, at an altitude of some 9,000 ft. above sea-level. The furnaces had a section at the tuyeres of 36 in. × 84 in., with a height from tuyeres to charging floor of 12 ft. 6 in.; each having an actual capacity of 90 tons of charge per 24 hours. They are supplied with air through five 3-in. Devereaux tuyeres, by which the inclination of the blast may be varied at will; the blast pressure being about 10 oz. per square inch. The furnace-gases are taken off by a 3-foot wrought-iron downtake, leading into a long flue 6 ft. × 8 ft. in cross section, which is ultimately to be carried up the hill to a height of 350 ft. The blowers, of which three are required for the two furnaces, are of the Baker type, each supplying 30 cub. ft. of air at atmospheric pressure per revolution; and all delivering into a 3 ft. wrought-iron air-main. They are driven by a 6-ft. diam. Pelton wheel, supplied with water under a head of 487 ft., through a 12-in. wrought-iron pipe, with a $2\frac{1}{2}$ in. nozzle, which delivers 350 cub. ft. per minute, and is calculated to develop 253 H.P.

The foundations for the furnaces were filled in with old slag, broken to pass through a 3-in. ring; while under the water-motor it was broken to pass a 2-in. ring, and thoroughly rammed. As some doubts were felt as to the stability of this slag-filling, a block of 840 cub. ft. of masonry was built under the Pelton water-motor, and similar blocks under the reserve steam-engines. The foundation blocks under the furnaces were 5 ft. thick, large stones being placed immediately under the cast iron columns which support the main weight of the structure. The lead well of the furnace has $\frac{1}{4}$-inch wrought-iron plates covering the sides and bottom, to prevent the soaking of lead into the foundations.

The ore smelted is a sulphide of iron and zinc, carrying 15 to 30 per cent. of silica, with sulphide and arsenide of silver. It is at present roasted in open heaps, from 5 to 8 per cent. of sulphur remaining in the burnt ore. This is mixed with nearly an equal weight of slag, and considerable amounts of litharge from the cupellation of the silver-lead, roasted matte, and lime flux, so that roasted ore forms only 40 per cent. of the entire charge. The fuel used is a mixture of 31 parts coke to 69 parts local charcoal, generally obtained from pine-wood; a furnace charge being 600 lbs. of ore mixture to 80 lbs. of fuel. The products of the smelting are "base bullion" assaying about 130 oz. silver per ton; iron matte assaying 20 oz. per ton, which carries about one-fifth of the silver of the original charge, and is roasted and re-smelted; and slag, assaying 1 to $1\frac{1}{2}$ oz., which is mostly thrown away; the loss of silver being finally about 5 per cent. The cost of smelting a ton of ore is between 1*l*. 17*s*. and 2*l*. 6*s*., and per ton of charge about 16*s*.—J. H. C.

The Magnetic Concentration of Iron Ore. H. S. Cleare. Tech. Quarterly 5 (1 and 2, 64–69).

The magnetic separation of iron ore has lately come into extensive use, as by its means low grade ores can be cheaply concentrated. As in all concentration previous sizing is requisite, which is effected by treatment of the ore in crushers followed by rolls and screens. The fineness attained depends on the size of the particles of magnetite as compared with those of the constituents of the gaugue. Crushing to pass a twenty mesh sieve generally suffices, but a finer product even small enough to pass a fifty mesh sieve is sometimes turned out. Such fine stuff can be used in the blast furnace but the expense of grinding is excessive. On account of this objection, and also of the fact that when the grinding is coarse, complete separation cannot be effected, it is usual in modern practice to crush the ore coarsely first and put it through a separator which yields tailings free from magnetite, several middle fractions containing some magnetite, and a pure concentrate consisting almost wholly of magnetite. The middle portions are then re-crushed and again separated, the cost of crushing the whole of the ore to the fineness necessary to allow of the removal of the smaller particles of magnetite, being thus saved.

The author describes a magnetic separator of his own invention, working either wet or dry, which is stated to work efficiently with various American ores. In the absence of an illustration no intelligible description can be given.—B. B.

PATENTS.

Improvements relating to the Treatment of Ores containing Blende or Zinc in Association with Gold, Silver, Lead, Copper, Antimony, Sulphur, and other Metals or Metalloids, and to Apparatus therefor. H. R. Lewis, London, and C. Gelsthrap, Newcastle-on-Tyne. Eng. Pat. 8467, May 4, 1892.

Complex ores containing zinc are roasted, preferably in a special furnace invented by the patentees (Eng. Pat. 6567 of 1892, *see* Provisional Specification) and the evolved sulphurous anhydride converted into sulphuric acid. This is then used for extracting zinc from the roasted ore, the solution of zinc sulphate being afterwards neutralised and electrolysed for the production of zinc. In the latter operation a porous diaphragm is used and the zinc solution is placed in contact with the cathode whilst the anode is surrounded with water in which is placed limestone or other alkaline earth or alkali to neutralise the acid as it is liberated. The cathodes are of carbon or lead, the anodes are of zinc and are made to revolve to ensure the absorption of the acid by the lime. Silver and copper are removed before electrolysis by means of zinc chloride and scrap iron, and iron is removed as ferric oxide by the addition of a small quantity of bleaching powder. If the zinc does not dissolve out easily from the calcined ore, the latter is placed around the anode in the electrolytic cell, the cathode being surrounded with water. If the ore is deficient in sulphur it is roasted with sulphate of iron. The patent also includes a description of the vats and electrolytic cells used.
—H. K. T.

Improvements in the Extraction of Gold and Silver from Ores or Compounds containing the same, and in Apparatus applicable for use in the Treatment of such Materials by means of Solvents. J. E. Montgomerie, Dalmore, Stair. Eng. Pat. 12,641, July 8, 1892.

These improvements relate to the cyanide process for extracting gold and silver, and consists in adding caustic soda to the solution of potassium cyanide, whereby the consumption of the latter is reduced, and in using the solution several times without extracting the precious metals, whereby its contamination with zinc is avoided. In using the solution in this way it is drawn off and sufficient water is added to the ore to make up the original bulk of liquid, the percolating liquor being added to the main portion. This is then tested for potassium cyanide and caustic soda and sufficient of these substances added to bring the liquor up to the original strength. After being used several times the gold is extracted, the washings from the ore being also treated. The improvements also relate to the use of a barrel for extracting purposes, having a lining of tiles secured by suitable cement and to a filter bed consisting of filter-cloth supported on wire gauge coated with a resisting enamel, the cloth being held between the upper and lower parts of the vessel.—H. K. T.

Extracting Gold from its Ores. F. W. Durham, New Barnet. Eng. Pat. 14,147, August 5, 1892.

In this process molten lead is used for extracting gold from its ores, instead of mercury. The lead is melted on a shallow hearth and the powdered ore is fed in at one end and carried forward as a film over the surface of the lead by means of an agitator moving over that surface. It is thus brought to the other end where it escapes through a hopper. In order to prevent oxidation of the lead, the chamber is kept filled with carbonic oxide from a gas-producer.—H. K. T.

A New Apparatus for Extracting Gold from Auriferous Alluvial Earth. S. S. Bromhead, London. Eng. Pat. 14,451, August 10, 1892.

The apparatus consists of "a series of troughs on an inclined plane closed by a sluice gate and grating, the said troughs being fed by means of a raised feeding way, along which run trucks or waggons; a series of sieves of the same number as the above-mentioned troughs; two or more large sieves furnished with brushes operated mechanically for cleaning the sieves and a channel for conducting the mixture on to the above sieves; agitators arranged at the lower extremity of the large sieves together with a series of troughs arranged in cascade in which suitable stirrers are employed." Alluvial soil is mixed with water in the troughs, and then runs through the first sieves to the common channel which conveys it to the larger sieves, whence it passes through the cascade of troughs which contain mercury. Any lumps which collect on the sieves are crushed in a mill and are examined for nuggets or scales of precious metals.—H. K. T.

Improvements in or relating to the Smelting of Zinc. E. Ruck and F. N. Raggatt, Swansea. Eng. Pat. 16,891, September 21, 1892.

In the smelting of zinc in the ordinary way a considerable amount of this metal escapes at the mouths of the retorts as fume, and is both injurious to the workmen and a source of loss. The improvements consist in the adaptation of hoods over the mouths of the retorts, connected with a flue through which the fumes are drawn by a steam jet or other means. The fumes are caught by means of canvas screens or by forcing the gases through water. Dampers are provided, which close the flues whilst the retorts are being emptied, so that the dust which is produced does not contaminate the recovered zinc oxide.—H. K. T.

Improvements in the Extraction of Gold and Silver from Ores or Compounds containing the same. J. C. Montgomerie, Dalmore, Stair. Eng. Pat. 16,894, September 21, 1892.

The improvements consist in the use of sodium dioxide, together with air pressure, in the extraction of gold and silver by the cyanide process instead of using oxygen pressure. In carrying out the process, potassium cyanide and caustic soda are dissolved in water, and the ore with admixed sodium dioxide added. Good proportions are 12 lb. of potassium cyanide, 3 lb. of sodium dioxide, and 9 lb. of sodium oxide to a ton of ore, containing, say, 4 oz. of gold and 12 oz. of silver.—H. K. T.

A Silver-Plating Compound. A. Culley, London. Eng. Pat. 17,081, September 24, 1892.

This is a plating mixture for silvering metals, including iron and steel, and consists of an amalgam of silver, nickel, tin, and copper, which is ground to a powder with ferrous carbonate and mixed, when required for use, with a paste made by mixing together ferrous carbonate, copper sulphate, nitric acid, and water. The patent is a development of a previous one (Eng. Pat. 6297 of 1891).—H. K. T.

Improvements relating to the Treatment of Complex Sulphide Ores. W. R. Ingalls and F. Wyatt, New York, U.S.A. Eng. Pat. 9817, May 16, 1893.

Complex sulphide ores are roasted and the evolved sulphurous anhydride converted into sulphuric acid in a vitriol chamber. The roasted ore is lixiviated with the sulphuric acid and the zinc precipitated with sodium carbonate. The solution of sodium sulphate is evaporated and heated with coal and a little common salt forming sodium sulphide and carbonic oxide. The former is dissolved and is led to the top of a tower whither the carbonic oxide is also conducted after being burnt to carbonic anhydride. The two react forming sodium bicarbonate and sulphuretted hydrogen. The bicarbonate is converted into normal carbonate and used for precipitating zinc. The sulphuretted hydrogen is burnt to sulphurous anhydride and converted into sulphuric acid. The zinc carbonate is converted into zinc oxide and carbonic anhydride. Any deficiency in carbonic anhydride required for the process is made up by burning lime-stone. The zinc oxide, lime and any excess of sulphuric acid are sold. The extracted ore is ready for the lead smelter.
—H. K. T.

Improvements in the Construction of Metallurgical Furnaces. C. James, Swansea, and W. Griffiths, Burry Port. Eng. Pat. 12,931, July 1, 1893.

These improvements consist in forming the bottoms of metallurgical furnaces used for smelting copper, lead, silver, &c., of an inverted arch of refractory bricks instead of the usual sand bottoms, whereby absorption of metal is avoided. The shape of the lining prevents the bricks from floating upwards through the molten charge. The bricks are grouted with the material of which they are composed and rest upon a non-conducting bed composed of two parts of coke and one part of fireclay.—H. K. T.

Improvements in Separating and Concentrating Apparatus. B. J. Atterbury and P. Ewens, both of London. Eng. Pat. 10,580, May 30, 1893.

See under IX., *page* 764.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Production of Oxygen and Hydrogen by Electrolysis of Water. P. Gareiti, Florence, Itali. Eng. Pat. 16,588, April 25, 1892.

Within the bath there is an inverted leaden case with partitions of sheet lead soldered together so as to form a case divided into parallel cells opened only to the water at the bottom. The partitions of the cells separate the anodes and cathodes which are placed alternately, and are insulated in the cells by means of combs made of any suitable material. Connection is made with the leads in suitable chambers at the bottom of the bath, and these chambers also serve to collect the gas.—G. H. R.

Process and Apparatus for the Extraction, Separation, and Refining of Metals by Electrolysis. D. Tommasi, Paris, France, Eng. Pat. 16,892, April 1, 1892.

The polarisation of the cathodes is prevented by making them in the form of discs of carbon, either alone or mixed with oxide of copper, and causing them to revolve so that their acting surfaces are alternately immersed and exposed to the air, and by subjecting them to continuous friction. The apparatus consists of a rectangular trough divided into compartments by a number of perforated rectangular containers placed a few inches apart and between which, the discs (or cathodes) which are mounted on a revolving shaft and only partially immersed, rotate so that every part of the acting surface shall be alternately exposed to the air and to the electrolyte. Each disc is caused to pass between two friction brushes which not only remove the bubbles of hydrogen, but also the metallic deposit. In treating ternary alloys such as, for example, in extracting silver from argentiferous slags or skimmings in which two metals (say lead and zinc) may precipitate simultaneously upon the cathodes it is necessary to place metallic bars or discs on each side of the cathode discs so as to precipitate one of the two metals. These bars are not traversed by the current. The baths are varied according to the operation to be performed and in the case of the extraction of silver from pig lead, or argentiferous slags baths of a composition which is given are recommended.—G. H. R.

Process and Apparatus for the Extraction, Separation, and Refining of Metals by Electrolysis. D. Tommasi, Paris, France. Eng. Pat. 16,893, May 21, 1892.

This patent relates to the cathode disc referred to in the foregoing specification. The disc is composed of sector-shaped segments whose edges are tongued and slide in grooves in their supporting arms, which are made of insulating and unattackable material fixed to an insulating hub keyed on the shaft. There are grooves in the lateral faces of the arms to receive the tongues on the edges of the segments, which are held in place by strips of insulating material or screws. A metal strip pressed against the inner ends of the segments by means of springs connected to the conducting axis of the disc makes contact.—G. H. R.

Improvements relating to Electric Accumulators or Secondary Batteries, and to the Manufacture of Plates or Electrodes therefor. A. J. Smith, Kingston-on-Thames. Eng. Pat. 14,658, August 13, 1892.

The improved method or process of manufacturing plates or electrodes consists in repeatedly covering or coating a metal sheet or plate with the metallic oxide and driving or kneading such oxide into the metal by means of pointed rods or needles.—G. H. R.

Manufacture of Caustic Soda and Potash and Hydrochloric Acid by Electrolytic Treatment of Chloride of Sodium and Chloride of Potassium, and Apparatus for this Purpose. J. P. Roubertis, Bordeaux, V. Lapeyre, Paris, and N. Grenier, Ponyaud, France. Eng. Pat. 15,113, August 22, 1892.

See under VII., *page* 762.

An Improved Process of and Apparatus for the Electrolytic Decomposition of Alkaline Salts. H. Y. Castner, London, Eng. Pat. 16,046, September 7, 1892.

The invention consists in the employment of a mechanically moving body of mercury or other liquid metal or alloy between the anode and cathode compartments of a decomposing cell, so arranged as to completely separate the materials therein, and so placed that the current in its passage through the cell, from the actual anode to the actual cathode, must pass into and through the moving metal. Thus while the alkaline metal is being deposited in such liquid metal in the anode compartment and like amount of the alkali metal is being set free in the cathode compartment, thereby reducing the counter electromotive force, and rendering it possible to carry on the electrical action continuously with a very high current density, and yielding at the same time, where water is used in the cathode compartment, a solution of pure caustic of any desired strength. It is necessary that some sodium should be present in the mercury, and the best proportion and the means by which this may be maintained in it are described.
—G. H. R.

Improvements in the Production of Easily Separable Metallic Deposits. C. A. Netto, J. Pfleger, and L. Hausmann, all of Frankfort-on-the-Main, Germany. Eng. Pat. 17,918, October 7, 1892.

According to this invention the plates or moulds, coated with nickel or made of alloys of nickel, constitute the cathodes upon which the deposit is produced, the object being to render the surface of such plates perfectly smooth and thus avoid the necessity for subsequently polishing them. The plates or moulds are treated with oxidising agents, preferably chromic salts or salts of manganese, by which means all the pores of the surface are filled up and easily separable deposits of from ·001 to ·002 of a millimetre in thickness may be produced.—G. H. R.

Improvements in Secondary Batteries. F. King and E. Clark, London. Eng. Pat. 17,922, October 7, 1892.

According to this invention grids, retainers, or supports are prepared having perforations or interstices of any suitable form, but with pins or projections protruding from the inner walls of the perforations towards their centres, and curved round or inclined at an angle to the sides or faces of the grid or support so as to form a claw-like arrangement to engage and retain in position the active material without distortion of the plate by its expansion.—G. H. R.

Improvements in Secondary Batteries. F. King, London. Eng. Pat. 24,127, December 31, 1892.

According to this invention the plates (preferably the pure or spongy lead plates or plates of like denomination) are provided with ribs or pins projecting from their surfaces, a distance slightly less than the distance apart at which the plates are to be maintained. At the outermost face or edge of the projections are placed pieces or strips of insulating and acid resisting substance, which is held in position against the opposing plate by the projection, and is preferably so shaped as to deflect away from the rib or pin any material resulting from the exfoliation of the surfaces of the plates.—G. H. R.

An Improved Enamel. J. M. F. Alber, Hamburg, Germany. Eng. Pat. 7500, April 12, 1893.

The enamel is designed for insulators, which can be made of sheet iron coated with the patented material. The following prescription is adopted in about the proportions specified:—

	Parts by Weight.
Calcined silica	8—10
Borate of soda	5—7
Clay	1·2—5
Arseniate of soda	0·1—3
Precipitated phosphate of lime	0·1—3
Nitrate of soda	0·2—3

—B. B.

A Method of and Apparatus for Coating Large Surfaces with Copper. T. S. Crane, East Orange, U.S.A. Eng. Pat. 10,620, May 30, 1893.

By this invention, an object like the hull of a large iron ship, which cannot be immersed conveniently in a bath of electroplating solution, is provided with an integral coating by depositing the metal upon definite portions or sections of the surface successively, and causing the deposits to overlap upon one another.—G. H. R.

Improvements in Electrolytic Apparatus. T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 11,105, June 6, 1893.

The apparatus consists of a number of cells arranged upon different planes, each cell composed of separate cathode and anode compartments, connected at the base through a hollow trunk, and an upward and downward extending elbow connection for each compartment, at a point above the space to be occupied by the liquid, whereby the joints formed in connecting the vessels are not submerged. The like compartments of the cells are connected in series by elbow connections, and the supply pipes are controlled by valves.—G. H. R.

Improvements in Electrolytic Cells. T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 11,106, June 6, 1893.

The electrolytic cell consists of a vessel containing the cathode, of a combined anode and diaphragm consisting of perforated holders filled in between with non-decomposable porous material, such as asbestos. The inner holder is filled with particles of carbon, the upper portion of the outer is perforated and the conducting wire is embedded in a carbon pencil.—G. H. R.

Improvements in Electrolytic Apparatus. T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 11,107, June 6, 1893.

The apparatus consists of a series of electrolytic cells containing the liquid to be electrolysed, and each divided into two compartments through a porous medium composed wholly or partly of the solid body of the salt to be electrolysed. The anodes and cathodes are enclosed in their respective compartments, and feed and discharge connections into and from the cathode compartments of the cells, containing them in series, provide for a flow of the liquid.

—G. H. R.

Improvements relating to the Electrolysis of Salts and to Apparatus therefor. T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 11,108, June 6, 1893.

The improvement consists in an electrolytic cell having separate anode and cathode compartments, each provided with a separate system of supply and discharge adapted to maintain the liquid in the respective compartments in a uniform condition during continuous working. Like compartments of the cells are connected in series, and there are separate connections for supplying fresh liquid in regulated quantities into the first compartments and for discharging it from the last.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

The Oil-Producing Plants of Formosa. Alex. Hosie. Consular Rep. No. 11, 1893.

Oil-Producing Plants.—Since the introduction of kerosene oil into China the demand for native lighting-oils has been on the decline, but for cooking purposes some of these oils are produced in large quantities. Oil-yielding seeds are likewise exported, to a limited extent, to foreign countries, where the oil is extracted and used to adulterate more valuable oils.

Of the 17 oil-producing plants cultivated in China eight grow in Formosa. They are:—

1. *Dolichos soja*, L. (?).—More oil is extracted from this bean than from any one of the other oil-yielding plants of China. The two kinds of bean treated for oil are small in size and oval in shape, one having a whitish-yellow epidermis and interior, the other being green throughout. They are probably sub-varieties of the *soja* bean. The process of extraction is worthy of description.

The beans are first crushed under a huge stone wheel. They are thus flattened into thin round wafers, and are crushed a second time before they are ready for further manipulation. After the second crushing, bean wafers sufficient to make a cake 4 inches thick and 2 feet in diameter when compressed, are put in a square piece of sacking, and placed on a wooden grating above a cauldron of boiling water. In a few minutes they are rendered quite soft by the steam, which passes up through the grating to the sacking and its contents. During the process of steaming, another workman has been arranging a series of soft straw brooms, which are also steamed, so as to form the bottom of a couple of narrow metal bands surmounted by a wooden casing, over which the long tips of the straw broom project. Into this the steamed beans are poured and trampled down by foot till the mass is quite hard. The projecting straw tips are then brought over the top of the beans by foot, and trampled down so as to form a covering. The wooden casing is removed, and the metal bands arranged a short distance apart near the top and bottom of the cake respectively. The whole is then put into a primitive wooden press, and subjected to considerable pressure by the driving in of successive wedges. The oil is expressed and drains into an underground tank, the top of which is on a level with the stone-guttered slab on which the lowest cake rests, for half-a-dozen cakes, one above the other, may be undergoing pressure in the same press at the same time. When all the oil has exuded from the cakes, they are taken from the press, the metal bands and straw casings are removed, and, after being left to dry for a time, they are ready to be shipped to other parts of China for manure. The beans yield about 10 per cent. weight of oil, and the cakes, when removed from the press, weigh some 64 lb., and are worth about 2*s.* 9*d.* each. They constitute a very valuable manure, and are carefully macerated before being applied to the soil.

To show the commercial value of this industry, the author mentions that 60,000 tons of bean cakes were exported from Chefoo during 1890. Nor is Chefoo the principal exporter. Newchwang sent out over 156,000 tons in the same year. In Formosa these beans are grown, and the oil is extracted in the above manner, but only in quantities sufficient to meet local requirements. The refuse cakes are not exported. The oil is used for both cooking and lighting purposes.

2. *Brassica Chinensis*, L.—Rape is usually a winter crop in China. Towards the end of October the seeds are planted about a foot apart in beds; in March the plants are in full flower, and in early June the crop of seeds is harvested. This refers to Mid-China, where the temperature is mild and the frost is not so severe as to retard sowing till after winter. It is more widely cultivated in China than any of the other oil-yielding plants. The seeds are treated much in the same way as beans, being crushed, steamed, and subjected to pressure. Like the preceding, rape-oil is used for lighting as well as for cooking.

3. *Sesamum Indecum et Orientale*, D.C.—Both the white- and black-seeded varieties of sesame are cultivated in China, and from Formosa there is a very considerable export of seeds which find their way to France, where sesame is largely used to adulterate olive oil. It is a summer crop; the seed is sown in May, usually in rows with other crops, such as cotton on the mainland; the plant blossoms in July, and the harvest takes place in September and October. Sesame is essentially a food oil. Refuse seed-cake is much used in Formosa for adulterating opium.

4. *Arachis hypogæa*, L.—The ground-nut, a native of Africa, is extensively cultivated in China, not only for the food which the nuts supply, but also for the oil which they contain. Although the Chinese have not yet discovered a good practical method of removing the shells before pressing, yet the oil, necessarily impure on that account, is highly appreciated as a food, as well as a lamp oil. To obtain the oil, the nuts are roasted, rolled, winnowed—to get rid of the shells—steamed, and pressed. The plant prefers a sandy soil, such as is found in the neighbourhood of Chefoo, but it appears to be equally at home in Western China and in Formosa. The author states that these nuts are found on every roadside stall in China.

5. *Stillingia sebifera*, S. and N.—From the seeds of the vegetable tallow tree, both tallow and oil are produced. They are used for lighting purposes only, and as the method of extraction is ingenious a short description thereof may be of some interest. When the fruit is ripe the dark brown protecting covering which encircles each seed opens and falls to the ground, leaving exposed bunches of greyish-white berries, which resemble coffee-beans in appearance and size. These are collected by hand, steamed, and thereafter pounded in an ordinary rice trough. By pounding, the soft mealy mesocarp is partially separated from the kernels. The whole is then placed in a bamboo sieve, the meshes of which are just large enough to allow the mealy matter to be scrubbed through, and small enough to keep back the kernels, which are hard, black, and about the size of peas. From the mealy substance the tallow is expressed in primitive wooden presses. The oil is derived from the kernels in the following manner. They are dried in the sun and passed between two millstones held at such a distance apart, by means of a bamboo pivot, as to crush the hard shells of the kernels without injuring the white interiors. The whole is then passed through a winnower, which separates the broken shells from the solid matter. The latter is thereafter placed in a deep iron pan over a fire, the crushed oily shells making an excellent fuel, and roasted till it begins to assume a brownish colour, the process being accompanied by continual stirring to prevent burning. It is then crushed by a huge stone roller in a circular stone well, steamed, made into cakes, like cheeses, with bamboo and straw casings, and passed through the wooden press. The resultant is a good lighting oil of a brownish-yellow colour.

In Formosa this tree is utterly neglected, but in the great centres of tallow and oil manufacture in China it is grafted, and consequently yields superior fruit.

6. *Camellia thea*, Link.—In all the tea-growing districts throughout China, the seeds of the tea-plant not required for raising new bushes are collected and treated for their oil, which is employed for both food and lighting.

7. *Cinnamomum camphora*, N. and E.—Although the camphor laurel is found in many of the provinces of China, where it is highly valued on account of its wood, yet Formosa is the only province in which camphor is manufactured. When the camphor is being distilled from the chips of camphor-wood an essential oil exudes and drops into the boiling water underneath. This, as well as the liquid which exudes from the camphor when awaiting shipment, is collected and exported under the name of camphor oil.

8. *Ricinus sp.*—The castor-oil plant grows wild throughout Formosa; but in the north of the island oil is not extracted from the seed, nor is any use whatever made of the plant. In the south a little oil is extracted for purely local uses, but no attempt is made to cultivate the plant. This species, which has green stems and leaves, does not attain the height of *Ricinus communis*, which is distinguished by its purple stems, branches, and leaves. The latter, grown from imported seed, may be seen as an ornamental shrub in gardens near Tamsui.

Diospyros kaki, L. f., grows in Formosa as well as on the mainland. The juice of its fruit should be classed as varnish and not as oil.

The Castor Bean in India. Reports from the Consuls of the United States, **42**, [153] June 1893, 163—171.

Numerous varieties of the castor oil plant (*Ricinus communis*) are met with in India, all of which however may be classed under two main types. The one of these represents a tall bush or small tree and is a perennial, grown as a hedge plant, whilst the other is an annual plant grown either as a crop or more frequently in rows or lines through fields containing other crops. Large seeds, yielding an abundance of an inferior oil are obtained from the tree-like plant whereas the annual produces a small seed from which the finer qualities of oil are derived. The primitive methods for the cultivation of the soil in vogue in India are also applied to the raising of the castor oil plant. The crop is very seldom irrigated, and usually depends upon the rainfall. Six month's growth are necessary before the capsules form and the picking of the seed commences in the seventh and terminates in the ninth month. The seed pods are stacked in a corner of a house, covered with straw and compressed by weights to exclude the air and bring about the softening of the capsules. This takes place after six days, whereupon they are dried in the sun and the seeds loosened by beating with a heavy wooden mallet, any seeds remaining in the husks being obtained by a repetition of the processes of drying and beating.

While in most parts of India the different varieties of the castor bean are simply designated the large and the small, three kinds seem to be generally distinguished in the presidency of Bengal, namely the "Chunaki" (small size) the "Gohuma" (middle size) and the "Jagia" (large size). The first of these is planted without previous preparation of the land and no further care is bestowed upon the crop. The stems reach a height of from 10 to 12 feet. The Gohuma variety, considered the best, and cultivated with greater care than the former kind, grows only 6 feet high. Jagia is generally sown with Indian corn. Chunaki seeds are bright black, dotted with gray. Gohuma seed somewhat resembles wheat in colour, and Jagia seed is red and slightly flattened. The treatment of the fruits after harvesting consists in allowing the pods to rot in small trenches with water or liquid manure and then proceeding to release the seed in the manner already described. The processes of extracting the oil differ somewhat in different districts. The following methods are in use in the Madras Presidency.

1. After having been roasted in a pot and pounded in a mortar, the seed is boiled with four times its volume of water with frequent stirring with a wooden spoon. After a time the pot is removed from the fire and the oil skimmed off. From the residue, by a second boiling, a further quantity of oil is obtained superior to that of the first boiling.

2. The seed is first boiled, then dried in the sun, and heated as in the first process.

3. The seed, after soaking in water over night, is crushed in the ordinary native oil-mill and then squeezed between folds of cloth.

In Bengal the seeds are partially roasted in a pan and pounded in a mortar, without being husked, the oil being extracted by boiling with water in a manner similar to that already described. The oil obtained is freed from moisture and impurities by boiling in a separate pan.

These defective native methods have been supplanted to some extent by European processes, in which machinery is employed. Thus in one of the manufactories at Calcutta a very pure medicinal oil is obtained by careful cleaning of the seed by hand, breaking in the crushing machine, and subsequent cold-pressing in hand presses. The oil is bleached and purified by exposure to the sun in galvanised iron vats, careful boiling, treatment with charcoal, and filtration through flannel or paper. A second quality is made by hot-pressing the seed treated as in the previous case. This oil, without being filtered, is exported in large quantities. A third quality is derived from the seed husked by machine, which is less clean and therefore lower in price. Previous to being crushed the seed is invariably exposed to the sun, this being essential for the removal of moisture and the liquefaction of the oily matter. The boiling of the oil is conducted with great care in copper pans (sometimes with the addition of from $\frac{1}{8}$ to $\frac{1}{5}$ part of water), and is the most delicate part of the whole process of manufacture, the length of the operation being a matter of judgment based upon experience.

The uses to which castor oil is generally put in Europe are well known. In India it is much used for burning in lamps, for it gives a light surpassing in brilliancy that obtained by means of any other vegetable or mineral oil, and possesses the further advantage of great safety and freedom from smoke in burning. It is also largely used as a lubricant for machinery, as a dressing for hides and skins it enjoys an excellent reputation, and the Indian dyers also make frequent use of it. The press cake forms a useful manure, and is a very good material for making illuminating gas. Gas thus made is used at the Allahabad East Indian Railway station. In Assam the leaves of the plant furnish food for the silk worm and good paper pulp can be made from its bark.—K. E. M.

Pigmy Coco-Nuts. E. Kinch. Agrl. Students' Gazette, New Series, **6**, 103—105.

This nut is the fruit of the *Coquito* or honey palm of Chili (*Jubæa Spectabilis*). In size it is rather larger than a cob-nut; the average weight of individuals in the sample analysed, which was rather dry and had lost its milk, was 5·87 grms. The shells constituted 56·7 per cent. of the sample. The kernels contained 5·15 per cent. of moisture, the composition of the dry matter being given in the following table, where it is compared to that of the kernels of the shop coco-nut (*Cocos Nucifera*), which contained 5·81 per cent. of moisture:—

—	Jubæa Spectabilis.	Cocos Nucifera.
	Per Cent.	Per Cent.
Albuminoids	7·75	9·43
Fat	71·38	71·13
Soluble carbohydrates	15·22	13·21
Fibre	4·67	4·31
Ash	0·98	1·92
	100·00	100·00

It is thus seen that the composition of the large and the pigmy coco-nuts is almost identical, and it is suggested that should the pigmies be obtainable in large quantities they might be advantageously crushed for oil and cake for cattle food. The proportion of husk to kernel is, however, much larger in the case of the pigmy nut.—A. G. B.

PATENTS.

A Detergent Composition for Laundry, Washing, or other Purposes. B. Pitt, Bristol. Eng. Pat. 14,896, August 18, 1892.

The detergent is made by mixing ammonia and turpentine with a hot or cold solution of ordinary soap in water, or "the materials of which soap is composed."—J. L.

An Oil-Testing Apparatus for Ascertaining the Frictional Co-efficient of Oils and Fats. G. Thomas, Manchester. From A. Stauber, Leipzig. Eng. Pat. 15,270, August 25, 1892.

See under XXIII., *page* 786.

Improvements in Tallow Melting or Rendering. W. J. Fraser and T. Cassiénet Palmer, London. Eng. Pat. 8710, May 1, 1893.

Previous to being introduced into the melting apparatus the raw fat is subjected to a treatment with diluted sulphurous acid whereby the membranes are caused to swell and loosen, and the fat is freed from blood and putrid matter. The rendering of the fat thus treated and thoroughly washed with water can be accomplished without the evolution of the nauseous gases peculiar to the old method.—K. E. M.

Improvements relating to the Treatment of Oils for Imparting Drying Properties thereto. H. H. Lake, London. From W. N. Blakeman, Mount Vernon, U.S.A. Eng. Pat. 9291, May 9, 1893.

The inventor imparts drying properties to fatty oils, both the "non-drying" and the "drying" oils, by rendering them capable of absorbing carbon dioxide. The oils are said to dry rapidly by the absorption of this gas, either when they are used alone or as pigment vehicles.

To carry out the process the inventor imparts to the oil an alkaline or basic reaction, by the addition of an alkaline or basic agent (preferably an alumina soap or basic acetate of lead) and then incorporates with it a chemical agent "having an affinity" for the oil (metallic oxides or salts), and lastly mixes it with chemicals having an affinity for carbon dioxide. As an example, the treatment of cotton-seed oil may be given. The inventor dissolves in cotton-seed oil about 5 to 8 per cent. of alumina soap; 20 parts of oil rendered basic or alkaline; 20 parts of basic acetate of lead are then incorporated with the oil, and finally three parts of magnesium borate are added. On stirring into the mixture 20—30 parts of any pigment, a quick-drying liquid paint is said to be obtained. This method of preparing drying oils, in the opinion of the patentee, will supersede the present method of boiling oils with metallic oxides, on account of the rapidity of the process and because of its being carried out in the cold, thereby giving a better coloured product than can be obtained in the case of boiled oils. However, the inventor claims also, that the oils may be boiled in the usual manner previous to their being subjected to the above-described operations.—J. L.

Improvements relating to the Treatment of Drying Oils for Thickening the Same. H. H. Lake, London. From W. N. Blakeman, Mount Vernon, U.S.A. Eng. Pat. 9292, May 9, 1893.

The patentee dissolves 20 to 30 per cent. of a metallic soap (alumina soap) in cotton-seed oil, and mixes from 5 to 7 per cent. of this thickened oil with a drying oil with or without further application of heat.—J. L.

Process for the Manufacture of New Soaps containing Sulphur in Chemical Combination. J. Wetter, London. From J. D. Riedel, Berlin, Germany. Eng. Pat. 10,707, May 31, 1893.

This process consists in heating oils and fats containing fatty acids of the unsaturated series or the fatty acids themselves (oleic acid, linoleic acid, &c.), or resin acids with sulphur, to a temperature of 120° C. to 160° C., whereby sulphur is absorbed, forming, with the fats or otherwise, fatty acids, "thio-fats," that is to say, "thio-acids." These fats or fatty acids are converted into soaps by the cold process. The soaps thus formed are called "thiosapoles."—J. L.

Improvements in the Art of Treating Cotton-seed, Linseed, and other Vegetable Oils. G. Washington Scollay, New York. Eng. Pat. 11,034, June 6, 1893.

The vapour produced by heating cotton-seed, linseed, or other vegetable oils to about the boiling point is heavier than air and remains on the surface of the oil. On continuing the boiling the vapour combines with the oxygen of the atmosphere to form acrolein. This substance, being at that temperature in its gaseous form and lighter than air, immediately escapes, causing the slow process of boiling to be also a disagreeable one. By removing the vapour before its conversion into acrolein the process is said to proceed quicker and without the production of an offensive odour or discoloration of the oil. The apparatus used consists of a tank furnished with a cover with a spout attached thereto, and is suspended on pivots. The cover is provided on the under side with a marginal trough enclosing a cooling coil, through which water flows, and is hinged to the tank where the spout is attached. There is a tipping arrangement for inclining the tank and a parallel twin-link connection between tank and spout by means of which the inclination of the latter can be maintained constant. The vapour passing upwards is condensed in the trough of the cover and flows out through the spout. By tipping the tank the level of the oil can always be kept near the cover, which latter remains parallel with the surface of the oil.—K. E. M.

Improvements in the Method of Refining Vegetable Oils. G. Washington Scollay, New York. Eng. Pat. 11,035, June 6, 1893.

This method is founded upon the observation that linseed oil first becomes lighter in colour when heated, and that the well-known darkening produced by continued heating can be avoided by interrupting the heating process so soon as the point of bleaching is reached. The more rapid the rise of the temperature to this point and the more rapid the subsequent cooling the better the result. The process, which is applicable to other oils beside linseed oil, is conducted in an apparatus consisting of a tank to which a pipe is attached leading downwards and passing through a sand-bath or other device for maintaining an even temperature. The oil is kept under pressure and flows in a constant stream through the pipe in the sand-bath, being thereby heated to from 615° to 630° F. On leaving the sand-bath the oil rapidly cools, but is, whilst still hot enough to allow the aqueous vapours to escape (derived from the mucilage), run into the settling tanks.—K. E. M.

Improvements in Naphtha Soap and in the Method of and Apparatus for Producing such a Soap. E. W. Stanton, U.S.A. Eng. Pat. 12,116, June 20, 1893.

Naphtha is incorporated with saponifiable materials and the mixture, either before or after treatment with alkali, is heated to ebullition in a vessel provided with a condensing arrangement to prevent the escape of volatile components. Good results are said to have been obtained with the following mixture:—100 gallons of naphtha ("at 65° gravity"), 750 lb. of pulverised resin, 100 lb. of caustic potash dissolved in limewater and reduced to 60° B., 100 lb. of caustic soda in solution at 38° B.—K. E. M.

An Improved Cleansing Medium. J. Schicht, Aussig a/E., Austria. Eng. Pat. 12,593, June 27, 1893.

Benzine and turpentine are incorporated with a strong soap-lye possessing the capacity of remaining fluid at a temperature below the boiling point of these solvents. A little pine resin and colophony are added afterwards to prevent the separation of the solvents from the soap, and partial or complete saponification and formation of a thorough emulsion is brought about by the addition of a solution of an alkali or ammonia. "Any quantity of alcohol may be added to the emulsion."—K. E. M.

Improvements in and relating to the Manufacture of Material applicable as a Waterproof Covering for Roofs and other such like Purposes, or as a Substitute for Glass. W. Noel Hartley, Dublin, and W. E. B. Blenkinsop, Wandsworth Common, Surrey. Eng. Pat. 13,825, July 29, 1893.

The drying oil prepared by the inventors' processes (Eng. Pat. 11,629, 1890, and Eng. Pat. 7251, 1891; this Journal, 1891, 263; and 1892, 170, 445) is used for covering and closing up the meshes of wire gauze previously tinned, varnished, or dipped in paraffin wax or similar material. The colouring yellow of the film by the action of the iron is thus prevented and a colourless, transparent, and waterproof material is obtained.—K. E. M.

Improvements in Presses for the Expression of Oil or other Liquids from Substances containing the same. G. Mitchell, Dalswinton, Dumfries. Eng. Pat. 16,259, September 10, 1893.

In this hydraulic press the press-boxes for containing the seed are arranged horizontally and slide upon the stay-bolts in the same manner as the plates of a filter-press. The boxes are of such construction that by means of draw-bars of a special form and operated by the ram, they are alternately opened for being charged with material to be pressed, and closed or brought into contact with each other when the pressing commences. The seed is fed in from a hopper trolley running on rails above the press. The press-cake is discharged through holes in the sole-plate located directly under the spaces formed between the boxes in their extended position. A sliding plate is provided, which closes these holes during the introduction of the seed, and from which the oil runs off into suitable conducting channels. The boxes are provided with passages for steam.—K. E. M.

Improvements in and relating to the Recovery of Soap and Suint from Wool Grease. W. Mills, Glasgow. Eng. Pat. 16,767, September 20, 1893.

Soap and suint or lanoline are separated by adding to the grease (100 parts) contained in a vessel heated by steam a solution of potassium carbonate or borax of about 8° Tw. (300 parts) and boiling for about six hours. After settling, the vessel is heated by direct fire and a solution of sodium hydrate (25 parts) added at a strength of 30° Tw., the mixture being boiled for three hours. The suint rises to the surface as a sticky, pasty scum as soon as the fire is drawn, while underneath it remains a pure, dark-coloured "oleine soap," which, by boiling down and the addition of small quantities of potassium hydrate (35° Tw.) and mixing with pale soap (5 parts) and cocoa-nut oil soap (2½ parts) or olive soap (5 parts), is converted into a marketable product.—K. E. M.

Improvements in or relating to the Production of Neutral Wool Grease from Suint or Wool Washings. J. C. Lahusen, Bremen, Germany. Eng. Pat. 17,230, September 27, 1893.

The water from the wool-washing machines is, after separation of the coarser portions of the matter suspended in it, treated with a solution of calcium or magnesium chlorides containing sufficient free acid to exactly neutralise the alkaline carbonates in the wash liquor. The fatty acids are thus precipitated as insoluble salts and the wool-fat is carried down by the latter. After running off the surplus water, the precipitate is subjected to a washing process in large tanks with pipes placed at the bottom for the even distribution of the water. The latter rises through the precipitate in a slow current and carries away with it the specifically lighter portions of the wool grease, which, on account of their possessing a very low melting-point and being particularly well adapted for some purposes, it is specially desired to obtain. By raising the specific gravity of the washing water by the addition of neutral salts to 1·025—1·040 the process of washing out the fat may be facilitated. From the wash liquor, which contains only neutral grease free from soap, the latter is separated by filtration or extraction with benzine or ether. The grease obtained by the process described is distinguished from any similar product at present in the market by its low melting-point (25° to 36° C.).—K. E. M.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

The Physical Properties of the Copal Resins. M. Bottler. Dingl. Polyt. J. 283, 21—22.

The copals examined were: Hymenæa Copal (South America), two samples, Congo Copal, Sierra Leone Copal, Pebble Copal from Sierra Leone, White and Yellow Benguela Copal, White and Red Angola Copal, Zanzibar Copal, Yellow Manila, and Kauri Copal. A determination of the specific gravity gave the following figures:—

—	Bottler.	Earlier Authors.	
I. Hymenæa Copal B.........	1·070	1·082	..
II. Yellow hard Manila........	1·069	1·121	1·062
III. Red Angola and Hymenæa A	1·068	1·081	1·064
IV. Pebble Copal from Sierra Leone.	1·067	1·09	..
V. Yellow Benguela...........	1·065	1·062—1·081	..
VI. Sierra Leone...............	1·064	1·06	..
VII. Zanzibar....................	1·0321	1·068	1·067
VIII. White Benguela............	1·0593	1·062—1·081	..
IX. Congo.......................	1·0480		
X. Kauri.........................	1·0456	1·109	1·050
XI. White Angola..............	1·035	1·062—1·081	..

Nos. VII., VI., IV., III. being hard copals, V., VIII., IX., X., XI., II. soft copals, and I. and III. the softest of all, it follows from the above figures that generally the hardest copals are also the lightest. The cause of this was found in the fact that the softest copals are richest in enclosed air. The hardness of the hardest copals is slightly less than that of rock-salt. Arranged according to their hardness, beginning with the softest, the following grouping results:—1. Hymenæa A; 2. Hymenæa B; 3. Kauri; 4. White Angola; 5. Manila; 6. Congo; 7. White Benguela; 8. Yellow Benguela; 9. Sierra Leone; 10. Pebble Copal from Sierra Leone; 11. Red Angola; 12. Zanzibar. The melting-points of these copals were found as follows:—

—	° C.	Specific Gravity Figures.	Solubility.
I. Hymenæa A.........	90	III.	VIII.
II. „ B.........	95	I.	VI.
III. Yellow Manila.......	145	II.	II.
IV. Kauri.................	150	X.	III.
V. Yellow Benguela.....	180	V.	VII.
VI. White „	185	VIII.	X.
VII. Congo................	190	IX.	IV.
VIII. Sierra Leone.........	195	VI.	V.
IX. Pebble Copal.........	230	IV.	XI.
X. White Angola........	245	XI.	I.
XI. Zanzibar.............	275	VII.	XII.
XII. Red Angola..........	315	III.	IX.

In the third column of these tables a scale of the solubility of these copals is given, the solubility decreasing from I. to XII.—C. O. W.

Experiments on the Decolorisation of Oil of Amber. A. Jolles. Dingl. Polyt. J. 283, 22.

Amber-oil is a product of the dry distillation of amber, and consists, in its crude state, of a mixture of water, succinic acid, and oil of amber. On standing it separates into three layers, the lowest consisting of water, the next containing the bulk of the succinic acid, whilst the upper layer contains the oil of amber. By drawing off the oil thus collected it is obtained as a dirty brown, fluorescent liquid, possessing a nauseating odour. It is insoluble in water, but soluble in alcohol, ether, benzene, and many other solvents. The oil is scarcely acted upon by dilute mineral acids, but concentrated sulphuric and nitric acids react violently with it. By the action of nitric acid much succinic acid is produced, and an orange-coloured resin possessing a strong odour of musk is produced, which is used as an "artificial musk." Reducing agents have no effect upon amber-oil. Treatment with animal charcoal and other decolorising agents do not in the least improve the colour of the oil. In distilling oil of amber, first water, then a yellow oil, followed by a green oil, and lastly a dark green oil, is obtained. The temperatures during distillation range between 150° and 360° C. A tarry matter remains behind amounting to about 15 per cent. of the crude oil used. The distillates obtained still possess the repugnant odour of the original oil. By carrying out the distillation, however, in a current of steam, almost odourless distillates are obtained. These distillates can be bleached by adding to them about 8 per cent. of permanganate of potash or bichromate of potash, together with the required quantity of dilute sulphuric acid. The oil is then left to separate from the water, the latter is drawn off, the oil completely dehydrated by addition of common salt or plaster of Paris, and then filtered. In the bleaching from 7 to 9 per cent. of the oil are lost.—C. O. W.

The Technical Application of Kauri and Manila Copal. M. Bottler. Dingl. Polyt. J. 287, 88—90.

Although Kauri and Manila copal have been in the market for some time, only small quantities of them are used at present for manufacturing purposes, no doubt owing to the fact that their properties are still very little known. Kauri copal is obtained either from *Dammara australis Don*, occurring in New Zealand, or from *Dammara ovata Moore*, a native of New Caledonia. The resin is obtained in the form of angular or globular lumps. It begins to soften at about 55° C., melts at about 150° C., and begins to decompose at 200° C. The specific gravity at 15° C. is 1·0456. Manila copal is obtained from *Vateria indica*, and forms large, irregular-shaped lumps of a yellow or brownish-yellow colour. It begins to melt at 105° C., and melts completely at 140° C. Its specific gravity at 15° C. is 1·069. To test the solubility of copals they are treated with various solvents in the dry, roasted, and molten state. The copals are finely powdered, and at a temperature of from 15° to 20° C. exposed to the air. For roasting them they are treated for 48 hours at a temperature of from 40° to 50° C. For melting them funnel-shaped vessels of copper are used, which are provided with a perforated bottom. The vessel is heated by placing charcoal round it and the molten copals are allowed to drop into a mortar placed underneath the copper vessel. The molten copal is subsequently powdered and exposed to the air for a week. The copals so prepared are then mixed with an equal quantity of powdered glass and tested with various solvents:—Absolute alcohol (sp. gr. 0·795), equal parts of absolute alcohol and amyl alcohol (b.p. 130° C.), dry ether (sp. gr. 0·728), ether-alcohol, camphorated ether (1 part camphor, 12 parts ether), chloroform, acetone, equal parts of carbon bisulphide, benzene, and turpentine, rectified turpentine (sp. gr. 0·870), linseed oil, methyl alcohol (b.p. 70° C.), light tar oils, resin oil, campher oil.

Kauri Copal.—a. Dry.—Swells with alcohol, almost completely soluble in alcohol mixture and ether alcohol. Partially soluble in ether, camphorated ether, chloroform, acetone, methyl alcohol, resin oil. Practically insoluble in benzene mixture, fatty oils, tar oils, and camphor oil.

β. Roasted.—Soluble in alcohol, alcohol mixture, ether, and ether alcohol. Partially soluble in camphorated ether, chloroform, and acetone. Very little soluble in turpentine and fatty oils.

γ. Fused.—In this state the resin is slightly more soluble than when only roasted. By dissolving the resin in hot turpentine and linseed oil, remelting the undissolved residue, and again treating it with a fresh quantity of solvent, complete solution can be effected.

Manila Copal—a. Dry.—Soluble in alcohol, alcohol mixture, ether, ether alcohol, camphorated ether, benzene mixture, and camphor oil. Partially soluble in chloroform, acetone, methyl alcohol, tar oils, and camphor oil. Insoluble in turpentine and linseed oil.

β. Roasted.—Soluble in alcohol, alcohol mixture, ether, ether alcohol, and camphorated ether. Partially soluble in acetone, less so in turpentine and linseed oil.

γ. Fused.—Behaviour very much like that of the roasted resin. Keeping it in the molten state for some time and then slowly adding linseed oil, the resin becomes much more soluble; the same treatment can be adopted with turpentine. Fused Manila copal easily forms clear solutions with camphor oil.

The solutions of these copals can be used as varnishes or lacquers. For spirit varnishes the following solvents give good results: abs. alcohol, alcohol mixture, ether alcohol, camphorated ether. Varnishes with turpentine and linseed oil may be obtained in the manner before mentioned. For spirit varnishes one part of resin and five parts of solvent are suitable proportions; for oil varnishes, eight parts of the resin, 25 of linseed oil, and 20 of turpentine will be found to give good results. This solution is finally boiled with 0·125 part of borate of manganese for every 50 parts of linseed oil.—C. O. W.

PATENTS.

A New or Improved Method of Mixing and Dissolving Solids and Liquids, and in Apparatus therefor. O. Hamilton, Northfleet. Eng. Pat. 11,249, June 15, 1892.

See under I., *page* 741.

Improvements relating to the Treatment of Oils for Imparting Drying Properties thereto. H. H. Lake, London. From W. N. Blakeman, Mount Vernon, U.S.A. Eng. Pat. 9291, May 9, 1893.

See under XII., *page* 771.

Improvements relating to the Treatment of Drying Oils for Thickening the Same. H. H. Lake, London. From W. N. Blakeman, Mount Vernon, U.S.A. Eng. Pat. 9292, May 9, 1893.

See under XII., *page* 771.

Improvements in and relating to the Manufacture of Pigments or Paints. H. H. Lake, London. From W. N. Blakeman, jun., Mount Vernon, U.S.A. Eng. Pat. 9293, May 9, 1893.

The process patented has for its object the increase of the tendency of certain pigments to absorb carbon dioxide from the air by the addition to them of such substances as magnesium borate or "monometa-borate of soda." In the case of a lead oxide pigment a small quantity of neutral acetate fluid may also be used, as well as an aluminium soap, the latter especially for ready-mixed paints. It is claimed that a paint which dries perfectly white can be obtained by this method, the carbonation proceeding after its application.—B. B.

An Improved Composition for Preserving Vegetable Fibre. H. H. Lake, London. From W. A. Gayle, Montgomery, U.S.A. Eng. Pat. 9816, May 16, 1893.

See under IX., *page* 764.

Improvements in and relating to the Manufacture of Material Applicable as a Waterproof Covering for Roofs and other such like Purposes, or as a Substitute for Glass. W. Noel Hartley, Dublin, and W. E. B. Blenkinsop, Wandsworth Common, Surrey. Eng. Pat. 13,825, July 8, 1893.

See under XII., *page* 772.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

The Theory and Practice of Tanning. W. J. Salomon. Tech. Quarterly, 1892, **5** [1 and 2], 81—88.

This paper contains an outline of the various tanning processes. With regard to the action of bates the author remarks that the different dungs which are employed owe their activity to pepsin and pancreatin, and attributes an efficacy of 2½ to dogs' dung, and 2 to pigeons' dung, when chicken dung is taken as unity. The popular supposition that bateing is conducted for the removal of lime is an error, for as a rule the lime has been removed by previous rinsings; should any lime remain when the hide reaches the bate it will be dissolved out as calcium sulphide by the sulphuretted hydrogen which is usually present. The activity of bates, whether dung or bran, is to be largely attributed to the presence and action of bacteria.

The author advocates the following theory of the actual tanning process. "The tannin molecules in solution in in the bark liquor attack the hide from both sides, and first tan the outside fibres; then they are redissolved and proceed to the next inner layers, their places being taken by other molecules. Now they leave the second fibres and go on to the third, being again replaced, and so on, until . . . . the hide is tanned. The outside fibres are consequently tanned and retanned thousands of times." Any benefit which may accrue from the use of an electric current in the tan pits is attributed to the precipitation of undesirable colouring matters, thus leaving an easily-soluble tannin, which will pass into the hide at a quicker rate.—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

Estimation of Water in Syrups and Massecuites. A. Josse. Bull de l'assoc. des Chim. **10**, 656.

White filter paper is cut into strips of 1—2 cm. wide to a total length of about 3 m. A spiral is formed out of these strips, after they have been previously folded so that the windings of the spiral do not adhere to one another. This spiral is then placed in a metallic capsule 2 cm. high and about 7 cm. in diameter, provided with a tightly fitting cover. The paper has thus a surface of 1 sq. m. and can absorb 100 cc. of liquid. The capsule containing the spiral is dried in an oven, and, after placing the cover upon it, its weight is ascertained. The spiral is then removed, and a portion of the substance (about 2 grms.) weighed out in the capsule, 6—8 grms. of water added, and the substance dissolved at a gentle heat; the solution is then absorbed by the spiral. Care must be taken that none of the solution is left on the bottom of the capsule. The capsule and its contents are then heated at 100°—110° until the weight remains constant, which is so in about two hours, when the lid is replaced, and after cooling the weight determined. The method is applicable to all substances which are difficult to dry, such as glucose, honey, wine, beer, &c.

—A. R. L.

Practical Calculation of the Yield of Mascuite and of White Sugar. M. Zouzal. Zeits. f. Zuckerind. Böhm. 1893, **17**, 302—305.

The formula for the calculation of the yield of mascuite from 1,000 kilos. of beetroots is:— M = α (P − 1), in which α is a coefficient dependent on the quotient of purity of the massecuite and the percentage of water that it contains, and P = the polarisation of the normal beetroot juice. This formula holds only for beetroot containing 90 per cent. of normal juice; in the case of beetroots which contain A per cent. of juice, and which give a polarisation P^1; this latter value may be converted into P by the equation $P = P^1 \frac{A}{90}$.

In the above formula 0·8 per cent. of the weight of beetroots is allowed as loss due to the manufacturing process. The numerical values of α for massecuites of various purity quotients and percentages of water are shown in the following table:—

Purity Quotient of Massecuite.	88.	89.	90.	91.	92.	93.
Percentage of Water.						
5	10·75	10·63	10·52	10·40	10·29	10·17
6	·87	·75	·63	·52	·40	·29
7	·99	·87	·75	·63	·52	·40
8	11·10	·99	·87	·75	·63	·52
9	·22	11·10	·99	·87	·75	·63
10	·34	·22	11·10	·99	·87	·75

If, for example, a massecuite having a purity quotient of 91 and containing 6 per cent. of water, is obtained, the coefficient α will be 10·52. The yield of massecuite from 1,000 kilos. of beetroot containing 90 per cent. of juice of 14·2 per cent. polarisation will then be—

$$M = 10·52 \times (14·2 - 1) = 138·86 \text{ kilos.};$$

that is, a yield of 13·88 per cent. of massecuite giving the following values:—*sugar*, 85·54 per cent.; *non-sugar*, 8·46 per cent.; *quotient of purity*, 91; and *water*, 6 per cent. If the beetroots yielded 93 per cent. of juice of polarisation 13·8—calculating as mentioned above $13·8 \times \frac{93}{90} = 14·26$; the formula M = α (14·26 − 1) is applied as if the beetroots contained 90 per cent. of juice of polarisation 14·26.

The formula for the calculation of the yield of white sugar from 1,000 kilos. of beetroots is $S = \beta (P - 1)$, in which β is a coefficient dependent upon the purity quotient of the massecuite and the proportion of sugar to non-sugar (*molasses factor*) in the last molasses, and P is the polarisation of the normal juice. The formula is constructed for beetroots containing 90 per cent., and a manufacturing loss of 0·8 per cent. is assumed. The polarisation for beetroots yielding other amounts of juice is calculated as already given.

The numerical values of β for various purity quotients and molasses factors are shown in the following table:—

Purity Quotient of Massecuite.	88.	89.	90.	91.	92.	93.
Molasses Factor.						
1·3	7·40	7·56	7·70	7·84	7·98	8·14
1·4	·30	·44	·60	·75	·91	·05
1·5	·15	·33	·50	·66	·83	7·99
1·6	·03	·22	·40	·57	·75	·92
1·7	6·92	·10	·30	·48	·67	·85
1·8	·79	·00	·20	·39	·60	·78
1·9	·67	6·89	·10	·30	·52	·71
2·0	·55	·77	·00	·21	·44	·63

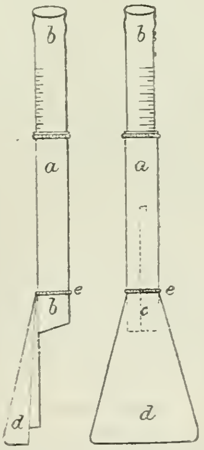
Example.—If the massecuite has a purity quotient of 91, and a molasses factor of 1·5 [that is, the last molasses contains sugar (1·5 parts), and non-sugar (1 part)], then the yield of white sugar from 1,000 kilos. of beetroots containing 90 per cent. of juice of 14·2 polarisation is:—
$S = 7·66 \times (14·2 - 1) = 101.11$ kilos. or 10·11 per cent.

When the value of M (in the first formula) is divided by that of S (in the second formula) and the quotient multiplied by 100 the "*rendement*" of the mascuite is obtained thus:— $R = \frac{100\,S}{M}$, or in the case in which α = 10·52 and β = 7·66 R (the "*rendement*") = $\frac{7·66 \times 100}{10·52}$ 72·81.

—A. R. L.

Regulator for Osmose Apparatus. F. Weyr. Zeits. f. Zuckerind. Böhm. 1893, **17**, 301—302.

The arrangement shown in the cut has been devised for regulating the inflow of molasses and water into any form of osmose apparatus. It consists of two tubes *a* and *b*, and a shield *d*. The exterior tube *a* fits over the inner tube *b*, which is closed at the bottom, so that by pushing it up or down the slit *c* is more or less opened. The shield *d* is free to rotate round the tube by means of the ring *e*; it serves to conduct the outflowing liquid into the metallic funnel of the osmogen.



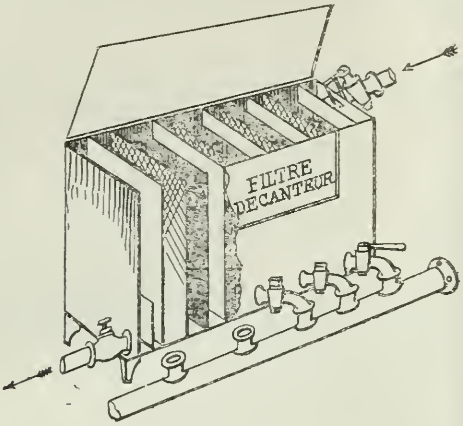
The regulator is connected with the conduit of the molasses or water reservoir in such a manner that the outflow of the liquid occurs under pressure.

The shield *d* is turned round when it is necessary to remove any obstruction from the slit *c*, which is accomplished by means of a wire. Such a stoppage only occurs in the case of very impure molasses, and when the liquid does not enter the regulator under pressure, otherwise it is not to be feared.—A. R. L.

Filtration of Juice after Saturation. J. Bouvier.

La Sucrerie indigène et coloniale, **41**, 127.

The filter shown in the cut differs entirely from existing frame- and cloth-filters, and its application is based upon the property which the saturated juice possesses of becoming clarified by settlement. This property has not been up to the present time utilised even for partially clarified juice, such as is obtained from the settling tanks and filter presses, because closely-woven filter-cloths have always been employed to filter the juice; but the pores of the latter soon become clogged, especially when cane juices, containing slimy suspended matters, are being dealt with. The two operations of decantation and filtration may, by means of the author's device, be combined.



When a continuous stream of saturated juice is passed through a rectangular receptacle with such speed that the suspended matter cannot settle, only inconsiderable quantities of the latter will collect on the bottom of the vessel. If, however, the speed of the stream be slackened by placing in the vessel obstacles or perpendicular divisions, through which the juice is forced to flow from one to the other of the compartments thus formed, the suspended particles will be held back by their own gravity, and there will be a precipitate in each compartment, and the liquid will become clearer as it reaches successive chambers; *i.e.*, the juice will be decanted. Suppose, however, a filtering medium be interposed between each compartment, the two operations of decantation and filtration proceed simultaneously. A tap is attached to each chamber, which allows the mud to run off into a common duct.

One of the greatest advantages arising from the adoption of this apparatus is that instead of the ordinary somewhat closely-woven filter-cloths, which occasion great cost in cleansing, a material consisting not of woven but of pressed fibres, can be made use of; a very ready circulation of the liquid is thus attained, and the material is even re-cleansed by the juice being filtered. Any filtering medium may be employed which does not become soft at 80°—85° C., and can be washed with warm water.—A. R. L.

Manometer for Control of Vacuum Gauge. M. Zouzal.

Zeits. f. Zuckerind. Böhm. 1893, **17**, 394.

See under I., *page* 740.

New Observations on the Manufacture of White *Granulated Sugar.* J. Hanuš. Zeits. f. Zuckerind. Böhm. 1893, **17**, 359—381.

The observations contained in this paper are said to have been collected from actual experience in the working of a factory, and are therefore of value. The length of the article precludes its full insertion, and its nature is such that it does not admit of abridgment. The data relate to the boiled green syrup (II.) obtained after the separation of the first mascuite, and also to the syrup (III.) obtained after the separation of the second mascuite. The employment of animal charcoal is gradually becoming obsolete, and methods of working have accordingly been introduced which are more productive of mascuite, but which render the syrup obtained from product II. only fit to sell as molasses. The notes apply to factories which turn out white granulated sugar and only one after-product, viz., II., without employing animal charcoal.—A. R. L.

Saccharine Fluid exuded by the Orange Tree. E. Guinier.

Comptes rend. **116**, 1001—1002.

An orange tree kept at 10°—14° C. throughout the winter was observed to secrete drops of a syrupy saccharine fluid becoming nearly solid without losing transparency. This had a sweet taste devoid of aromatic flavour. It was principally observed on the leaves, though also on other green parts of the plant (petioles, &c.).—C. R. A. W.

A New Ferment Splitting up Trehalose into Glucose. E. Bourquelot. Comptes rend. **116**, 826—828.

Under the influence of a special ferment, trehalose (found in mushrooms) becomes hydrolysed, forming glucose, thus:

$$C_{12}H_{22}O_{11} + H_2O = 2C_6H_{12}O_6$$

the reaction takes place quantitatively. Hence trehalose is a diglucose. To obtain the ferment, *Aspergillus Niger* is cultivated on Raulin's liquid; when covered with fructification the mass is removed and the lower surface washed with distilled water; it is then rubbed up with sand and digested with alcohol of 95° for 5 or 6 hours. The residue is pressed in blotting paper and dried *in vacuô;* on rubbing up with distilled water and macerating for some time, filtering, and treating the filtrate with alcohol, the ferment is precipitated. A simpler method suffices when only a watery solution of the ferment is required; the culture-fluid is siphoned off and replaced by distilled water; the ferment diffuses into the water, so that in two or three days' time a solution is obtained, highly active and perfectly clear after filtration. To this ferment the term *trehalase* may be given; it is different from yeast invertin, saliva diastase, and almond emulsine, none of which have any action on trehalose. The trehalase thus obtained appears to contain *maltase,* as it also hydrolyses maltose, even after heating up to temperatures not exceeding 74° or 75°, whereas the action on trehalose is destroyed by heating to 63°.—C. R. A. W.

The Sucrates of Lime. P. Petit. Comptes rend. **116**, 823—826.

The amount of lime dissolved by sugar solution is variable with the temperature, the concentration, and the duration of contact. By dissolving calcium chloride in water and adding to it a solution of caustic soda containing sugar, and determining by means of the calorimeter the heat evolved, definite conclusions may be arrived at respecting the constitution of the sucrates of lime formed under different conditions. The author finds that the values correspond with two compounds, respectively $C_{12}H_{22}O_{11}CaO$ and $C_{12}H_{22}O_{11}2CaO$; the heats of formation of solutions of which (from dissolved lime and dissolved sugar) are 7·2 and 11·7 calories respectively. When the monocalcium compound is digested with excess of lime, the dicalcium compound results, with evolution of 4·5 calories; when treated with sugar, heat is also evolved to an extent that increases until the proportions between sugar and lime are indicated by $4C_{12}H_{22}O_{11}, CaO$, after which it becomes sensibly constant at 3·1 calories.

Attempts to prepare definite solid compounds, and in particular the tricalcium compound described by previous authors, did not lead to satisfactory results; probably because some kind of chemical action of a more deep-seated order takes place between the lime and the sugar under the influence of heat, as in the parallel case of maltose.—C. R. A. W.

Preservation of Beetroot, &c. from Insects. A. Laboulbène. Comptes rend. **116**, 702.

The larvæ of *Agrotis segetum* and *A. exclamationis*, and also of other species, are very destructive to market garden produce, especially betroot. Mineral poisons, such as arsenite of copper, are open to serious objections when used as insecticides; certain vegetable decoctions, however, may be used with good effect and less danger of poisonous results; thus ranunculaceous plants may be eaten with impunity by cattle when dry, although poisonous when green and fresh; and similarly with the leaves of colchicum; the author accordingly proposes to water the plants to be protected against insects with decoctions or macerations of vegetables containing alkaloids. *Delphinium grandiflorum*, *D. Ajacis*, and *D. Staphysagria* appear to be well suited for the purpose, and have given encouraging results. The aconites, datura, belladonna, hyoscyamus, and similar poisonous plants may also prove valuable as insecticides.
—C. R. A. W.

XVII.—BREWING, WINES, SPIRITS, Etc.

Inulase and the Indirect Alcoholic Fermentation of Inulin. E. Bourquelot. Comptes rend. **116**, 1143—1145.

If the spores of *Aspergillus niger* be allowed to germinate in a nutritive solution containing inulin, it is found that the inulin is converted into levulose. The reaction goes on slowly and regularly in cold dilute solution 1·3 grms. of inulin in 100 cc. solution, were completely converted into levulose in about 3 days. The ferment (*inulase*) is different to trehalase and invertase, as it may be heated in aqueous solution to 64° C. without being weakened; whether it is different from maltase cannot be determined. Inulin is not fermentable by yeast but on the addition of inulase, the levulose formed is quickly fermented.—A. L. S.

The Utilisation of Wine Press Residues. A. Muntz. Comptes rend. **116**, 1472—1474.

The residues contain from 7 to 20 per cent. of the amount of wine obtained by pressing.

The distillation of these residues yields a spirit of low value. The best method appears to be to submit them to a kind of sparging whereby weak wines are obtained either for local consumption or for distillation. The residue is suitable for feeding cattle.—A. L. S.

Effront's Method for the Purification of Yeast by means of Hydrofluoric Acid or Fluorides. A. Jörgensen and J. C. Holm. Chem. Zeit. 1893, **17**, 393—394.

The authors point out that the principle of this method is the same as that of Pasteur's, which consists in treating the yeast with tartaric acid, and that it is inconceivable that a single substance should only act favourably towards the one desired species of yeast and detrimentally towards all the disease germs and all the undesirable cultivated yeasts which may be present.

They show further that the development of a number of known disease germs is actually favoured by this treatment just as Hansen proved this to be the case with the tartaric acid treatment, so that such disease germs may get the upper hand and the desired cultivated yeast become suppressed (this Journal 1892, 256).

The authors have made an elaborate series of experiments in order to thoroughly test Effront's method (see also this Journal 1890, 748, 1055; and 1892, 50, and 626—627), from which the following results may be quoted:—

1. A distillery-yeast which contained *Mycoderma* in such small amounts that it could be detected only with difficulty by the microscope, showed a very strong development of this impurity after treatment by Effront's method.

2. Pure cultures of *Mycoderma* and *Bacterium aceti* were added in very small quantity to a pure culture of a distillery-yeast. After treatment with ammonium fluoride, the *Mycoderma* cells were found to have multiplied very freely whilst *Bacterium aceti* was by no means suppressed; in another experiment, *Bacterium aceti* was found to have multiplied considerably. In an experiment with a pure brewery-yeast (low) to which a very small quantity of *Mycoderma cerevisiæ* was added, the yeast was almost entirely suppressed by the latter organism.

3. A distillery yeast, which gives good results in practice was mixed with 20 per cent. of a brewery yeast (low) and after treatment twice by Effront's method, the distillery-yeast was completely crowded out by the beer-yeast.

4. In another mixture of an excellent distillery yeast with a small quantity of a brewery-yeast (high) *Sacch. cerevisiæ I. Hansen*, the latter yeast gained the upper hand.

5. In experiments with mixtures of the yeast known as Carlsberg II. with small quantities of *Sacch. Pastorianus III. Hansen*, the latter, which is a disease yeast, multiplied considerably, and in one case the yeast Carlsberg II. almost completely disappeared. Similar results were obtained with mixtures of a distillery-yeast with small quantities of Sacch. Pastorianus III.

The above results show that treatment by Effront's method favours the development of the so-called disease-yeasts, of *Mycoderma*, of brewery-yeasts when present in distillery yeasts, and finally also of *Bacterium aceti*; and the conclusion cannot be too strongly emphasised that the employment in practice of hydrofluoric acid and fluorides for the purification and preservation of yeast is attended with very great danger.—A. K. M.

Pure Yeast Fermentations of the Jerusalem Artichoke. L. Levy. Comptes rend. **116**, 1381.

The raw material cut into thin slices was exhausted at 60° C. with water containing 2 parts per 1,000 by weight of potassium bitartrate in solution; the extract of sp. gr. 1·03—1·04 was sterilised by boiling, and subjected to fermentation at 20°—25° C. The fermentation completed, the liquor was distilled and the distillate, amounting to one-half the original volume, re-distilled. In the earlier fraction below 78° C. a small quantity of aldehyde was observed. At 79°—79·5° C., 76 per cent. of the total alcohol distilled, constituting a spirit of good flavour; at 80° a further 16 per cent. of the alcohol distilled, also giving a spirit of good quality. The results are regarded by the author as containing promise of industrial development.
—C. F. C.

A New Ferment splitting up Trehalose into Glucose. E. Bourquelot. Comptes rend. **116**, 826.

See under XVI., *page* 776.

The Sucrates of Lime. P. Petit. Comptes rend. **116**, 823—826.

See under XVI., *page* 776.

The Manufacture of Alcohol from Peat. J. Matthëus. Dingl. Polyt. J. **287**, 91.

See under XX., *page* 781.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

The Foliage of Trees as Cattle Food. A. C. Girard. Comptes rend. **116**, 1010—1013.

The leaves of many trees contain a considerable percentage of digestible nitrogenous matter, so that in case of scarcity of hay and cattle fooder they may be employed advantageously as food for stock. Of course poisonous trees, such as laburnum and yew, &c. must be avoided.
—C. R. A. W.

Adulteration of Butter. A. Honzeau. Comptes rend. **116**, 952—956.

See under XXIII., *page* 789.

(*B.*)—SANITARY CHEMISTRY.

PATENTS.

Improvements in the Production of a Ferric chloride Preparation for the Treatment of Sewage or other Foul Water. C. A. Burghardt, Manchester. Eng. Pat. 13,316, July 21, 1892.

250 parts of common salt are mixed with 100 parts of ferric oxide, made into a thin paste with water, and 225 parts of sulphuric acid run in gradually. The mixture is moulded, dried at 100° C., and then heated to 180° C. until it becomes yellow from the formation of ferric chloride. The product consists of ferric chloride mixed with sodium sulphate, and is stated to be more convenient for use in the treatment of sewage than is ferric chloride in its usual commercial form.
—B. B.

Improvements in the Production of a Ferric Preparation for the Purification of Sewage or other Foul Water. C. A. Burghardt, Manchester. Eng. Pat. 15,285, August 25, 1892.

The patent applies to a material similar to that described in Fng. Pat. 13,316, of 1892 (see preceding abstact). The ferric preparation is a mixture of ferric chloride and sodium sulphate prepared by mixing the two ingredients in solution and evaporating to the crystallising point. The proportion of dry ferric chloride should not exceed 30 per cent. Salt cake or nitric cake may be used in place of pure sodium sulphate.—B. B.

Improvements in the Manufacture of Materials used in the Purification and Filtration of Sewage and other Liquids. C. E. Bell, Durham. Eng. Pat. 14,175, August 5, 1892.

Natural carbonate or hydrated oxide of iron is exposed to the heat of the products of combustion of producer gas containing little or no free oxygen. Air is then admitted in quantity sufficient to bring the iron to the state of oxidation required.—B. B.

Improvements in the Treatment of Sewage and other Fou Waters of Analogous Nature for Effecting the Purification thereof. C. Dreyfus, Manchester. Eng. Pat. 14,664, August 13, 1892.

The patented process consists of two operations, precipitation and filtration. Precipitation is obtained by adding to the sewage a solution of basic persulphate of iron (which may be prepared from the acid product from the purification of crude naphtha or petroleum, and from the nitrification of organic substances by dilution and treatment with waste iron from the manufacture of amido compounds and an oxidising agent) and a small proportion of milk of lime. After the impurities have settled out the liquors are passed through a filter bed, composed of dried or calcined iron residue derived from works where iron is used for reducing nitro compounds into amido compounds. Or the oxide may be used in conjunction with coarse and fine gravel, sand, coke, cinders, &c.—E. G. P. T.

An Appliance for Facilitating Withdrawal of Sludge or Deposit in Sewage Tanks; applicable also to Clarifying Water and other Liquids. A. P. J. Cotterell, Bristol. Eng. Pat. 17,302, September 28, 1892.

The appliance consists of a pipe extended from a pump to a point towards the bottom of the precipitation tank and carried round it, the hoop thus formed being fitted at intervals with nozzles or spouts, through which jets of water are discharged so as to create a rotary movement of the contents of the tank and consequent scouring of the sludge into the lower part of it. Accordingly, a smaller portion of water than hitherto is pumped up through the sludge pipe, while the continuous precipitation in that part of the tank which is above the nozzles is not prejudicially affected.—E. G. P. T.

Improvements in the Construction of Vertical Tanks or Receptacles for the Purification of Sewage and for like Purposes. E. W. Ives and C. T. L. Bristow, Derby. Eng. Pat. 2844, February 9, 1893.

The device patented consists essentially of a cylindrical tank having a conical bottom and fitted with a cover with entrance and exit pipes. The sewage is distributed to the circumference of the tank, and caused to flow downwards to the bottom of the cylindrical part and then upwards on the side of an annular plate near the axis of the cylinder, by reason of which circuitous route deposition of the more solid portions takes place and the precipitated matters falls to the apex of the cone forming the bottom of the apparatus whence it can be drawn off by a suitable pipe without opening the apparatus or hindering its working.—B. B.

Improvements in and connected with the Manufacture of Iron Salts. P. Hart, Manchester. Eng. Pat. 6815, April 1, 1893.

See under VII., *page* 763.

XIX.—PAPER, PASTEBOARD, Etc.

Sulphite Wood Pulp in America.
See also this Journal, 1892, 174.

The following is a description of an American sulphite wood pulp mill. The mills from which the one described is selected, are known as the Kimberly Mills, and are situated on the Fox River. In America, Germany, and Scandinavia, the production of wood pulp has established itself more surely than in England. Manufacturers in the United States have perhaps been bolder in their plan of operations, and hence, in some respects, their operations and plant differ in a notable degree from those employed in Europe.

Formerly boilers made of bronze were in use at the Kimberly Mills, but they have been removed and replaced by three vertical boilers, provided with a steam jacket and protected inside with the Salomon-Brügger protecting composition (a coating of sulphate of lime). Each boiler is 6 ft. 6 in. in diameter and 30 ft. in height, and when full yields 3,500 lb. of dry pulp. The filling and emptying occupies about 30 minutes, while the boiling process lasts from eight to nine hours. Every 24 hours there are prepared eight boilings with the three boilers. The bisulphite of lime liquor is prepared by burning English recovered sulphur in three ovens and passing the sulphurous acid gas, first through a cast-iron tube, and then through towers containing limestone. The three towers are connected together with earthenware pipes, and the last one with a chimney to produce the necessary draught. Samples of the gas passing from the last tower to the chimney are repeatedly taken and passed through iodine and starch solution to ascertain whether the whole of the sulphurous acid gas has been absorbed, or converted into bisulphite of lime.

The wood is mostly brought from Canada by water carriage, and is first of all cleaned by being held in an upright position against a revolving disc containing knives, which quickly removes the bark. It is then chopped with circulating knives fixed in a disc, and from the cutter goes to a duster, through the sieve of which pass the sawdust and small impurities. The larger pieces of wood fall from this duster into a ventilator, by which they are broken up or pulverised, and conveyed to a second revolving sieve, through a tube 18 in. in diameter. The first part of this revolving sieve is covered with a gauze having $\frac{1}{4}$-in. holes, whilst the lower part (more than one-half the whole length) is covered with gauze with $1\frac{1}{4}$-in. holes. The good wood passes through this latter, the knots and large pieces being retained. The latter fall from the end of the sieve, and are used for raising steam under the steam boilers. The quantity is only a few wheelbarrows full per day, however. The good wood is conveyed by ventilator and chain conveyors to the floor over the boilers, into which it falls by gravitation when the openings in the bottom of the receptacles are opened.

As little time is lost in filling in the lye as in filling in the wood. The sulphite liquor formed in the tower is pumped by the aid of a bronze centrifugal pump into a receiver in the highest part of the building, where all insoluble particles are deposited, and from thence it flows to the boilers through a wide pipe. The boilers are emptied more quickly than they are filled. When they are opened at the bottom, the whole of the contents, under the prevailing steam pressure, is blown into an upright circular wooden tank, built of 4-in. planks, 14 ft. high by 16 ft. in diameter. The side of the vat against which the pulp is ejected is covered with a double layer of 4-in. planks, and these again are covered with bronze plates, which break up the bundles of fibres as the pulp is thrown violently against them. The lye at this point of the manufacture does not give off much smell, as the sulphurous acid is used up in the boiler. A sample of the liquor is taken from the boiler and the quantity of sulphurous acid ascertained by testing with iodine. In this way the workmen know when the boiling is finished. By thus blowing out the whole contents of the pulp boiler, the emptying occupies only three minutes. As the lye contains no free acid, it is allowed to flow uninterruptedly into the river.

The boiled and broken pulp is now pumped upon large knotters with slit plates, which retain all the thick parts, such as knots, &c., allowing only the fine good fibres to pass through. In the knot-catchers small water-spray pipes are arranged over the plates and parallel with the slits, from which a stream of water forces all solid particles remaining on the plates from one end to the other, where they are taken out. The perforated pipes lie over the plates, keeping these clean, and facilitating the work. From these knotters the pulp flows over a broad and very long sand-catcher into the stuff-chest, from which it is pumped to the press pâte.

The whole arrangement, which is common throughout America, is designed with the object of economising labour; the limestone is conveyed by a mechanical arrangement to the top of the towers, and the wood is cleaned and freed from knots in the same way.

It is therefore possible to make about 28,000 lb., or from 12 to 13 tons of air-dry pulp in 24 hours with 40 labourers. There are so few knots in the pulp that it can be bleached to a fine degree of whiteness, and can be used for better class papers. The works are built on the duplicate principle, so that three more boilers, &c. can be added whenever it is found necessary to do so.—*Chemical Trade Journal.*

PATENTS.

Improvements in or connected with the Method and Means for Treating Wood and other Materials at High Temperatures, whereby Heat may be more effectually Utilised. J. Beveridge, Gravesend, and J. B. Alliott, Nottingham. Eng. Pat. 14,105, August 4, 1892.

In preparing wood for the manufacture of paper, when the process of digestion is finished, it has been usual to blow away the steam from the digesters and thus lose all the heat stored up in them. The inventors use a multiple evaporating apparatus combined with the digesters in such a way that the steam given off during the process of reducing the pressure may be entirely or in part used for effecting the evaporation on the multiple evaporator. In the manufacture of paper from wood pulp the steam obtained from the digesters may be made to effect a great part of the evaporation needed to concentrate the soda lye employed, and to prepare it to be passed into the special furnace in which it is transformed into sodium carbonate for further use.—E. G. P. T.

A New or Improved Process of Manufacturing Incombustible and Inodorous Celluloid. F. Cadoret and E. Degraide, Deville, France. Eng. Pat. 21,485, November 25, 1892.

Cotton or any other form of cellulose is purified by successive treatments with alkalis, acids, and, finally, with nitrous acid, prepared by adding nitric acid to a mixture of equal parts of molasses and starch dissolved in water. It is then nitrated and bleached by means of a "double salt of hyposulphite of soda and magnesia" mixed with a quantity of liquid containing chlorine. To this is added a small quantity of the solution containing starch, molasses, and nitric acid. The bleached dinitro cellulose thus obtained is treated with a 2 per cent. solution of zinc chloride, and after removal, and while in a damp condition, it is mixed with zinc oxide and powdered. A substance called by the inventors camphogine is added to the mass, and imparts ductibility while diminishing combustibility. It can be drawn out into fine silk-like threads, and is applicable to the manufacture of yarn and textile fabrics. It is obtained by the decomposition of turpentine by means of hydrochloric acid gas with the addition of a metal, say zinc, and subsequent boiling with alkali. This camphogine, with an addition of an alcoholic solution of zinc chloride, is intimately mixed with the dinitrocellulose, and certain organic animal substances, such as albumin or casein, are further added to remove part of the moisture of the mass. At the same time complete incombustibility is obtained.
—E. G. P. T.

Improvements in Boilers for Boiling or Chemically Treating Fibrous Materials. G. Sinclair, Leith, N.B. Eng. Pat. 6441, March 27, 1893.

The present invention relates to improvements in boilers of a kind described in the inventor's patent 2035 of 1880, and used for boiling or chemically treating rags, esparto, &c. Two modifications are claimed; the one contains a central cleaning opening in the inner bottom plate, which can be closed by a disc, and, in the space below the plate, two or more shoe-like boxes or short pipe lengths made with dipping nozzles and with openings communicating with lateral vertical vomiting passages made easily detachable, the upper perforated diaphragm being also easily removable. In the other modification there is a central vomiting pipe with a flange near its bottom end in a recessed plate bolted to the horizontal inner bottom plate, which plate is fitted with dipping pipes, the lower ends of which are made with projecting segments resting on the bottom of the boiler.
—E. G. P. T.

Improvements in or Relating to the Manufacture of Paper, and Apparatus for Effecting Same. J. Holden, Darwen. Eng. Pat. 6925, April 4, 1893.

This invention relates to the dyeing or colouring of paper on one or both sides from one pulp, either before or after calendering. Suitable colour or dye boxes are provided with or without adjustable doctors, and the paper, in its passage from the ordinary heated or other cylinders of the paper machine, is conducted by suitable rollers to the dyeing apparatus or to the calendering portions of the machine.—E. G. P. T.

Improvements in or Connected with Apparatus for Straining Paper Pulp and the Like. R. G. Hutchison, Woburn, Bucks. Eng. Pat. 7112, April 6, 1893.

The invention comprises, as essential features, the adoption of a strainer of conical shape, its disposition within the vat with its upper surface horizontal so as to be below and level with the surface of the pulp to be strained, and its suspension within, and connection with the vat in such a manner as to allow of pulsating movements being given to it endwise and in a vertical plane. When the apparatus is in operation, the combined endwise and vertical pulsations imparted to the strainer submerged in the pulp produce a powerful vacuous tendency within the strainer, causing the pulp to stream through its straining slits into the interior, and to escape in a regular discharge of strained and finished pulp ready for the paper-making machine.—E. G. P. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Manufacture of Essence of Roses in Saxony. Report of Belgian Consul at Leipsic, 1893.

The rose plantations established two years ago as an experiment in the suburbs of Leipsic, have given such brilliant results that they have been largely extended.

The rose trees withstood the long and severe winter of 1892—93, and their development has left nothing to be desired. It is a mistake to suppose that these flowers in order to thrive and acquire a delicate perfume require eastern warmth. It has been proved to the contrary at Leipsic that a fresh and even a slightly moist temperature is the first condition of a good yield, and that great heat is prejudicial.

The house which first tried these plantations has built a special factory in the midst of the rose fields, which was to commence working this summer. It will consume each day 50,000 kilos. of leaves, and will produce as a minimum about 40 kilos. of oil, rose-water, and pomade of roses, of an estimated value of from 2,000*l.* to 2,500*l.*

This factory is to have three boilers to commence with, and the roses will, immediately after gathering, be transferred into the macerating receptacles, where by means of this process they yield their perfume with all their freshness and delicacy. Only that quantity of flowers which is immediately wanted will be gathered. The rose will therefore be only a few minutes in passing from the tree into the apparatus.

Nowhere else has this important fact been noted; it often happens in Turkey, for example, and also in France, that roses gathered in the morning are only distilled in the evening.

As regards the oil of roses produced in Saxony during the past year, it is asserted that not only is it in no way inferior to that of Turkey, but further, that it is superior to its rival as regards delicacy and strength, and in the durability of the perfume.

The Properties of Hydrogen Peroxide Solutions. H. P. Talbot and H. R. Moody. Tech. Quarterly, **5**, [1 and 2] 123—131.

The preparation of pure or of concentrated solutions of hydrogen peroxide has received little mention in chemical literature. Thénard's method consists in evaporation *in vacuo* over sulphuric acid. Hanriot found that on partially freezing a solution of hydrogen peroxide, the portion that remained liquid was richer in hydrogen peroxide than the original solution. Working in this way he obtained solutions of hydrogen peroxide so concentrated that they would yield 70—80 times their own volume of oxygen. The same chemist also observed that dilute solutions of hydrogen peroxide could be concentrated by distillation under diminished pressure without suffering much decomposition. Thus distilling under a pressure of 3 mm. he obtained a solution which would yield 267 times its volume of oxygen, and he states that no appreciable decomposition takes place below a strength corresponding to the evolution of 150 volumes of oxygen.

The authors have examined commercial samples of various origins with the view of preparing pure or concentrated solutions therefrom. The strength of those examined varied from 18—23 "volumes," when freshly prepared; older samples were found as low as 8-volume strength.

It has been pointed out by Kingzett (this Journal, 1890, 4) that custom varies in stating the strength of hydrogen peroxide, and that a 10-volume solution strictly means one that by itself yields 10 volumes of oxygen, and not one that yields 10 volumes when the oxygen derived from the decomposing agent such as potassium permanganate is reckoned in. According to American practice, however, the latter is the interpretation put upon the expression, and the figures given by the authors are based on this method of valuation. A preferable method of stating the strength is in per cent. of H_2O_2, as suggested by F. H. Williams; a 20-vol. (American) solution contains 2·9 per cent. H_2O_2; a 50-vol. solution 6·9 per cent. H_2O_2; a 100 vol. solution 13·4 per cent. H_2O_2 by weight.

The use of hydrogen peroxide in analysis is frequently advocated, but all commercial samples are too impure, containing as they do such foreign matter as hydrochloric, sulphuric, phosphoric, and hydrofluosilicic acids, sugar, and glycerin (*Cf.* this Journal, 1889, 640). The latter two substances were found chiefly in samples prepared for medicinal use. One sample contained 0·16 per cent. and another 0·13 per cent. of phosphoric acid, and was therefore unfit for analytical use. Another left a residue of 0·0588 grm. from 50 cc. on evaporation on the water-bath. A sample for medicinal use gave a residue of 0·44 grm. from 50 cc., which consisted largely of sugar and glycerin. The presence of hydrofluosilicic acid is very objectionable, and one sample was found to contain 0·05 per cent. of this impurity. An attempt by certain manufacturers to prepare a pure solution of hydrogen peroxide resulted in the obtainment of a sample which was free from phosphoric acid, and left 0·0049 grm. of fixed residue on the evaporation and ignition of 50 cc. of the solution. The amount of silica was 0·0026 per cent., and traces of lime, alumina, and organic matter were present. The authors consider this good enough for analytical use.

They state that the following method of purifying commercial hydrogen peroxide proved successful. The solution was treated with about 10 per cent. by volume of alcohol, after which barium hydrate in powder, as free from carbonate as possible, was added, until the reaction was distinctly alkaline. The resulting precipitate, containing most of the impurities, was filtered off with the aid of gentle suction, using a porcelain filter plate, and the excess of barium in the filtrate removed by the addition of sulphuric acid in excess. The barium sulphate was allowed to settle, and the supernatant liquor quickly filtered as before. Provided the first filtration be rapidly conducted, so that the time during which the solution is alkaline is reduced as much as possible, there is but little loss of hydrogen peroxide. The alcohol remaining in the purified solution can be removed by distillation under diminished pressure. A sample thus treated had the silica present reduced from 0·028 to 0·003 per cent. The purified solution "may then be used for analytical purposes without further precaution than the customary blank analysis."

The method of purification, consisting in the addition of ferric chloride and subsequent precipitation with barium hydrate, cannot be employed, as the ferric hydrate formed causes rapid decomposition of the hydrogen peroxide, which decomposition is not hindered by the addition of alcohol or ether. Another method, consisting in shaking hydrogen peroxide out of its aqueous solution with ether, is also useless on account of the fact that phosphoric and hydrofluorilicic acids are simultaneously extracted. A better method of concentrating solutions of hydrogen peroxide than freezing consists in distilling off the water, preferably under diminished pressure. It has the additional advantage of yielding a weak but pure solution of hydrogen peroxide in the distillate, as a limited amount comes over with the water. The apparatus used by the authors was simple, consisting of a round-bottomed flask heated in a water-bath, a Liebig's condenser, and a receiver connected with a pump capable of reducing the pressure to 30—40 mm. In order to prevent bumping it was found advisable to draw a slight current of air through the apparatus by means of a capillary tube opening into the flask. The fact that this precaution is necessary proves that but little decomposition of the hydrogen peroxide can take place during distillation.

Numerous experiments on the rate of concentration and the loss of hydrogen peroxide during the operation, were performed, the results of which are recorded in tables. The sample used was a 20-vol. solution, containing as impurities phosphoric, hydrofluosilicic, sulphuric, and hydrochloric acids, together with a small quantity of iron. Under atmospheric pressure the highest concentration of the liquid left in the distilling flask was to 81-vol. strength. Under a pressure of 390 mm., hydrogen peroxide of 84-vol. strength was obtained. Under 140 mm., 189·4 vol.; under 30 mm., 151·2 vol. At atmospheric pressure, with the addition of phosphoric acid, 69·0 vol.; at 390 mm., with phosphoric acid, 107·3 vol., but in each case the total loss of hydrogen peroxide by decomposition was considerable. The addition of other supposed preservatives, such as sulphuric acid, boric acid, and glycerin was also tried, but proved unsuccessful in hindering decomposition during distillation. When distillation is conducted under a pressure of 30 mm., appreciable quantities of hydrogen peroxide appear in the distillate, corresponding in the last fractions to as much as 9·4 vol. strength. The only impurity likely to pass over, together with hydrogen peroxide, is hydrofluosilicic acid, so that distillation allows of the preparation of a specimen of approximate purity, but is, of course, wasteful of material. The weak solution thus obtained can be concentrated to 20-vol. strength, after the addition of a quantity of sulphuric acid sufficient to amount to 0·2 per cent. on the liquid after concentration.

Hanriot's statement that pure hydrogen peroxide has an acid reaction is doubted by the authors, as they have prepared solutions the feeble acidity of which they ascribe to the presence of traces of hydrofluosilicic and hydrochloric acids, which when rendered neutral by the addition of a drop of alkali still contained an undiminished amount of hydrogen peroxide.

The authors arrive at the conclusion that concentrated solutions of hydrogen peroxide of a moderate degree of purity can be readily prepared. They themselves have succeeded in preparing such solutions of 30—588 volume strength. It is usually advisable to concentrate the crude solution to 50 vol. strength before attempting purification, save in the case of purification by the barium hydrate method given above where purification must precede concentration. A plan whereby the bulk of the impurities can be removed is as follows:—The solution is neutralised with caustic potash, as free as possible from carbonate, and decanted through a ribbed filter from the precipitate of silico-potassium silicofluoride, &c. The solution which contains only potassium salts of such acids as phosphoric orginally present, is acidulated with sulphuric acid or hydrochloric acid in the proportion of 0·5 per cent. for a 50 vol. solution.

Experiments were made to determine whether strong solutions could be kept under ordinary conditions. It was found that those of less than 100 vol. strength may be kept for many days at the ordinary temperature without great loss, but that solutions of greater strength up to 400 vol. (chiefly used in medicine and dentistry) must be kept at about 0° C., preferably in the dark and without opening the containing vessels or agitation. It was ascertained that the ordinary method of valuation by titration with potassium permanganate agreed sufficiently closely for most purposes with the gas-solumetric evolution method, consisting in causing a measured quantity of hydrogen peroxide to decompose by heating with a strong solution of caustic potash and collecting and measuring the oxygen.—B. B.

A Soluble Derivative of β-Naphthol. Dujardin-Beaumetz and Stackler. Comptes rend. **116**, 1477—1478.

A NEW β-naphthol monosulphonate, which has been previously described by one of the authors, and which has since been shown to be the calcium salt of the sulphuric ether of β-naphthol $(C_{10}H_7O.SO_3)_2Ca.3H_2O$ possesses valuable antiseptic powers, it has been named *Asaprol* (ἀ, σαπρός).

It is very soluble in water and alcohol; possesses almost the same antiseptic and therapeutic powers as sodium salicylate. It may be used in cases where sodium salicylate cannot be suitably applied.—A. L. S.

The Manufacture of Alcohol from Peat. J. Matthëus. Dingl. Polyt. J. **287**, 91—92.

C. KAPPESSER proposed in 1891 to utilise peat in the manufacture of alcohol. The idea of converting cellulose into sugar and subsequently into alcohol is a very old one. But Braconnot and Flechsig's experiments, as well as those made in 1885 by Melsens on a large scale, showed that although by treating wood with sulphuric acid dextrose could be obtained, which might by fermentation be converted into alcohol, yet the expense of this process was so great in consideration of the small yield of alcohol that the process must be regarded as a commercial failure. The use of peat, however, offers the following advantages as against wood:—

(1.) No mechanical disintegration is required for the purpose of allowing aqueous solutions to penetrate the material. (2.) The conversion of peat into dextrose commences at 120° C., that of wood not below 150° C. (3.) Peat constitutes a much cheaper raw material than wood, since it can be had at about 4½*d.* per 100 kilos. of dry material. The manufacture is conducted in the following manner:—To the peat so much sulphuric acid of from 30° to 35° B. is added as will produce, together with the water contained in the peat, a 2·5 per cent. solution of sulphuric acid. Any waste sulphuric acid (spent acids, &c.) may be used. The peat and sulphuric acid are then heated together for five hours under pressure, at a temperature of from 115° to 120° C. The solution thus obtained is separated from undissolved residue by means of the filter press. The solution is then concentrated, and freed from sulphuric acid by treatment with milk of lime and carbonate of lime. The solution thus obtained is then cooled to 25° C. and fermented, and finally, the alcohol produced is distilled off in the usual way. Working in this manner with a peat containing 14 per cent. of moisture, 2,326 grms. of the peat required 75 cc. of sulphuric acid of 28° B., this mixture filled about 1·5 litres. After boiling under the above-mentioned conditions for four hours, the mass was filtered and the solution evaporated to one-third its volume. After neutralisation with lime the liquor was cooled to 25° C., after addition of yeast left to ferment, and subsequently the alcohol was distilled off. 200 grms. of peat thus yielded 12·5 cc. of absolute alcohol. This appears very encouraging, considering that 500 kilos. of the best potatoes, containing 20 per cent. of starch, yield under the most favourable circumstances about 61 litres of absolute alcohol, a quantity which, according to the experiment quoted above, would be obtained from 1,000 kilos. of dried peat.—C. O. W.

Presence in Alcohol of Higher Alcohols and other Impurities. E. Gossart. Comptes rend. 116, 797—800.

See under XXIII., *page* 790.

Distillation of Mixtures of Water and Alcohol. E. Sorel. Comptes rend. 116, 693.

Gröning's tables are in general use for the determination of the relationships between the composition of the mixture of vapours of alcohol and water given off on boiling aqueous spirit, and that of the fluid boiled. Practical experience, however, often indicates a considerable difference between the results thus deduced and those actually observed; the cause of this is the partial condensation of vapours on the inner surface of the distilling vessel above the level of the boiling fluid. The author obtained the following figures in an experiment with a cylindrical retort of copper furnished interiorly with a gutter running round the upper portion, so as to collect the fluid condensed on the uppermost walls; by means of an inverted siphon the condensed liquid passed outwards through the wall of the cylinder for collection and examination. By means of an inverted condenser attached, the evolved vapours not condensed on the sides of the cylinder were condensed and brought back into the distilling vessel. The exterior air was at about 18° C.:—

Liquid Boiled.	Condensed and Collected by Gutter.
° G. L. 3·9	° G. L. 8·8
7·1	14·0
13·0	29·0
17·9	37·0
26·7	52·3
35·7	60·6
43·4	67·4
60·9	76·0

Hence up to 25° G. L. (Gay-Lussac) the condensed liquid was only of about double the richness of that experimented with; whereas, according to Gröning, it should have contained a far larger proportion of alcohol. Obviously, the vapours passing out from the boiling cylinder would be proportionately richer in alcohol, on account of the partial removal by condensation of water vapour in the upper portion of the boiler.

By means of a distilling vessel of copper holding 5 litres, and entirely plunged in a bath of brine or glycerol, so as to prevent condensation on the copper walls, the following figures were arrived at:—

Liquid Boiled.	Distillate.		Difference.
	According to Gröning.	Found by Sorel.	
° G. L. 0	° G. L. 0	° G. L. 0	0
5	43·4	35·75	7·65
10	57·2	51·00	6·20
15	65·4	61·50	3·90
20	71·3	66·20	5·10
25	75·1	67·95	7·15
30	78·1	69·26	8·84
35	80·5	70·60	9·90
40	82·3	71·95	10·35
45	83·8	73·45	10·35
50	85·1	74·95	10·15
55	86·2	76·64	9·66
60	87·3	78·17	9·13
65	88·2	79·92	8·28
70	89·0	81·85	7·15
75	89·8	84·10	5·70
80	90·6	86·49	4·11
85	91·5	89·05	2·15
90	92·6	91·80	0·80
95	95·4	95·05	0·35
97·6	97·6	97·60	0

If *a* be the Gay-Lussac strength of the liquid distilled and U that of the distillate, the relationship between the two, between the limits of strength 25° and 65°, is given by the equation—

$$U = a \times 0{\cdot}2975 + 59{\cdot}86$$

—C. R. A. W.

Preparation of Pure Chloroform by Means of Salicylide-chloroform or o-Homosalicylide-chloroform. R. Anschütz. Annalen, 273 [1], 94—96.

In a paper "On the Formation of Salicylide" the author showed that the salicylide and *o*-homosalicylide or β-cresotide possess the remarkable property of forming beautifully crystalline compounds with chloroform. These compounds, on gently heating, give up the whole of the chloroform they contain, and as neither of the impurities occurring in chloroform combine with either salicylide or *o*-homosalicylide, these compounds suggest themselves as very useful for the preparation of pure chloroform. The quantities of chloroform taken up by these compounds are 33·24 and and 30·4 per cent. respectively, according to the formula of salicylide-chloroform $[C_{14}H_8O_4]_2.3CHCl_3$ and *o*-homosalicylide-chloroform $[C_{16}H_{12}O_4]_2.2CHCl_3$. The former is much more unstable than the latter, and is also much more soluble in chloroform. To prepare pure chloroform by means of these substances, they are heated in connection with a reflux condenser with excess of chloroform, and then left to stand for 12 hours. It is not necessary to use such a quantity of chloroform as would be necessary to dissolve the salicylide. The crystallised chloroform compounds are then pressed, and dried at a low temperature. The dried mass is then subjected to dry distillation at a low temperature, and the pure chloroform is condensed by suitable appliances.—C. O. W.

Odorous Power of Chloroform, Bromoform, and Iodoform. J. Passy. Comptes rend. 116, 769.

Comparative experiments gave fairly sharp results leading to the values in millionths of a gramme—

Chloroform	30
Bromoform	2 to 5
Iodoform	0·06 to 0·7

Bromoform in large quantity has the ethereal penetrating perfume characteristic of chloroform; whilst in attenuated doses the effect resembles that of the tenacious and disagreeable odour of iodoform.—C. R. A. W.

Dextro-Licareol. P. Barbier. Comptes rend. 116, 1459—1461.

The author has already described levo-licareol. The object of the present note is to show that the alcohol contained in the essential oil of coriander (*Coriandrum sativum*), described as "*Coriandrol*" is only the dextro-rotatory modification of licareol. Essence of coriander, submitted to a series of fractionations, breaks up into three chief parts:—1st. A hydrocarbon, $C_{10}H_{16}$, boiling between 165° and 180° C., and smelling strongly of coriander. 2nd. Coriandrol or dextro-licareol, b.p. 92°—93° C. under 15·5 mm. pressure. 3rd. At 120° C., under 16 mm. pressure, an oxygenated substance, forming the main subject of the author's inquiry.

The result of the inquiry is that coriandrol is very similar in all its properties to (levo-) licareol, except that it is dextro-rotatory and its odour is different. So great is the similarity that the author does not hesitate to style it "dextro-licareol." The aldehydes, hydrochlorides, acetates and alcohols of the two bodies (coriandrol and licareol) have been prepared, and their properties correspond too closely to leave any doubt on this subject. They are therefore optically isomeric.—A. L. S.

Licarene derived from Licareol. P. Barbier. Comptes rend. 116, 993—994.

(See preceding abstract). It is shown that licareol is transformed on dehydration by means of acetic anhydride, with loss of water, into the cyclic hydrocarbon group, $C_{10}H_{16}$, whilst under the influence of dry hydrogen chloride ("hydrochloric acid gas") it yields the body $C_{10}H_{18}Cl_2$.

The hydrocarbon, $C_{10}H_{16}$, is an active limonene, whilst the substance, $C_{10}H_{18}Cl_2$ is the inactive dihydrochloride.

Hashish. W. C. Mackenzie. Chem. and Drug. June 29, 1893, 183. This Journal 1893, 619.

The seeds of *Cannabis indica*, although almost identical in appearance with those of common hemp, differ in having a tougher coat, which difference may be distinctly observed by taking the seeds between the teeth and crushing them. The hashish seeds are also more flattened and sharper at the edge when cut through the middle; the section thus seen shows a dark line between the husk and the albumen, while in common hemp-seeds this dark substance is not so conspicuous or is absent altogether.

The active principal of hashish is generally supposed to be a resin, which was first obtained by T. and H. Smith; other investigators have isolated a volatile oil named cannabene (Personne), and an alkaloid, tetano-cannabine (Hay). Nicotine is said to have been obtained, but that has since been denied, and some authorities say the active principle has not yet been isolated.

By distilling hashish with water in a current of steam the writer has obtained a colourless volatile oil with a most penetrating odour, identical with that given off by heating hashish in a dry test-tube. For several days the condenser-tube smelled of this oil, even though the amount was very small (1 per cent.) The residue having been filtered off, the liquid on evaporation gave a residue, insoluble in alcohol and ether, equal to 6·7 per cent. The substance insoluble in water, after drying, gave 55·5 per cent. of a brown oily body by extraction with petroleum ether. By distillation this oily substance gave off, first, some colourless oil (230° C.) with a strong but not unpleasant odour somewhat resembling malt vinegar, and later, a thick yellow substance (320° C.), the odour of which reminded one of crude shale oil. The residue, after extraction with petroleum ether, was treated in the same way with alcohol, and gave 6·5 per cent. of a brown resin, which melted at about 70° C. The residue, insoluble in water, petroleum ether, and alcohol, equalled 31·80 per cent., and contained mineral matter equal to 13·7 per cent.

Approximate Composition of Hashish.

	Per cent.
Volatile oil	1
Substances soluble in water	6·7
Soluble in petroleum ether (oil)	55·5
„ alcohol (resin)	6·5
Insoluble organic matter	18·1
„ mineral „	13·7

General Expression for "Toxicity," and the Toxicity of the Stereoisomeric Acids. C. Chabrié. Comptes rend. 116, 1410.

See under Analyt. and Scientific Notes, *page* 790.

A New Apparatus for Measuring the Strength of Perfumes. E. Mesnard. Comptes rend. 116, 1461.

See under XXIII., *page* 786.

Contributions to our Knowledge of the Aconite Alkaloids Part VI.—Conversion of Aconitine into Isaconitine. W. R. Dunstan and F. H. Carr. Proc. Chem. Soc. [127], 1893, 171.

In a previous communication it has been shown that the roots of *Aconitum Napellus* contain, besides the highly poisonous aconitine, an almost non-poisonous isomeride—isaconitine (this Journal, 1893, 175). These alkaloids are evidently intimately related, as both furnish aconine and benzoic acid on hydrolysis. The authors now show that when an aqueous solution of aconitine hydrobromide (m.p. 163°) is heated, change very gradually takes place, the isomeric *isaconitine hydrobromide* (m.p. 282°) being produced. The change is facilitated by the addition of a small (1—2 per cent.) of hydrogen bromide, but is not assisted if sufficient is present to induce hydrolysis of a large proportion of aconitine. The isaconitine was identified not only by the high melting point of its salts, but also by the formation and analysis of the characteristic auchlorisaconitine. No similar change could be detected in the case of aconitine nitrate, either when neutral or acid solution was used, nor could the conversion be effected by heating aconitine with glacial acetic acid, although in this case anhydraconitine is produced if the heating be continued during 18 hours at 120°. Aconitine may be dissolved in concentrated sulphuric acid, and the solution gently heated without the conversion into isaconitine taking place; nor does aconitine sulphate undergo conversion into the isomeride when it is heated many hours in contact with very dilute sulphuric acid. No isaconitine seems to be produced during the hydrolysis of aconitine by cold soda solution. The authors are making further experiments in the hope of gaining information with regard to the mechanism of the conversion of aconitine hydrobromide into isaconitine hydromide.

The Essential Oil of Hops. Preliminary Notice. A. C. Chapman. Proc. Chem. Soc. 1893, 177.

About 80 kilos. of hops, some of which had been grown in Burgundy, some in Alsace, and the remainder in Kent and Sussex, were submitted to steam distillation in quantities of about 1 kilo. at a time.

When the greater part of the oil had been prepared the author was compelled, owing to pressure of other work, to discontinue its examination, and it was placed aside in a well-stoppered bottle, which it filled; at the end of about 10 or 11 months the remainder of the oil (about 30 cc.) was prepared, and the whole was then twice steam-distilled to free it from resin; about 140 cc. were obtained. On submitting the oil to distillation it commenced to boil at 170°, the thermometer rapidly rising to 230°, the greater part distilling over between 230° and 270°. After several fractionations, finally over sodium, about 40 cc. of oil were obtained, boiling between 256° and 261° (uncorr.). This was found on examination to be a sesquiterpene, three combustions giving numbers closely agreeing with those required by the formula $C_{15}H_{24}$.

Another freshly distilled sample of hop oil which was examined soon after its preparation was found to boil at much lower temperatures, and consisted of lower boiling point terpenes, together with an oxygenated constituent, and contained but little of the sesquiterpene.

PATENTS.

Improvements in Purifying Saccharine. J. Y. Johnson, London. From Dr. F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 10,769, June 1, 1893.

A concentrated solution of the crude substance, which consists of a mixture of para-sulphamine-benzoic acid and o-benzoyl-sulphonic imide (pure saccharine) is neutralised with a carbonate of any of the alkalis or alkaline earths, when the para-sulphamine-benzoic acid salt of the base employed crystallises out, leaving the saccharine salt in solution, from which solution, by neutralising with acid, pure saccharine is obtained.—J. G. W.

Manufacture of Aluminium Tannico-Tartaricum. J. Wetter, London. From J. D. Riedel, Berlin, Germany. Eng. Pat. 11,379, June 9, 1893.

When an aluminium salt is treated with tannic acid in dilute solution, sodium acetate being added to neutralise the liberated inorganic acids, a grey, insoluble, basic aluminium tannate results, which has the formula—

$$Al_2\genfrac{}{}{0pt}{}{\overline{T_2}}{(OH)_4} + 10\ aq.$$

If this be treated with a solution of tartaric acid in the proportion of two molecules of the acid to one molecule of the basic salt, and the resulting solution evaporated, a double tannate and tartrate of aluminium is obtained, to which the names "*Aluminium tannico-tartaricum*" and "*Tannal*" are given. It is a yellowish white, crystalline powder with a strongly astringent taste, is soluble in water and has the formula—

$$Al_2\genfrac{}{}{0pt}{}{\overline{T_2}}{T_2} + 6\ aq.$$

The combined therapeutic effects of its components are claimed for this compound.—J. G. W.

Improvements in the Manufacture of Spermine; that is to say, that Form of Spermine which is represented by $C_4H_{10}N_2$. W. Majert, Berlin, Germany. Eng. Pat. 15,404,* September 29, 1890. See also this Journal, 1891, 791.

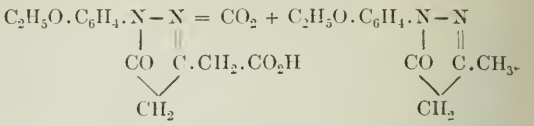
The author has amended the title of his patent, apparently now considering the formula of spermine as C_2H_5N, and that of piperazine as $C_4H_{10}N_2$.—J. G. W.

Improvements in the Manufacture of Piperazine or a Form of Spermine represented by $C_4H_{10}N_2$. W. Majert, Berlin, Germany. Eng. Pat. 11,957,* July 14, 1891. See also this Journal, 1892, 773.

See preceding abstract.—J. G. W.

Improvements in the Production of Pyrazolone Derivatives. O. Imray, London. From The Farbwerke, vormals Meister, Lucius, and Brüning, Hoechst-am-Main, Germany. Eng. Pat. 14,716, August 15, 1892. See also this Journal, 1893, 288.

Ethoxy-phenylhydrazine when treated with acetone dicarboxylic acid in the presence of hydrochloric acid yields *p*-ethoxy-phenyl-pyrazolone carbonic acid, a crystalline body, melting at 164° C. with decomposition at the same time into carbonic anhydride and *p-ethoxy-phenyl-methyl-pyrazolone*, in accordance with the equation—



$$C_2H_5O.C_6H_4.\underset{\underset{\displaystyle\mathrm{CO}\diagdown\!\underset{\displaystyle CH_2}{}\!\diagup C.CH_2.CO_2H}{|}}{N}-\underset{\|}{N} = CO_2 + C_2H_5O.C_6H_4.\underset{\underset{\displaystyle\mathrm{CO}\diagdown\!\underset{\displaystyle CH_2}{}\!\diagup C.CH_3}{|}}{N}-\underset{\|}{N}$$

p-Ethoxy-antipyrine (see also this Journal, 1893, 371) is prepared by heating *p*-ethoxy-phenyl-methyl-pyrazolone carbonic acid with methyl alcohol and iodide to 100° C., distilling off the alcohol, and heating the residue to 170° to drive off the CO_2. The residue is then extracted with water and the solution made alkaline with soda-lye and shaken up with benzene. The benzene solution, on evaporation, leaves *p*-ethoxy-antipyrine, which is purified by recrystallisation from ethyl acetate.

p-Ethoxy-homo-antipyrine may be prepared from either *p*-ethoxy-phenyl-methyl-pyrazolone carbonic acid or *p*-ethoxy-phenyl-methyl-pyrazolone by heating with ethyl alcohol and iodide, and subsequently treating as in the preparation of the preceding compound, save that, in the latter case, the residue does not require heating to drive off the CO_2. It is a crystalline body, melting at 121°—122° C., is readily soluble in water and alcohol, forms a green nitroso-compound, and in aqueous solution gives a dark red coloration with ferric chloride.

p-Ethoxy-phenyl-methyl-ethyl-pyrazolone separates in a crystalline form when ethyl-aceto-acetic ester and *p*-ethoxy-phenyl-hydrazine are heated to 130° C. and the product poured while warm into ether. After recrystallisation from dilute alcohol it melts at 132° C., is easily soluble in alcohol, ethyl acetate, dilute acids, and alkalis, but difficultly so in ether and water.

p-Ethoxy-ethyl-antipyrine is formed by methylating *p*-ethoxy-phenyl-methyl-ethyl pyrazolone and treating the product as in the case of *p*-ethoxy-antipyrine. It has a melting-point of 105°—106° C., is easily soluble in alcohol and dilute acids, with difficulty so in cold water and ether, and insoluble in alkalis.—J. G. W.

The Manufacture or Production of New Bases and Salts thereof, containing Sulphur, from Dithiobiurets. H. E. Newton, London. From The Farbenfabriken, vormals F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 14,881, August 17, 1892.

When dithiobiurets of the general formula $RC_2H_4N_3S_2$ are treated with oxidising agents, in alkaline, neutral, or acid solution, new basic disulphides or "*thiurets*" are produced, which have the general formula $RC_2H_2N_3S_2$. Several of these derivatives have been obtained from dithiobiurets of both the benzene and naphthalene series. Alkylhydroxythiurets of the general formula $R^1ORC_2H_2N_3S_2$ (such as ethoxythiuret) have been obtained by oxidising alkylhydroxyphenyldithiobiurets in the same way. When an acid is employed in effecting the oxidation, or is formed during the oxidation, the base is liberated by treating the resulting thiuret salts with dilute alkalis.

Thiuret, the derivative of α-phenyldithiobiuret, forms brilliant yellow crystals, melting at 146° C. with decomposition, and is readily soluble in cold, strong alcohol.

Para-methylthiuret, the thiuret of paratolyldithiobiuret, crystallises from alcohol in pale yellow, prismatic crystals, melting at 101° C.

Ortho-methylthiuret, formed from orthotolyldithiobiuret, occurs as light grey crystals, readily soluble in alcohol, and melting at 87° C.

Dimethylthiuret, the thiuret of metaxylyldithiobiuret, melts at 90°.

All these thiurets readily form salts with inorganic acids, including boric acid, and also with organic acids, such as phenolsulphonic, salicylic, and ortho-cresotinic.

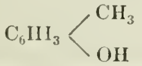
p-ethoxythiuret hydrochloride forms needles of a greyish colour, melting at 156°. The α-naphthyl derivative of thiuret melts at 238°, and forms a yellowish-green hydrochloride and also a hydri-iodide.

The inventors claim that these thiurets are capable of being employed medicinally, or as disinfectants.—J. G. W.

The Manufacture of Iodine Compounds from Phenols or Carboxylic Acids thereof. H. E. Newton, London. From The Farbenfabriken, vormals F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 16,112, September 8, 1892.

Iodine derivatives of phenols and carboxylic acids thereof, in which the iodine takes the place of the hydrogen atom of the hydroxyl group, have been described in previous patents (see this Journal, 1890, 412; and 1892, 370). The present invention is of tri-iodo-derivatives which contain a hydroxyl group, the iodine taking the place of three hydrogen atoms of the benzene nucleus, with simultaneous separation of carbonic anhydride from the carboxyl group. The method of preparation consists in dissolving molecular proportions of the phenol and sodium carbonate in a large quantity of water and treating gradually with the requisite amount of iodine dissolved in potassium iodide.

The tri-iodo-derivative of metacresotinic acid has the formula—



$$C_6HI_3\left\langle\begin{matrix}CH_3\\OH\end{matrix}\right.$$

is easily soluble in ether, benzene, and chloroform, but with difficulty in alcohol. It melts at 121·5° C. The triiodide of *o*-cresotinic acid melts at 60·5°, whilst that from *p*-cresotinic acid melts at 57°. Both compounds are easily soluble in alcohol, ether, benzene, and chloroform. Salicylic acid yields tri-iodophenol, melting at 156° C.

It is claimed that these products may be used for pharmaceutical purposes other than those for which the former products were applicable.—J. G. W.

Improvements in the Manufacture of Chloro-para-oxybenzoic Acids. B. Willcox, London. From Dr. F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 17,147, September 26, 1892.

Contrary to the statement of Peltzer (Annalen, **146**, 285), the inventor finds that free *p*-oxybenzoic acid can be easily converted by chlorine, first into monochloroparahydroxybenzoic acid and then into dichloroparahydroxybenzoic acid, with a yield almost equal to the theoretical amount. A mixture of *p*-hydroxybenzoic acid and acetic acid is treated with chlorine, or chlorine-yielding materials such as hydrochloric acid and potassium chlorate, so that the amounts of *p*-hydroxybenzoic acid and chlorine are in molecular proportion. On diluting the resulting solution a crystalline mass of monochloroparahydroxybenzoic acid is formed. The dichloro-acid is produced by doubling the proportion of chlorine employed.

These chloroparahydroxybenzoic acids are applicable to the preparation of catechol and pyrogallol in the same way as are the similar bromo-acids (this Journal, 1892, 369). —J. G. W.

A New or Improved Manufacture of Double Salts containing Fluorine and an always Constant Amount of Antimony. W. P. Thompson, Liverpool. From T. Mayer, Feuerbach, Germany. Eng. Pat. 17,228, September 27, 1892.

This is a process for preparing compounds of antimony fluoride and alkaline sulphates having the general formula $2SbF_3.M_2SO_4$, and containing a larger amount of antimony than any similar double salt hitherto known.

Antimony oxide is dissolved in hydrofluoric acid or in hydrofluoric acid and 33 per cent. hydrochloric acid, and then the requisite quantity of alkaline sulphate stirred into the warmed solution. On cooling it, the double salts crystallise out, but more readily and in finer crystals from the solution containing hydrochloric acid.

The potassium and ammonium salts are very soluble in water and are permanent. The sodium salt could not be obtained in the crystalline state.—J. G. W.

Improvements in the Method of Closing and in the Construction of Receptacles for the Reception of Chloride of Ethyl or Methyl or other Similar Liquid. J. W. Mackenzie, London. From Dr. J. Bengué, Paris, France. Eng. Pat. 12,037, June 19, 1893.

This invention consists of a stopper for tightly closing receptacles for very volatile liquids, which will allow a fine jet of liquid to be obtained when desired. It is composed of a glass tube having a capillary bore opening out into a cup at the lower end, which cup is covered with a bit of cloth for filtering any liquid that has to pass up the tube. The tube is encased in a metallic covering, which screws into the receptacle. The upper end of the tube is closed by a cap, packed with rubber, which screws on to the metal casing.—J. G. W.

Addendum.—This Journal, 1893, 707, col. 2, line 14 from top, after authors' names, insert Ber. 1893, **26**, 777—784.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic Applications of Cobaltic Salts. A. and L. Lumière. Comptes rend. **116**, 1361.

Peroxide of cobalt (hydrate) is precipitated by the addition of sodium peroxide to a solution of a cobaltous salt; the precipitate after thorough washing is digested with a saturated solution of oxalic acid in the cold. A green solution of a very unstable, *i.e.*, photosensitive, oxalate is thus obtained. Paper coated with gelatin is impregnated with this solution and dried in a dark room. This paper when suitably exposed gives a negative image owing to reduction of the cobaltic salt; the image is fixed by reaction with potassium ferricyanide (5 per cent. solution), and the unattacked cobaltic salt removed by copious washing. The image thus produced is of a pale reddish tone and gives satisfactory effects on conversion into sulphide. Further investigation of the process is promised.—C. F. C.

PATENT.

Improvements in Photographic Developing Solutions. R. G. Williams, Manchester. Eng. Pat. 17,766, October 5, 1892.

Rosolic acid, in the form of either of its compounds with the alkaline metals, is mixed with the developing solution in the proportion of 25 parts of a 1 per cent. solution to 250 parts of developer, and it is claimed that its use enables development to be carried on in gaslight or in imperfectly light-tight dark rooms without risk of fogging. The plate becomes stained, but this stain may be removed by successive treatment, after fixing, with alum solution, a very weak solution of sodium carbonate, and, finally, alum solution again.

Phenolphthaleïn or any other suitable yellow or red colouring matter which is soluble in alkalis, and does not dye the film, may be used instead of rosolic acid.—J. G. W.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

Improvements in or Connected with Ships' Rockets, Signal Lights, Roman Candles, and other Fireworks. G. Pinder, Newark, Nottingham. Eng. Pat. 8226, April 24, 1893.

The object of this invention is to obviate the present somewhat dangerous practice of placing a portion of the igniting material in contact with the composition of the rocket or signal light. In the present invention this is attained by allowing the ignition to first take place in a supplementary tube outside, and attached to, the rocket or signal light, with which it communicates by a time fuse. The specification is accompanied by six figures, which illustrate the adjustment and working of the rocket. —W. M.

Improvements in Pyrotechnical Compositions or Fireworks. G. Gillischewski, Berlin, Germany. Eng. Pat. 11,073, June 6, 1893.

This invention relates to a composition for pyrotechnical purposes in which finely-divided aluminium is employed with the object of producing brilliant sparks.—W. M.

Improvements in Lighting Compositions. A. Lange, New Weissensel, near Berlin, Germany. Eng. Pat. 11,226, June 8, 1893.

The object of this invention is to produce a "lighting composition to be ignited by friction for lighting material which is not very inflammable." The composition found to answer the purpose best is—

	Parts.
Chlorate of potash	2½
White phosphorus	20
Sandarac	20
Gum arabic	100

In order to produce a continuous lighting band, the mixture is fastened on strips of paper or linen. Ignition is obtained by striking a hard object across the end of the band.—W. M.

Improvements in and relating to the Manufacture of Matches. C. M. Bowman, Lebanon, Pennsylvania, U.S.A. Eng. Pat. 12,168, June 20, 1893.

This invention "relates to friction matches, and has for its object certain improvements in the manufacture thereof, to produce them economically, greatly reduce the cost of transportation, and facilitate their use, and the convenience of handling or carrying them on the person of the consumer." The method of making the matches consists in "feeding paper in a sheet, puncturing the paper longitudinally and transversely to form the continuous edges and ends of the match-splints, and depositing fulminate in drops on the upper surface of the punctured paper intermittently, before separating the paper."—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS, ETC.

Diminution of the Co-efficient of Expansion of Glass. L. C. Baudin. Comptes rend. **116**, 971—974.

When a thermometer is strongly heated so as to re-boil the mercury in it, shrinkage of the bulb usually takes place, so that the zero point rises. The stem is also affected in similar fashion, so that the capacity of the stem is lessened in the same proportion as that of the bulb, and consequently the length is correspondingly shortened. Taking these variations into account, it still results that the co-efficient of expansion of the glass is diminished; thus observations made with a green glass thermometer, the zero point of which rose 26·22°, indicated that if the co-efficient before reheating was 0·000021552, afterwards it became reduced to 0·00002096.—C. R. A. W.

A New Apparatus for Measuring the Strength of Perfumes. E. Mesnard. Comptes rend. **116**, 1461—1464.

The method is based on two reactions :—

(1.) A certain quantity of vapour of terebentene mixed with a definite volume of air is able to prevent the phosphorence which phosphorus exposed to air always exhibits.

(2.) A mixture of vapour of terebentene and any perfume may be obtained such that the mixture may be said to possess a neutral odour, *i.e.*, a small addition of either body causes the predominance of its own distinctive odour.

The apparatus used consists of a balloon of blackened glass, in the interior of which is suspended a fragment of starch rendered phosphorescent by being dipped in a solution of phosphorus in carbon bisulphide. A tube is provided for viewing this. A second vessel consists of a bell glass resting on a dish of mercury, and of about 10 litres capacity; it is thus of sufficient capacity to contain a plant or bouquet of flowers.

The air under the bell glass being well mixed by the aid of a suitable apparatus, air charged with essence of terebentene is introduced until the odour has become neutral. The amount of terebentene is measured by the amount of air from the bell glass necessary to extinguish the phosphorescence.

The apparatus for measuring the very small quantities of essences is composed of two plano-convex lenses of very large curvature, which produce Newton's rings when brought into contact. A drop of essence between these two glasses will produce a circle of a certain diameter, of which the cubical contents are easily calculated. The instrument the author used gave with 1 cubic millimetre a circle of 20 mm. diameter.

Some essences act like terebentene in extinguishing the phosphorescence, but most have no such action.

The intensity of perfumes is not in all cases found to be the same for each cubic millimetre, when the amount used in a test is varied.

For some scents (essence of roses, Ylang-Ylang, Neróly) the intensity was most marked when the test quantity was least; for others (geranium, &c.) the converse holds good.—A. L. S.

PATENT.

An Oil-testing Apparatus for Ascertaining the Frictional Co-efficient of Oils and Fats. G. Thomas, Manchester. From A. Stauber, Leipzig. Eng. Pat. 15,270, August 25, 1892.

The patented apparatus, two views of which are given in a drawing, consists of a flanged disc wheel supported on a horizontal shaft and driven by pulleys so as to revolve in a vertical plane. The flange of the wheel forms an annular groove, into which the lubricant to be tested is poured. Into the same groove is fitted a brake, which is carried round for a certain distance with the wheel when the apparatus is set in motion, and the frictional resistance of the oil is measured by this distance. This is automatically indicated by a pointer connected with the brake.—J. L.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Estimation of Manganese by Oxidimetric Methods. A. Carnot. Comptes rend. **116**, 1375—1378.

The author has determined the conditions under which manganese may be precipitated from solutions of its salts as a peroxide of definite composition, in a condition therefore permitting exact estimation by the various oxidimetric methods available.

The most satisfactory process consists in adding hydrogen peroxide to the solution, then ammonia in excess, followed by boiling for a few minutes. The precipitate obtained is of constant composition, viz., $5MnO_2.MnO$. One or two special variations are to be noted, viz.: —(1.) In presence of much ammoniacal salt the peroxide must be added in excess. (2.) In presence of salts of copper, zinc, nickel, and cobalt it is necessary to redissolve the precipitate in very dilute nitric acid with addition of hydrogen peroxide, and repeat the precipitation as above. A third similar treatment may be necessary in presence of relatively large quantities of copper, zinc, and nickel salts, and even further treatment in presence of cobalt. (3.) If iron salt is present in quantity it is better to eliminate it by a preliminary precipitation of the manganese, which may be conveniently effected by solution of the substance in strong nitric acid and adding potassium chlorate in successive small quantities.

The manganese may also be precipitated as the oxide Mn_6O_{11} by means of bromine and ammonia, taking care to digest for some time with bromine in the nearly neutral solution. The precipitate requires exhaustive washing with boiling water. The author's experience, however, leads him to give preference to the peroxide method of precipitation as above described.—C. F. C.

The Determination of the Salts of Iron by an Iodometric Method. Edouard Nihoul. Rev. des Mines et de la Met. Eng. and Mining J. **56** (1893), 83.

This method is founded on the fact that ferric salts react with potassium iodide in presence of an acid. Hitherto quantitative methods making use of this reaction have not been successful, as under ordinary conditions the reaction is not completed. The author's modification of the process consists in conducting the reaction by heating under pressure and eliminating the iodine as it is formed. The apparatus consists of a flask, such as is used for fractional distillation; it is closed with a perforated stopper through which passes a tube. The tube outside is bifurcated, and one of the branches communicates with a carbonic acid generator, while the other serves for the introduction of the potassium iodide. The products of distillation are received in a Volhard condenser containing a solution of potassium iodide. The ferric salt is introduced into the flask either as a solid or in solution. Hydrochloric acid is added and heat applied if needful. The apparatus is then cleared of all contained air by a current of carbonic acid. When all the air is expelled, a small excess of a moderately concentrated solution of potassium iodide is introduced by means of a small pipette. The contents of the flask are heated to ebullition, and a slight current of carbonic acid is introduced all the time. After ten or fifteen minutes almost the whole of the iodine will have been expelled, and condensed in the Volhard condenser. The contents of the flask are added to the distillate and the iodine is determined in the total liquid by a solution of sodium thiosulphate. In this reaction 0·4416 of iron corresponds to 1 part of iodine. Care must be taken to allow the contents of the flask to cool after distillation, with exclusion of air, by the current of carbonic acid. The determination should be made rapidly, so as to prevent the possible return of a part of the ferrous salts to the ferric state. A further modification of the process is required if it be desired to avoid adding the contents of the flask to the contents of the condenser, *i.e.*, if it be desired to expel the whole of the iodine by distillation. This can be affected by adding concentrated hydrochloric acid in several portions during the operation, especially at its end. In this case the excess of potassium iodide is changed into chloride. In using this method it is necessary to refrigerate the Volhard condenser in order to condense the vapours of chlorine rapidly. Also as far as possible, to make use of stoppers which have been used two or three times, as the action of iodine on new stoppers causes a loss.

The application of this method to the determination of iron in ores is thus described. Dissolve from 0·3 grm. to 0·5 grm. of the finely powdered ore, in the fractional distillation flask, with 25 cc. of concentrated hydrochloric acid, and then introduce a slow current of gaseous hydrochloric acid, heating almost to ebullition so as to keep the acid in as concentrated a form as possible. After solution is completed, the apparatus is placed in connection with the Volhard condenser, and a current of carbonic acid gas introduced. Pour the solution of potassium iodide in slight excess into the flask and heat to ebullition. When most of the iodine has been expelled, small quantities of gaseous hydrochloric acid are repeatedly introduced into the residue, and when all the iodine is thus removed it is determined in the distillate by thiosulphate solution.

It is sometimes useful to introduce a small crystal of potassium iodide into the flask at the very first, as the hydriodic acid thus formed considerably facilitates the solution of the ore. Sometimes even the whole of the potassium iodide may be introduced at the first, but special care must be taken to expel all the air preliminarily.

If the iron is in the ferrous state or partly ferrous and ferric, the ore to be tested is dissolved in the same way as described, but without the previous addition of potassium iodide. When the solution is complete, some crystals of potassium chlorate or permanganate are added, and while the solution is maintained at ebullition, a current of hydrochloric acid is introduced, until the chlorine has entirely disappeared. The apparatus is then swept out with carbonic acid, the flask reconnected to the condenser, and the operation completed as before.

De Koninck has recommended the substitution of hydriodic acid in solution for potassium iodide. With the reaction the iodine is not retained so obstinately in the flask, and it may be easily expelled at the end of a few minutes by a current of steam. The use of hydriodic acid also has the advantage of not requiring the use of gaseous hydrochloric acid in the solution of the ore, that is, if the iron is in the ferric state.

Determination of Phosphoric Acid. A. Villiers and F. Borg. Comptes rend. **116**, 989—993.

In order to get exact determinations by the molybdic process particular conditions must be observed. The authors lay down the following rules. In the absence of alumina and iron, for every decigrm. of phosphoric acid about 100 ccs. of molybdic solution should be used; this liquor is made by dissolving 150 grms. of ammonium molybdate in slightly warm water, making up to a litre with cold water, and pouring into a litre of nitric acid of sp. gr. 1·2. The precipitation should be effected at a temperature below 15° C., as at higher temperatures the precipitate is very fine, and readily passes through filters. The reagent should be gently poured down the sides of the containing vessel and the mixture not agitated for some two hours. With pure sodium phosphate the precipitation is complete in four hours; various salts, notably potassium salts, if present, slacken the reaction, which, however, is complete after a longer digestion in the cold (24 to 48 hours), or after four hours at 40°. The precipitate is washed by decantation and filtration with water containing one-twentieth of the molybdic liquor (with pure water it is apt to pass through the filter), and is then weighed after 6 hours drying. Under these conditions the precipitate has strictly the composition PO_5, $24MoO_3$, $3NH_4O$, $3HO$, one part containing 0·03728 parts of PO_5.

In presence of aluminium and iron the precipitate is apt to contain perceptible quantities of these metals sufficient to increase the weight of the precipitate by 3 or 4 per cent. of its true value. To eliminate these, the precipitate obtained as before is not collected on a filter, but is simply dissolved in ammonia, treated with tartaric acid, rendered alkaline with ammonia if requisite, and precipitated by magnesia as usual. Or the ammonical solution is reprecipitated by nitric acid, whereby much of the alumina and iron originally present is removed; the weight of the precipitate is still about 1 per cent. too high.—C. R. A. W.

The Volatility of Stannic Chloride. T. M. Drown and G. F. Eldridge. Techn. Quarterly, **5** [182], 136—156.

It is generally accepted that tin is volatilised on evaporating solutions of stannic chloride. The point of dilution at which the risk of thus incurring loss disappears has not previously been ascertained, to the detriment of analytical knowledge. In undertaking the present investigation the authors found it necessary, in view of the large number of determinations of tin which it involved, to adopt a standard method of estimation. That decided upon consisted in adding 0·2—0·3 grm. of powdered zinc to the solution of tin, which should have a volume of about 5 cc., and thus precipitating the tin as metal; 40 cc. of hydrochloric acid (sp. gr. 1·2) were then added and the stannous chloride formed, estimated by the addition of ferric chloride in slight excess, followed by titration of the resulting ferrous chloride with bichromate solution. The method is fairly accurate.

The stannic chloride used in the experiments was prepared by dissolving tin in hydrochloric acid, oxidising by means of chlorine and evaporating off excess of chlorine and the bulk of the hydrochloric acid. The vessel in which known quantities of stannic chloride were heated to determine the loss by volatilisation was a round-bottomed flask of 200 cc. capacity immersed to its neck in a bath of petroleum oil of high boiling point. The results obtained are recorded in numerous tables and are also illustrated by curves. They may be stated as follows:—

(1.) An acid concentrated solution of stannic chloride (1·4716 grms. of tin in 10 cc. and 10 cc. of hydrochloric acid sp. gr. 1·12) could not be heated for 15 minutes to 100° C. without the loss of an appreciable amount of tin, and at higher temperatures the loss was very rapid.

(2.) An acid solution of stannic chloride containing less than half the amount of tin mentioned under (1), *e.g.*, 0·6379 grm. in 10 cc., and 10 cc. of hydrochloric acid of sp. gr. 1·12 lost no tin when heated to 100°—110° C., until a certain amount of concentration had taken place.

(3.) The risk of loss with weaker solutions of stannic chloride was still less.

(4.) Much free hydrochloric acid favoured the volatilisation of tin both at high and low temperatures, but no volatilisation took place when the solution contained but little tin.

(5.) The limit to the loss of tin is set by the decomposition of the stannic-chloride; the stannic hydrate formed, being fixed.

(6.) As a deduction from (5) it was supposed, and confirmed by experiment, that the whole of the tin could be volatilised by repeated evaporation with hydrochloric acid; the ease and rapidity with which such volatilisation could be effected were found to be diminished by the presence of nitric acid, which probably tended to induce an earlier formation of hydrate.

An analytical method was based on these experiments. The separation of lead and tin can be effected by repeated evaporation of the chlorides of the two metals with strong hydrochloric acid, the lead chloride being non-volatile under these conditions.—B. B.

A Quantitative Method of separating Iodine from Chlorine and Bromine. D. S. Macnair. Proc. Chem. Soc. [127], 1893, 181.

The method is based on the fact that when treated with potassium bichromate and concentrated sulphuric acid, silver iodide is completely converted into silver iodate, whereas silver chloride and bromide are converted into sulphate. Two portions of a solution containing the three halogens are precipitated with silver nitrate: the one precipitate is weighed, the other is heated with the oxidising mixture, and the resulting iodate is then reduced by means of sulphurous acid, and the iodide is filtered off and weighed. The silver originally present as chloride and bromide contained in the filtrate from the iodide is precipitated and weighed as chloride. The method affords very accurate results.

At the suggestion of Dr. H. E. Armstrong, the author used a Gooch crucible asbestos filter, instead of paper, and found it advantageous both as regards speed and accuracy, as it is not necessary to use two portions of the liquid when the chlorine and bromine are to be determined; the precipitate of the mixed haloids may be dried at 120°, weighed, and then treated with sulphuric acid and potassium bichromate as usual, along with the asbestos previously used in filtering. When the oxidation is finished, the solution is diluted and sulphurous acid is added at once, *without* previously filtering off the asbestos, which is collected along with the silver iodide. The weight of the asbestos used in the first filtration is necessarily deducted from that of the silver iodide. It is evident that this asbestos might be removed by filtering before adding sulphurous acid, but this is not recommended, as silver iodate is apt to separate out during the filtration, and unless this be *completely* redissolved—no easy matter—before the addition of sulphurous acid, it will escape reduction, and the results will be unreliable.

The Use of Sodium Peroxide as an Analytical Agent. J. Clark. Proc. Chem. Soc. [127], 1893, 184.

Experiments are described showing that the sulphur and arsenic in minerals may be rendered soluble by cautiously heating the powdered substance with sodium peroxide, and that the peroxide may, in like manner, be used in estimating chromium in chrome ores and chromium alloys.

An ammoniacal solution af the peroxide may be used in separating manganese from zinc, nickel, and cobalt, a single precipitation sufficing in the case of zinc.

ORGANIC CHEMISTRY.—QUALITATIVE.

Notes on Oxycellulose and Bornesite. E. R. Flint and B. Tollens. Annalen, **272**, 288.

A. *Oxycellulose.*—The authors have prepared further quantities of oxycellulose from pine wood by oxidation with nitric acid (this Journal, 1892, 835). Ultimate analysis gave the following results: C, 42·32; H, 6·05. The product was found to contain no methoxyl. By solution in sulphuric acid, diluting, and boiling, &c., the author failed to obtain dextrose in appreciable quantity. The only positive reactions obtained were those indicating the presence of aldehydic groups, viz., boiling Fehling's solution reduced and violet colour with fuchsin sulphurous acid.

B. *Bornesite or Methyl Inosite.*—A quantity of a yellow crystalline substance separating from the wash waters of a caoutchouc factory, after purification, was investigated, with the following results:—Composition, $C_6H_{11}(CH_3)O_6$, by ultimate analysis and determination of methyl; m.p. 199°—203°; specific rotation $(a)_D = +31·16°$. Methyl inosite is therefore a constituent of certain caoutchoucs.—C. F. C.

Furfur Alcohol and Derivatives. L. von Wissell and B. Tollens. Annalen, **272**, 291.

The well-known reaction—

$$\underset{\text{Furfurol.}}{2C_5H_4O_2} + KOH = \underset{\substack{\text{Furfur}\\\text{alcohol.}}}{C_5H_6O_2} + \underset{\substack{\text{Potassium}\\\text{Pyromucate.}}}{C_5H_3O_3K}$$

carried out under the conditions described by the authors, gives satisfactory yields of both the alcohol and acid. The former is easily separated by distillation in a current of steam at 140° C. Ths pure alcohol is found to give no red coloration with aniline acetate. It is extraordinarily sensitive to acids, by which it is rapidly converted into resinous products. The following derivatives of the alcohol have been investigated:—

Furfuryl-methyl Furfuryl-ethyl Furfuryl-*n*-propyl Furfuryl-amyl	Ether.
Furfuryl-benzoic Furfuryl-acetic	Ester.

—C. F. C.

Amidonaphthol Sulphonic Acids. F. Reverdin and Ch. de la Harpe. Ber. 26, 1279.

See under IV., *page* 749.

Preliminary Qualitative Tests for Purity of Drinking Water. F. Wyatt. Eng. and Mining J. 1893, 168.

These simple tests require no apparatus that is not found in every household.

First.—Pour a glassful of the water into a decanter, cork it, and shake it up violently for a minute or two. If it develop any bad smell after this operation the water may be suspected of sewage or other animal contamination.

Second.—Add to a small glassful of the water two or three drops of dilute sulphuric acid and stir. Then pour in about two drops of a weak solution of permanganate of potassium or sufficient to colour it a faint rose. Cover the glass with a saucer and leave it standing for 10 minutes, when, if the rose colour has entirely disappeared, the water is probably unwholesome and requires to be investigated.

Third.—Take a very clean, dry glass and put into it a few drops of a solution of nitrate of silver, and then pour in a couple of ounces of the water. If it becomes milky add to it a few drops of dilute nitric acid. If the milkiness does not now nearly all clear away the water will be proved to contain much chlorine, and unless it be taken from some source near the coast or near to salt springs, is probably contaminated with sewage.

Fourth.—Take two white eight-ounce bottles with well-fitting stoppers and wash them thoroughly clean. Nearly fill one of them with the natural water and the other with the water after boiling it for 30 minutes. Now put into each bottle a teaspoonful of pure white granulated sugar, shake them until the sugar dissolves, and then place them side by side at a temperature of about 80° F., and let them stand for three days. If the unboiled water rapidly cloud up and show a marked fermentation, emitting an odour faintly recalling rancid butter, it probably contains phosphates, and may be suspected of contamination with sewage. If the boiled water show any signs of decomposition, the suspicion of serious contamination will be confirmed.

Fifth.—Pour a small quantity of the water into a white saucer and carefully add to it one drop of ammonium sulphide. If a dark colour is formed which immediately disappears on the addition of one or two drops of pure hydrochloric acid, iron salts are present. If the dark colour does not disappear, the water contains other and possibly poisonous metals, and should at once be rejected.

If any or all of the first four of these rough tests be doubtful or unfavourable in their results, they will render valuable service, if only by pointing to the necessity for purifying the water before it can be drunk with safety.

How this purification should be performed is a matter upon which there are numerous suggestions and much difference of opinion; the best and most efficient manner of doing it in the household is by boiling it for 30 minutes. Dr. Miquel, of Paris, has dispelled all doubt upon this subject by publishing the following figures:—Bacteria in each cubic centimetre of water, at 60° F., 460,800; 122° F. for 10 minutes, 600; 140° F. for 10 minutes, 90; 158° F. for 10 minutes, 89; 176° F. for 10 minutes, 63; 195° F. for 10 minutes, 27; 212° F. for 20 minutes, none. This evidence is too striking to require any comment, and the author states in conclusion that, if after it is boiled, the water be first cooled, and then passed through an ordinary charcoal or other suitable filter, its flat and uninviting taste will be immediately removed.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Detection and Estimation of Formaldehyde. A. Trillat. Comptes rend. 116, 891—894.

By the action of formaldehyde on dimethylaniline tetramethyldiamidodiphenylmethane is produced. This is made the basis of the following test for the aldehyde:—The substance to be examined is, if necessary, dissolved in or extracted with water. A few drops of dimethylaniline are added and intimately intermixed, and then a few drops of sulphuric acid. The liquid is next heated for half an hour on the water-bath, after which it is rendered alkaline and boiled to expel the unchanged dimethylaniline. The presence of formaldehyde is indicated by the formation of a precipitate of the diphenylmethane compound, which is recognised by the intense blue coloration it yields on treatment with lead dioxide and acetic acid.

The reaction between aniline and formaldehyde may also be applied to the detection of the latter:—An aqueous solution, containing 3 grms. of aniline per litre, is prepared, and 20 cc. of it added to a similar volume of the solution to be tested, which must be neutralised if necessary. Formaldehyde gives under these conditions a white, cloudy precipitate of anhydroformaldehydaniline, $C_6H_5N:CH_2$, on standing for a few hours. One part in 20,000 may be so detected, but in order to do this the test-liquid must be allowed to stand for several days. Acetaldehyde gives a similar reaction.

The quantity of formaldehyde present in commercial preparations of this substance may be approximately estimated by collecting the precipitate obtained with aniline on a tared filter, drying at 40°, and weighing. For this purpose 1—4 cc., according to the amount of formaldehyde present, of the neutral solution are treated with a slight excess of aniline solution. The precipitate formed, after agitation, settles well, and after 48 hours' repose may be filtered off without difficulty.

It has been proposed to determine formaldehyde by estimating the quantity of ammonia required for its transformation into hexamethyleneamine, this being in one method accomplished by adding a standard solution of ammonia to the formaldehyde solution and titrating the excess of ammonia with sulphuric acid. But the fact has been overlooked in this process that hexamethyleneamine has a distinctly alkaline reaction. The following method is more accurate:—10 cc. of the solution to be tested are placed in a flask, diluted with water, and treated with an excess of standard ammonia solution. The excess is removed by a current of steam and received in standard acid, the result being calculated from the following equation:—$6CH_2O + 4NH_3 = (CH_2)_6N_4 + 6H_2O$, which represents the reaction which occurs. A small quantity of hexamethyleneamine is, however, carried over by the steam.

—E. B.

Adulteration of Butter. A. Houzeau. Comptes rend. 116, 952—956.

A test for margarine or vegetaline in butter may be based on the temperature at which a limpid hot alcoholic solution of the material under examination, begins to become turbid on cooling, as compared with that observed with a sample of genuine butter similarly treated side by side with the first. Inasmuch as genuine butters of various districts, or even from the same cows at various times, differ considerably as regards their "temperatures of turbidity," a previous treatment for "unification" is requisite. This treatment consists in slowly cooling the alcoholic solution in a chamber, the temperature of which is not allowed to fall below a given limit, and filtering the fluid in the chamber, so that the funnel, &c. may be at the required temperature. The less soluble glycerides are thus removed. This unification treatment requires to be repeated in some cases at a somewhat lower temperature. The following figures indicate the kind of results obtained :—

	Turbidity Temperature after Second Unification.
Pure butter	42°·0
Same with 6 per cent. of margarine	43°·0
Same with 8 per cent. of vegetaline	41°·0

On testing the fats left after evaporating off the alcohol, for "volatile" acids, the falsified samples give lower results than the genuine one; thus, 18·3, 17·6, and 16·2 cc. of soda were used on titration in the above three cases respectively.—C. R. A. W.

Presence in Alcohol of Higher Alcohols and other Impurities. E. Gossart. Comptes rend. **116**, 797—800.

The author finds that it is practicable to obtain indications of the presence in alcohol of other substances by noticing whether drops of standard liquids of known composition falling from a height of 1 mm. every 30 seconds will roll over or penetrate into the liquid tested ; the principle involved being that the rolling will only take place when the two fluids are qualitatively alike but quantitatively different to an extent not exceeding a certain small limit. The liquid to be tested is arranged in a containing vessel holding some cubic centimetres, the falling liquid being allowed to drop on to its meniscus surface. With amylic alcohol as impurity, a difference of about five thousandths between the composition of the drop and that of the meniscus stops the rolling. Alcohol of 25° containing six thousandths of amylic alcohol is employed as a reagent, the liquid to be tested being brought to 25° by adding the exact quantity of water necessary, calculated by the rule that n ccs. of alcohol of N° will give a spirit of n° when diluted to N ccs. by addition of water. With pure alcohol thus diluted no rolling at all of the drops is noticed ; if it contain one thousandth of amylic alcohol, the first five or six falling drops will roll, but subsequent ones will not; whilst if two, three, four . . . thousandths are present, 10 consecutive drops will roll in each instance. In this case the fluid tested, already diluted to 25°, is further diluted with pure alcohol of 25° until the rolling ceases, whereby a measure of the amylic alcohol present is obtained dependent on the amount of this last dilution.

For butylic alcohol the same method is used, employing alcohol of 25° containing six thousandths of butylic alcohol as the standard test fluid. For propylic alcohol, alcohol of 25° containing seven thousandths of propylic alcohol is used. Alcohol of 25° containing 20 thousandths of acetone is the poorest solution which will plunge into pure alcohol; but with alcohol of three thousandths and upwards it rolls readily. Aldehyde and furfurol give about the same limits. When the degree of sensibility thus distinguishable is insufficient for the purpose, the impurities in the liquid examined may be concentrated by rectification.

—C. R. A. W.

PATENT.

A Process for Testing for Water in Butter and other Fatty Matters, and Appliances for that Purpose. G. R. Geldard, Hulme, Manchester. Eng. Pat. 9540, May 12, 1893.

The patented process consists in heating the butter until the water is driven off; the appliances consist of a Bunsen burner, a stand, and a metal plate combined as one appliance, an evaporating dish, and a stirrer. To prevent sputtering during the drying process, a mixture of carbonised grain (pearl barley) and butter-oil is added to the butter in the evaporating dish.—J. L.

ANALYTICAL AND SCIENTIFIC NOTES.

General Expression for "Toxicity" and the Toxicity of the Stereoisomeric Tartaric Acids. C. Chalrié. Comptes rend. **116**, 1410.

From a series of observations of the circumstances of death occasioned by peritoneal injections of concentrated solutions of tartaric acid, the author arrives at an expression for toxicity (x) in terms of the weight of the toxic substance introduced (p), the weight of the animal (P), and the time taken to succumb, as under :

$$\frac{1}{x} = \frac{p.\,1{,}000}{\mathrm{P}} \cdot f\,(\mathrm{T}).$$

Taking as an approximation $f\,(\mathrm{T}) = \mathrm{T}$ he finds for $x = \frac{\mathrm{P}}{p.\,1{,}000} \cdot \frac{1}{\mathrm{T}}$ the following values :—

Lævotartaric acid x_g	0·031
Dextrotartaric acid x_d	0·014
Racemic acid x_r	0·008
Inactive (para) acid x_p	0·006

The limitations of this formula are discussed and it is shown that for every poison there is to be found a range within which concordant values for x are obtainable, and x therefore becomes an expression for "*mean toxicity.*"

—C. F. C.

Influence of Atmospheric Pressure on Vegetable Development. P. Jaccard. Comptes rend. **116**, 830.

Experiments were made with ordinary air (1.) at the normal pressure ; (2.) under increased pressure ; (3.) under diminished pressure ; with oxygen or superoxygenised air under similar varying conditions ; and with mixtures of nitrogen, hydrogen, and oxygen, containing less oxygen than air, under the normal or under increased pressure. The final results were as follows :—

1. In general, changes of pressure in the atmosphere surrounding a plant exert a considerable influence on its development.

2. The intensity and nature of the phenomena naturally vary with the species, but the general curve representing the variations of development with pressure usually has two maxima ; one in air under diminished pressure, in most cases more marked than the other, under increased pressure. Normal pressure consequently is generally comprised between the two maxima.

3. Although the majority of the effect is due to variation in the oxygenisation, still the absolute pressure exerts a marked influence on the result.

The effect of pressure is not the same with animals as with chlorophyll-containing vegetables.—C. R. A. W.

New Books.

Anleitung zum Experimentiren bei Vorlesungen über Anorganische Chemie zum Gebrauch an Universitäten und technischen Hochschulen, so wie beim Unterricht an höheren Lehranstalten, von Dr. Karl Heumann, Professor am eigenöss. Polytechnikum zu Zürich. Zweite vermehrte und verbesserte Auflage. Mit 322 Eingedruckten Holzstichen. Braunschweig, Druck und Verlag von Friedrich Vieweg und Sohn. 1893. London : H. Grevel and Co., Covent Garden. 16*s*.

In his preface the author expresses considerable obligation as regards new and improved lecture experiments, suggestions, &c. to Professors Victor Meyer and Gattermann, of Heidelberg, and to Prof. J. Volhard, of Halle. The following excerpt of the contents of the volume, one of

8vo. size and 705 pages, including a six-page alphabetical index, will indicate the very complete and exhaustive nature of its scope:—

Introduction.—The Lecture-room for Experimental Chemistry and its arrangements. General remarks on the Preparation of Experiments and the Position of Lecture Assistants. Mechanical Operations. Mechanical Mixture and Chemical Combination. Demonstrations of Laws of Chemical Physics, in which are included determinations of Vapour Densities.

Metalloids.—Oxygen.—Methods of Preparation. Experiments on Combustion. (*a.*) Qualitative. (*b.*) Quantitative. Ozone. Methods of Preparation. This will serve as an example of the way in which the subject is subdivided. Then follow the other metalloids, ending with Carbon. This part of the subject occupies some 488 pages. Next follow the Metals, and first the Alkali Metals. Under this head are recorded and described some very instructive experiments on Ammonia and its Compounds.

The Alkaline Earth Metals are next considered from the standpoint of the Lecture Experimentalist, and, lastly, the Heavy Metals, commencing with Zinc and ending with Gold (pages 554 to 699). Nor are certain of the rarer metals by any means overlooked, as regards experimental illustration of preparations, properties, and combinations, for the following are included and comprehensively treated:—Uranium, Molybdenum, Tungsten, and Palladium.

The book is illustrated with no less than 322 good woodcuts.

Prevalence and Prevention of Lead Poisoning at the Broken Hill Silver-Lead Mines. Report to the Minister for Mines and Agriculture, New South Wales, 1892—3. Sydney: Chas. Potter, Government Printer. 1893. 4*s.* 6*d.*

This very comprehensive report shows that three deaths from Plumbism occurred in 1889, four in 1890, and four in 1891. It is shown also that the stores of drinking water furnished to the Central School were exposed to flue-dust from neighbouring smelters, and contained dangerous water for drinking purposes. It is proposed to remove them, and to connect the premises with the public water mains. Not much difference as to health was noticed from that observed in children in schools in other parts of New South Wales, but that little difference was on the wrong side nevertheless. It is instructive to note the mortality in this extensive Mining District, originally a waterless, timberless, and nearly desert salt-bush country in the north-west of the Colony, from another cause. Deaths from Typhoid in 1888, 123. This was a year of drought, and there was no water for the mass of the people but what they had conserved in the best way possible, and was very bad. After this, processes of cleansing were adopted, rational sewerage and water supply began to be undertaken, and were gradually perfected. The result as regards the Typhoid statistics, which are by far the most alarming, is seen in the returns of the subsequent years. In 1889, 84 deaths from Typhoid; in 1890, 27; and in 1891, 36.

Handwörterbuch der Pharmacie. Praktisches Handbuch für Apotheker, Ärzte, Medicinalbeamte und Drogisten. Herausgegeben von A. Brestowski, Lieferung 10. 1893. M. 4.80. 4*s.* 10*d.* Vienna und Leipsic. W. Braumüller, K. U. K. Hof- und Universität-Buchhündler. London: H. Grevel & Co., 33, King Street, Covent Garden.

Part 10 of this work is now issued. After completing the article *Gerbstoffe* on page 722, continued from Part 9, page 720, an article is commenced on the subject of *Gerichtliche Chemie.* Part 9 concludes on page 800, with an uncompleted article on *Hog-gummi*, a red translucent gum of unknown origin, coming from South America.

An important article by Jolles on "*Harn und Harnanalyse*" is contained in this part.

Chemisch-technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und Industriellen Chemie, mit Hinweis auf Maschinen, Apparate, und Literatar. Herausgegeben von Dr. Emil Jacobsen. 1892. Erstes Halbjahr. Zweite Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder. Schönebergerstrasse 26, S.W. London: H. Grevel & Co., 33, King Street. Covent Garden.

This issue forms the second for the second half-year of 1892, containing pages 113 to 305, which includes the Reviews of New Books and the Alphabetical Index. The book contains reports on articles in the following branches: Foodstuffs; Paper; Photography; Residuals, Manures, Disinfectants, &c.; Soaps. Explosives and Detonators. Preparation and Purification of Chemicals. Chemical Analysis, Apparatus, Machinery, Electrotechnology, Thermotechnology. Adulteration of Trade Products.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

(From the Board of Trade Journal.)

Russia.

Customs Decisions.

Note.—Poud = 36 lb. avoirdupois. Gold rouble = 3*s.* 2*d.*

According to a recent decision of the Russian Department of Customs, chestnut wood, the materials of which are used almost exclusively for the preparation of extracts for tanning and dyeing purposes, is to be classed under the corresponding numbers of section 124 of the tariff.—Duty, from 5 to 30 copecks gold per poud.

Plates of cement, polished, known under the name of *marmorites* and imitation marble.—Category 65, section 4. Duty, 10 copecks per poud.

Those metallic conducting wires will be considered as telegraph cables, which, being covered with insulating materials (such as caoutchouc, gutta-percha, animal and vegetable filaments impregnated with any substance whatever), are, besides, provided with an exterior covering of hemp or metal, sometimes itself covered with hemp, jute, &c. tarred. All other insulating conducting wire covered with textile materials or gutta-percha, but without metallic coverings, will pay the import duty provided for in category 156, section 2, letter *b*, viz., 9 roubles per poud.

Articles of celluloid as a substitute for paper, such as sheets intended for binding.—Category 177, section 6. Duty, 10 roubles 60 copecks per poud.

France.

Customs Decisions.

Copper, raw, alloyed with manganese, in ingots.—Category 221. Exempt from duty.

Preparation with a chromic base to be used in colouring enamels.—Category 282.

Iodide of methyl obtained by means of methylene, but without the aid of ethelic or common alcohol.—Category 282.

Portugal.

Exemption from Import Duties of all Cupreous Compositions used against Mildew.

Sir H. G. MacDonell, Her Majesty's Minister at Lisbon, in a despatch to the Foreign Office, dated the 31st July, transmits copies and translation of a Portuguese law exempting from the payment of import duties, sulphate of copper, ammonuriet of copper, and sulphasatyde, as well as any other cupreous preparations used against mildew. The following regulations must be observed :—

The vendors of any cupreous preparations intended for the treatment of vines are bound to declare in their invoices of sale the equivalent percentage of sulphate of copper contained in each kilogramme of the substance sold by them. The said percentage, as well as the name and distinguishing mark of the firm selling the same, shall be mentioned on the wrappers of the cupreous preparations, so that they may be easily read.

Non-compliance with the rules set forth in the preceding paragraph, and any discrepancy between the invoice statements and those in the wrappers and the percentage of the sulphate of copper as tested by the analyses made in the official laboratories, the certificates of which will be accepted as evidence, will be tried correctionally, at the instance of the purchaser who may have been defrauded, or of the Crown Prosecutor, and will be liable to be punished with a fine equal to the amount of the import duties on the article sold.

Should the offence be repeated, double the amount of the fine will be imposed. One half of the proceeds of the fines will go to the purchaser who shall have been defrauded, as compensation, and the other half will revert to the State.

The Government are authorised to spend during the financial year of 1893–4 not more than 3,000,000 reis (666*l.*) for the inspection of vineyards and for the analyses in the official laboratories.

The above-mentioned articles will be conveyed free of cost over the Government lines of railway.

UNITED STATES.

Customs Decisions.

India-rubber tubing about one-eighth of one inch in diameter, coloured to imitate stems of plants, and imported in pieces each one metre in length, used in the manufacture of artificial flowers, is dutiable at 30 per cent. *ad val.* under paragraph 460, N.T.

Candle matches, about three inches long and one-fifth of an inch in diameter, consisting of a cotton wick or core covered with wax, the tip end of this wick being coated with a preparation by means of which the article can be ignited by friction, are dutiable under paragraph 441 at 10 cents per gross of 144 boxes containing not over 100 per box.

Merchandise commercially known as patent leather, and chiefly used as upper leather in the manufacture of shoes, is dutiable at 20 per cent. *ad val.* under paragraph 456.

Thin leather in the piece, one side of the skin having a chamois finish, while the other has the surface dressed with a silver or bronze coating, is dutiable at 20 per cent. under paragraph 456, N.T.

NEWFOUNDLAND.

Tariff Changes.

By an Act passed by the Legislature of Newfoundland on the 24th May last, the list of goods imported free of duty is amended as follows :—

"Cotton-seed oil, olive oil, boracic acid, acetic acid, preservalene, when imported direct to be used in the preserving of fish or fish glue (previously 20 per cent. *ad val.*).

Parchment or waxed paper, when imported direct for wrapping boneless fish for export (previously 25 per cent. *ad val.*).

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

OPENING FOR BRITISH TRADE IN CHINA.

In the opinion of Mr. W. Beauclerk, Her Majesty's Secretary of Legation at Pekin, the rapid development of the trade in matches in China indicates a good opening for the British manufacturer. At present the majority of the enormous population of China use flint and steel, but the use of matches is increasing daily in favour, and all that is required for a successful competition in this branch of commerce is the production of a fairly good article at a very cheap rate. The Japanese matches now holding almost exclusive possession of the market are a poor imitation of the Swedish safety match; but the boxes are flimsy, and the matches, which light only on the box, fail in five cases out of six to ignite even there, and the composition which is intended to kindle them very quickly wears out under the unsuccessful attempts at procuring combustion. Their cost is infinitesimal, but if a fairly good article could be imported at a reasonable cheap price it ought to be able to drive this worthless commodity out of the market.

The difficulties to be encountered are the cost of distant transport for explosive material, and the fact that the Chinese are so accustomed to the very cheap Japanese matches that it might be difficult to convince them that a dearer and better article would come cheaper in the end. The Japanese matches cost one-third of the price of the goods which they imitate.

At Tientsin there is an Anglo-Chinese match factory, which does a good local business, but whereas the Japanese will hardly light at all, the Tientsin matches are highly explosive, and almost dangerous; the boxes are also rickety and slight, soon coming to pieces if carried about.—(*No.* 1280, *Foreign Office Annual Series.*)

INDUSTRIAL ENTERPRISE IN JAPAN.

In his report of February 1892, extracts from which were published in the *Board of Trade Journal* for June 1892 (see pages 641—59), Mr. Gubbins, Her Majesty's Secretary of Legation at Tokio, enumerated the various industrial enterprises which have sprung up in Japan, and gave details as to their operations and progress. Mr. M. de Bunsen, Her Majesty's Minister at Tokio, in transmitting to the Foreign Office a summary of the foreign trade of Japan for the year 1892, encloses a table giving the official figures relating to the export or import, during the last six years, of the articles enumerated in that report.

Making allowance for the fact that the stocks carried over from last year are considerably less than those carried over from 1891, it would seem that foreign imports have been considerably affected by the progress of Japanese industries.

Since 1887 the gold value of the import trade of Japan has increased 19 per cent., and the value of the export trade 60 per cent.

Both the import and export of paper have increased, the former 46 per cent. and the latter 77 per cent.

Although the manufacture of soap has been largely prosecuted of late years, the wants of the Japanese people seem to increase at a greater rate than the manufacturers can satisfy; for the export of this article has decreased 42 per cent., while the importation has increased 130 per cent.

The import of glass has increased 17 per cent. The export (which is confined to the coarser qualities) has increased 600 per cent. in value, allowing for difference in exchange.

The import of Portland cement in 1890 more than doubled that of 1887, but it rapidly declined until, in 1892, the import was 50 per cent. less in quantity than in 1887.

The import of matches has remained the same, at a very small amount; the export has increased in quantity 170 per cent.

The import of bricks has declined from 1,000*l.* in value to 600*l.*

The export of beer has risen from nothing to a value of 2,000*l.* in 1892; the import has declined from 5,500*l.* to 1,500*l.*, a decline of 70 per cent.

The import of lubricating oil has declined since the establishment of manufactures, and the export of sulphuric acid has largely increased.

These changes have taken place without tariff assistance; the total value of customs duties amounted, in 1892, to a little over 3 per cent. on the value of the year's trade.—*Board of Trade Journal.*

Coal Production in Japan.

In a report by the French Vice-Consul at Nagasaki, which is published in the *Moniteur Officiel du Commerce* for the 3rd August, the following information is given with regard to the coal production of Japan:—

The island of Kiou-shiou contains a large number of coal mines, the most important of which are those of Takashima, Mické, and Karatsou, worked by large companies with considerable capital at their disposal.

The provinces of Tchikouzen and Bouzen are the richest mining territories, but the deposits of coal are not in the hands of large companies, but in those of a large number of small proprietors.

In a few years Japanese coal has become one of the most important articles of the foreign trade of this country; it competes with some advantage (better market, more rapid production, less waste, &c.) in the markets of China and Singapore with the coal from England and Australia. The year 1892 was a very bad one for the coal trade. The extraction of coal having become a popular enterprise, the figure of 100,000 tons per month was exceeded, whilst in the mines of Kiou-shiou the proprietors and companies, without taking into account the requirements of navigation, sent their products on the Japanese and foreign markets with the sole idea of supplying as many tons as possible, so that there was in 1892 a stock absolutely disproportionate with consumption. This glut, added to the competition of the coal company of Hokhaido (Tauko-Tetsoudo Kaisha), brought about such a decline in prices that they fell to 3 dols. per ton during the last months of 1892.

The total yield of the coal mines of Japan has reached 3,000,000 tons. Japanese coal is in favour on foreign markets; its consumption in the country is also on the increase.

In 1890, the consumption of the workshops, salines, railways, &c., amounted to 1,430,000 tons. In 1887 it did not exceed 85,000 tons.

Notwithstanding the increase of the demand, both in Japan and in the foreign markets, no comparison can be established between the consumption and the increased production. Companies and mine owners seem to have only one aim, to extract as many tons as possible, without caring whether the requirements respond to their offers.

Under these conditions, a depression more and more marked commenced to show itself; just as the depression increased the need for disposing of the coal made itself more and more felt, especially for the proprietors who, working their mines without large capital, were forced, in order to keep working, to sell rapidly.

As a result works have been stopped or a diminution has taken place in the staff of the larger companies and complete ruin has been brought upon the small owners, who, having for the greater part mortgaged their mines, have not been able at the time of the crisis to pay their workmen. In consequence of this crisis the production of the Kiou-shiou mines fell in the final months of 1892 to about 60,000 tons.

Since the end of 1892 the situation has apparently improved, but if any epidemic such as the cholera should appear in the island of Kiou-shiou (which very frequently happens) the ports will be quite deserted for many months and the crisis will assume fresh gravity.

The idea has been mooted of establishing at Modji a coal depôt for the various mines in Kiou-shiou, but nothing has yet been done in this direction.

An analysis of Takashima coal has given the following results:—Carbon, 79·26 per cent.; hydrogen, 5·86 per cent.; oxygen, 8·76 per cent.; sulphur, 0·11 per cent.; ashes, 4·51 per cent.; water, 1·50 per cent. Total, 100.

The yield of the Takashima mine is at present very insignificant; there is also sold under this name a coal coming from Nakanoshima, its qualities being very much the same; it develops more heat than Takashima, but possesses the same defects.

The Mické coal is of a reddish colour, it gives less heat, contains too much oily matter, but is good for making coke.

The Sakagoutchi and Yenokibarou mines are just commencing to be worked; they supply an excellent coal, giving less cinders than Takashima, but also less heat.

Karatsou coal is specially reserved for the Japanese warships, since it is specially adapted for them.

Amakousa coal is only a kind of anthracite, which is generally refused by the ships, but used by private individuals. Only a small quantity is extracted.

Manufacture of Wood Pulp in Germany.

Reports Consuls of the U.S.A., May 1893, 123—128.

According to the United States Consul-General at Frankfort, the enormous development of the wood-pulp industry in Germany has been achieved in the face of several serious disadvantages, wood being twice as costly there as in Scandinavia and Austria, while labour, coal, and railway freights are higher and water power and interior water transport are comparatively limited. Notwithstanding these obstacles, the German chemical pulp industry has developed until its annual production has reached 150,000 tons, of which one-third is exported. Ten years ago most of the wood pulp produced in Germany was manufactured by the soda process; since then the superiority of the sulphite method, as perfected by the brothers Mitscherlich, has been so obvious that the product of 1892 included only 12,500 tons of soda pulp, the remaining 137,500 tons being produced by the sulphite process. The exports of wood pulp and cellulose to the United States from Southern and Western Germany during the past year were valued at 583,053 dols., of which 10,292 dols. came from the district of Kehl, 12,399 dols. from Mayence, 495,592 dols. from Mannheim, 16,669 dols. from Munich, and 48,073 dols. from the consular district of Frankfort. For a number of years the Mitscherlich brothers maintained their German patents, so that the price averaged 10 dols. per 100 kilos. But after long and determined litigation the German courts set aside the Mitscherlich claims, and from that time the number of factories increased to 63, of which 21 export part or all of this product, 21 sell only to German consumers, and 21 consume their own pulp in the manufacture of paper, &c. The price of air-dried chemical pulp has declined to 5·25 dols. per 100 kilos. The remainder of the report is devoted to a description of the well-known bisulphite of lime process. For an abstract of the Mitscherlich patent see this Journal, 1893, 701.—E. G. P. T.

German Economy in Iron Manufacture.*

Reports Consuls of the U.S.A., August 1893, 385—391.

It has been recently noted in England with something like alarm that the production and export trade of iron and steel in Germany have been steadily growing during the past 10 years at a rate out of all proportion to the development of Great Britain in the same field, and that railway wheels, ties, axles, wire, &c., of German origin are not only making serious inroads upon foreign markets which British exporters have hitherto almost exclusively controlled, but are now sold to some extent in England. The fact that, in spite of all advantages which English ironmasters derive from long experience, cheap and abundant coal, and unequalled shipping facilities, they are now undersold on their own ground by their German rivals would seem incredible if it were not sustained by actual statistics; and it may be of interest to American metal-workers to examine briefly the more obvious causes of the notable progress of Germany in this important branch of industry.

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* In submitting this report the consul says: "In consequence of inquiries which I have received from American mining and gas engineers concerning the improved methods by which certain by-products of coke manufacture are now saved in Germany, I have made a somewhat careful study of the study of the subject, and beg to submit herewith a report on that topic with some reference to the economical relation of such improved coking processes to iron and steel manufacture in Germany. In view of the surprise which has been caused by the metal exhibit of Germany at Chicago, it is believed that the subject of the enclosed report may possess at this time a somewhat general interest."

It is conceded that until about 1880 the British export trade in iron and steel was all that could be reasonably desired. Not only in respect to coal and skilled labour, but in facilities for import ores from Spain, Scandinavia, and other foreign sources, and for exporting their product, the English and Welsh furnace men seemed to have a secure advantage over their continental rivals. But it is now found that English exports of railway iron and steel have fallen from 1,000,000 tons per annum a few years ago to 703,370 tons in 1891, and 467,986 tons in 1892, while German exports of the same products, which had scarcely begun in 1880, have risen to 198,421 tons in 1890, and 233,943 tons in 1891, with a total export of pig and finished iron and steel amounting to a yearly average of 1,050,000 tons. Not only this, but, in spite of the increased cost of coal in Germany, due to higher wages demanded by miners and the steadily increasing coal consumption in face of a definitely limited supply, the metal production of Germany has continued to increase. The proportions of this growth will be apparent when, with the fact in mind that in 1870 the total output of Germany was only 886,000 tons of iron, and 125,000 tons of steel, we consider the following statistics of finished iron and steel manufacture in this country during the past two years:—

Description.	1891.	1892.
	Tons.	Tons.
Bar and section iron	1,335,000	1,334,000
Blooms, billets, and ingots	690,700	790,500
Plates	417,500	425,100
Tin plates	21,300	23,400
Steel and iron rails	824,800	801,400
Wire	339,200	492.510
War materials	10,100	11,100
Total	3.638.600	3,878,000

The increase in 1892, it will be seen, was 239,400 tons.

Comparing the growth of iron and steel production in Great Britain and Germany from 1880 to 1892, inclusive, it appears that, whereas England shows an increase of only 70 per cent., Germany has achieved during the same period a net growth of nearly or quite 400 per cent.

A result as striking as this must be the outgrowth of causes so radical as to be interesting to all who are concerned, either theoretically or commercially, in the metallurgy of steel and iron. The growing importance of Germany in this field would seem to be due largely to two fundamental facts: (1) the introduction of the basic process, which enables the iron and steel makers of Westphalia, Silesia, and the Saarbrück district to use their cheap and abundant native ores; and (2) the unrivalled chemical skill of the Germans, whereby they have succeeded in saving the by-products of coke manufacture, thus deriving a revenue from processes which in other countries entail a waste of material and financial loss.

The Basic Process.

Of the basic process itself there is little or nothing new to be said. It is understood as fully and practised as successfully in the United States as in any part of the world. But its introduction into Germany has revolutionised the whole economy of steel manufacture in this country. With fair facilities for importing the richer ores of Spain and Sweden the German furnace men found their whole list of native ores available, and when special processes were necessary to facilitate the employment of materials which had previously been considered worthless, they were invented and applied. In a previous report of this series (No. 137, p. 246) an account was given of a special process for the desulphuration of raw iron from the blast furnace by treatment with manganese, as invented and first practised in direct steel production at Hœrde, in Westphalia. This process, which has since been adopted at various other points on the Continent and in England, secures the production of excellent steel from materials so heavily charged with sulphur as to be impracticable for that purpose by ordinary methods.

Economy of By-products of Coke.

Equally original and not less important in the general economy of iron manufacture are the more recent German improvements in coke-making, by which the subsidiary products—ammonia, tar, and tar oils, with their valuable elements benzol, anthracene, &c.—are saved from the waste that attends the ordinary coking process. In this special field Germany is now so far in advance of other countries that some understanding of the methods employed here is important in the present connection.

The first record of any practical interest in the saving of ammonia and tar from the coking process appears in a paper which was read before a convention of ironmasters at Dusseldorf by one F. W. Lürman in 1858. The main principles involved were clearly stated, but the requisite apparatus was so elaborate and expensive, and the financial results then so doubtful, that progress was for a long time slow and uncertain. The improved methods now in use, and which have produced the best results, are mainly the work of the past five years. What is known as the Semet-Solvay system is the one principally in use in Belgium; but the most advanced representative of German progress in this direction is probably the Otto-Hoffman coke oven, of which there are about 1,550 now in use—535 in Westphalia, 700 in Silesia, 75 in the Saar district, and 240 in Austria. Although elaborate and costly in construction, this oven is durable, and, by reason of its great saving in gas, highly economical in operation, aside from its efficiency in saving the subsidiary products. The complete apparatus is a combination of the Otto oven (32 ft. long, 16 ins. wide, and 5½ ft. high) with the Siemens regenerator in such manner that the air to be used for the combustion of gases is first heated to a temperature of about 1,800° F.

For the most economical service these ovens are built in groups or batteries of 60, and half the number are alternately filled each 48 hours.

The operation of coking requires in the Otto-Hoffman ovens from 24 to 48 hours; and the product from good air-dried coal containing from 15 to 17 per cent. of water is about 76 per cent. of coke, 1·15 to 1·25 per cent. of sulphate of ammonia, and from 2·5 to 4 per cent. of tar. (See also this Journal, 1892, 879—880.)

From a trustworthy source it is announced that the revenue actually derived from the tar and ammonia produced by one year's working of a group of sixty ovens in Westphalia, which cost in construction 166,000 dols. (or 2,766 dols. each), was 40,200 dols., or about 25 per cent. on the capital invested in the plant. The price given above does not include the cost of condensing apparatus, which, although it is not a part of the oven, is worked in connection with it.

It should not be understood from the foregoing that the Otto-Hoffman is the only highly improved coke oven in Germany which saves the secondary products. There are, in fact, several others of later construction for which their inventors claim certain points of superiority over the Otto, but the latter has been longest in use and is therefore the best known. From the known aggregate product of tar and ammonia in this country, it is calculated that there are at present in operation in the country not less than 3,000 coke ovens which save the subsidiary products, so that the 1,550 Otto ovens in operation are something more than half the entire number of all kinds in actual use.

A comparison of the results obtained by the Semet-Solvay system in Belgium with those realised by the best German ovens shows a clear advantage in favour of the latter. In the Semet ovens an intense degree of heat is generated, so that it is not found necessary to combine them with regenerators to heat the air which is to be used in combustion. They are therefore considerably cheaper in construction; but, on the other hand, the Semet requires for good results a special mixture of "fat" and "lean" coal that is not always easy to provide, and, while the coke thus made is of a high and uniform quality, it produces much less ammonia, tar, and gas than the best German ovens, and is therefore in the end less profitable.

The direct production of benzole in the coking process is difficult, but it has been successfully accomplished during the past year by an inventor at Dortmund, whose process is thus far a secret. So far as can be ascertained, from 6½ to 15 pounds of benzole are obtained from a ton of dry coal; and, as benzole is an important element in aniline manufacture, it may be ranked among the products that will always have a standard value. The effect of the 3,000 improved coke ovens now in use in Germany and Austria has been to greatly increase the supply and reduce the market values of the by-products which they secure. Sulphate of ammonia, which, besides its uses as a fertiliser, is largely employed in making ice and in soda manufacture, was in 1883 worth 7·37 dols. per 100 kilos., but now sells for about 5·25 dols.; and tar has declined from 1·30 dols. per 100 kilos. to 95 cents in the same period. Notwithstanding this decline, the profits derived from these two subsidiary products of coke manufacture are stated by good authorities to be as high as 40 per cent., all of which goes to the credit side in the general account of Germany's mining and metal industries.

But this is not all. Still another point in which the Germans secure an important advantage, especially as respects their American competitors, is in economising the waste and coarser forms of fuel. It is conceded that Americans are masters of economy in labour, but they are extravagant with materials. In our country millions of tons of coal dust—the waste of mines, railways, and iron mills—are thrown away as useless. An official commission, after exhaustive study of the subject, has recently published the astounding information that for every ton of anthracite coal mined and marketed in Pennsylvania, 1½ tons are wasted; and the loss in bituminous coal, although somewhat less, is still enormous. In Germany, France, and Belgium all this refuse coal dust is carefully saved. Part of it is mixed with pitch derived from tar distillation and moulded into "briquettes," which are used as fuel for locomotives, stationary engines, and household grates. The remainder of this finely pulverised carbon is blown by jets of live steam into various kinds of furnaces, where it burns with almost the fierceness of crude petroleum. Coal dust from mines costs in Germany 25 cents per ton on cars, or in large quantities 2·38 dols. per carload of 10 tons, and the care with which it is saved and utilised adds an important percentage to the fuel supply of this country. It is by this application of scientific economy to every stage of manufacture, the saving of secondary products, and the invention of new processes and machinery to work most advantageously native materials that the German iron and steel makers have been able to face without disaster the declining metal markets of the past four years.

The question may be fairly asked whether the time has not come for Americans to study far more carefully than they have studied hitherto the scientific economies of manufacture. Europeans stand aghast at the recklessness with which our forests and mines and petroleum deposits are being exhausted and the soil of vast areas drained of its fertility by forms of culture which ring a yearly crop from the land, but give back little or nothing in return. There are in nearly every coal-mining district in the United States great mounds and embankments of discarded slack and coal dust which, under a better system, might be utilised as fuel; and fortunes are lost every year in the clouds of gas and smoke that rise from the coke ovens of Virginia, Pennsylvania, Ohio, and Alabama. With soda, salt, and phosphate beds in a dozen States, we import the heavy chemicals for soap and paper making and annually purchase from Europe sulphuric acids and chemical fertilisers which ought to be made at home. There is a lesson in the coke ovens and chemical laboratories of France and Germany which the economists and manufacturers of America cannot study too thoroughly or too soon.

GENERAL TRADE NOTES.

The Decimal System in the United States.

At the Engineering Congress held at Chicago on August 1 last, a paper on the "Fundamental Units of Measure" was read by Mr. T. C. Mendenhall, the Superintendent of the Standard Weights and Measures at Washington. Mr. Mendenhall stated that the U.S. Office of Weights and Measures would in the future regard the international prototypes, metre and kilogram, as fundamental standards; and the customary units, the yard and the pound, would be treated as derived therefrom. This amounts to an official notification that the United States have formally adopted the metre as the standard of measurement, and that in future in official business the yard will be represented as a fraction of the metre, and the pound as a fraction of the kilogram. This is a great step towards the introduction of the metric system in the United States, where there is now a strong desire to change the existing weights and measures for those of the metric system.—*Chemist and Druggist.*

Packing Salt in the Dutch Indies.

The Chemist and Druggist gave particulars, at the time, of the conditions under which a prize of 10,000 florins (about 850*l.*) had been offered by the Dutch-Indian Government for the most practical method of packing salt for retail sale in small parcels which will prevent the substance becoming damp. The money has now been awarded to Mr. C. von Belzberg, of Ischl, Austria, who proposes to pack the salt, either in powder form or compressed into bricks, in a waterproof cover of Lenz's *papier-mâché*, after having previously removed all particles of moisture by drying. Mr. von Balzberg's method has been subjected to practical tests and found to answer thoroughly. Its application costs about ½*d.* a packet for bricks, and $\frac{1}{35}$*d.* per packet for powder. The salt-trade is a Government monopoly in the Dutch Indies.—*Ibid.*

The Chemical Arts.

The French Society for encouraging National Industry has recently issued a syllabus of the prizes in connection with the chemical arts, to be offered for competition during the three forthcoming years. These comprise six prizes of 2,000 f. each and two of 1,000 f. for 1894; five of 2,000 f. and one of 1,000 f. for 1895; while for the year 1896, two prizes only, each of the value of 2,000 f., are announced. For next year the subjects include "How to utilise the residues of manufactories;" "The manufacture of glass destined for chemical purposes;" "The discovery of processes capable of supplying, by any kind of chemical transformation, useful organic compounds, such as quinine, cane-sugar, &c.;" "A scientific study on the physical and mechanical properties of glass," &c.—*Ibid.*

The World's Production of Zinc.

The production of zinc in the whole world has, for more than the last 10 years, shown steadily increasing progress. According to the French *Journal des Mines* of the 17th August last, it was estimated in 1881 at 260,088 tons; in 1885 at 293,302 tons; in 1890 at 343,096 tons; in 1891 at 356,501 tons; lastly it reached in 1892, 365,257 tons. This shows an increase compared with the preceding year of 8,759 tons, or nearly 2·5 per cent., and 105,168 tons, or 40·4 per cent., since 1881.

In the production of 1892, Europe figures for 287,607 tons, or 78·7 per cent., and the United States of America for 11,000 tons.

The production of the United States was, in 1881, 30,000 tons; that of Europe 230,088 tons.

Among the producing countries of Europe, Germany occupies the first rank with an annual average production of from 125,000 to 130,000 tons; then follows Belgium with nearly 100,000 tons.

The production of the different European countries during the last two years was distributed as follows:—

Rhenish Prussia and Belgium, 143,505 tons in 1892, as compared with 139,695 in 1891, an increase of 3,810 tons; Silesia, 87,760 tons in 1892 and 87,080 tons in 1891, an increase of 680 tons; Great Britain, 28,590 tons and 29,410 tons, a decrease of 820 tons; France and Spain, 18,462 and 18,360 tons, an increase of 102 tons; Poland, 4,270 and 3,760 tons, an increase of 510 tons; Austria, 5,020 and 6,440 tons, a decrease of 1,420 tons.

The production of zinc in pigs in Germany in 1891, including zinc used for the making of sheet and different articles, was 139,353 tons.

The largest consumer is England. The average price per ton was 24*l.* 17*s.* 6*d.* in 1892, and 23*l.* 4*s.* 6*d.* in 1891 and 1890.

Compared with this low price on the English market it is interesting to note that the value of a ton of zinc increased in Germany in a like proportion. Whilst in 1890 it was 18*l.* 2*s.* 6*d.*, it reached in 1891 22*l.* 8*s.*, and in 1892 22*l.* 9*s.*

The total value of the production in Germany in 1890 was 2,465,000*l.*, in 1891 3,120,000*l.*, and in 1892 3,130,000*l.*

THE SHALE WORKS OF SCOTLAND.

J. Constable. Engineering and Mining Journal. 1893, *September* 9, 271.

Shale mining and its related manufacturing industries have become one of the most important of the industries of Scotland, the total capital of nine incorporated companies being over 10,000,000 dols. The shale mines lie principally in the counties of Edinburgh and Linlithgow. The seams belong to the calciferous sandstone series, which underlie the lower coal measures. The Raeburn shale seam, which averages from $2\frac{1}{2}$ ft. to 3 ft. in thickness, has only been worked to a very small extent. The method adopted has been on the longwall principle. The next in order is the Mungle shale. Its average thickness is about 30 in., but it has been little proved by workings. About 24 fathoms below this shale lies the two-feet coal, the position of which is, however, sometimes occupied by a seam of blackband ironstone and a shale about 18 in. thick. No workings have been carried on in this, but the upper portion of the shale is said to be of fine quality. From about 34 to 50 fathoms below this lies the grey shale, which has only been worked to a small extent in the West Calder district, where it was found to be about 24 in. thick. In the refining processes it produced a large percentage of solid paraffin. From the gray shale to the Houston coal the distance varies from 10 to 14 fathoms. This coal has been mined by several of the oil companies on their leaseholds, but so far with little success. Only in some districts indeed has it been found workable, and even there the expense was great, owing to the soft nature of the roof and pavement. After this comes the Fells shale, which underlies the coal from about 30 to 40 fathoms. This seam has proved the most important. It has been worked principally by the longwall method. There are two qualities of shale in the seam. The yield of oil from the top or good portion is about 36 gals. per ton of shale, and from the lower about 18 gals., while the yield of ammonia is from 20 lb. to 30 lb. per ton. This is really the richest of the shales as regards the yield of oil. The next lower shale is the Broxburn shale, which averages $5\frac{1}{2}$ ft. in thickness. The quality of the shale varies considerably in different districts. In some cases the yield of oil is as low as 16 to 20 gals. of crude oil, while the sulphate of ammonia is about 40 lb.; in others again the oil increases to 35 gals., with the ammonia about 25 lb. per ton of shale. The Dunnets shale seam, which underlies the Broxburn at a depth varying from 45 to 70 fathoms, is from 6 ft. to 16 ft. thick. The yield of oil from the Dunnets shale is from 15 to 30 gals., and of ammonia 20 lb. to 40 lb. per ton. The Barracks shale, which comes next, has not been worked to any large extent. The average thickness is about 10 ft. Almost immediately below this shale lies the Camps limestone, although in one case the distance, as proved by boring, was 100 fathoms. From the Camps limestone again nothing is got until the Pumpherston shales are reached, some 120 fathoms below. These shales consist of five seams lying comparatively near one another, and are as follows:—No. 1, or Jubilee shale, about 8 ft. thick; No. 2, or Maybrick, about 6 ft. thick; No. 3, or Curly, about $6\frac{1}{2}$ ft. thick; No. 4, or Plain, about $8\frac{1}{2}$ ft. thick; No. 5, or Wee, about $4\frac{1}{2}$ ft. thick. And yet these seams have only been wrought on three properties. The winding inclines are generally driven in Nos. 3 or 4 seams, and level cross-cuts driven to win out the others. The average inclination is 1 in $1\frac{1}{2}$. The workings have been entirely by the stoop-and-room method, rooms being about $12\frac{1}{2}$ ft. wide, and the stoops from 20 to 30 yards square. Stooping has been carried on to a small extent. The yield of oil from these shales is comparatively small, being only about 20 gals. per ton, but this is made up for by the yield of ammonia, which is as high as 60 lb. to 70 lb.

FERTILISERS AND FEEDING-STUFFS BILL.

This Bill has passed through both Houses, and has received the Royal Assent. The objects of the Bill are to put down fraudulent dealing in fertilisers and feeding-stuffs, especially oilcake. Lord Ribblesdale states that the Bill proposes to place a purchaser in a better position to obtain his remedy, by civil proceedings, in cases in which the fertiliser or feeding-stuff is inferior in quality to what he is led or entitled to expect when he purchases it, and in the second place it makes certain offences the subject of criminal proceedings and penalties. If any person fails without reasonable excuse to give the invoice which, under the Act, must be given, and is to have effect as a warrantry; if the invoice or the description is false in any material particular, to the prejudice of the purchaser; if an article sold for use as food for cattle contains any ingredient deleterious to cattle; or if to any such article has been added any ingredient worthless for feeding purposes and not disclosed at the time of sale, the offending person is made liable on summary conviction to a penalty not exceeding 20*l.* for a first offence and 50*l.* for any subsequent offence. The Bill, however, makes a certificate of the Board of Agriculture an essential preliminary to such proceedings, except in cases where they are instituted by the council of a county or county borough. It further proposes to make it incumbent on county councils to appoint district agricultural analysts; and buyers of fertilisers or feeding-stuffs will be entitled, on payment of a fee, to have their purchases analysed. This analysis, subject to appeal to a chief analyst to be appointed by the Board of Agriculture, may be made the basis of proceedings either by the person aggrieved, by a county council, or by any association authorised by the Board in that behalf. The Bill extends to Scotland and Ireland.—*Chemist and Druggist.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

Articles.	Month ending 31st August	
	1892.	1893.
	£	£
Metals	1,871,894	1,656,211
Chemicals and dyestuffs	439,922	440,622
Oils	706,240	650,377
Raw materials for non-textile industries.	4,668,354	4,781,648
Total value of all imports	34,844,365	35,002,085

SUMMARY OF EXPORTS.

Articles.	Month ending 31st August	
	1892.	1893.
	£	£
Metals (other than machinery)	2,739,174	2,691,541
Chemicals and medicines	708,785	715,113
Miscellaneous articles..............	2,421,423	2,332,854
Total value of all exports.....	20,051,330	19,530,178

IMPORTS OF METALS FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Copper :—				
Ore............. Tons	7,253	6,122	35,541	23,865
Regulus .... „	10,739	8,681	251,656	197,075
Unwrought .... „	3,231	3,433	151,450	156,831
Iron :—				
Ore............. „	373,221	421,370	242,579	251,789
Bolt, bar, &c.... „	5,620	7,784	56,032	73,347
Steel, unwrought.. „	279	874	3,189	9,476
Lead, pig and sheet „	14,381	17,610	156,514	174,384
Pyrites .... „	49,804	54,644	88,393	92,737
Quicksilver....... Lb.	67,650	7,500	6,107	620
Silver ore....... Value £	..	..	270,777	237,439
Tin .... Cwt.	67,660	45,395	323,075	191,678
Zinc .... Tons	4,509	4,123	90,057	71,773
Other articles ...Value £	..	..	189,328	132,070
Total value of metals	..	..	1,871,897	1,656,211

IMPORTS OF OILS FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut......... Cwt.	17,684	8,715	19,866	10,906
Olive .... Tuns	1,857	1,343	66,600	51,295
Palm .... Cwt.	93,673	122,621	95,261	149,174
Petroleum .... Gall.	13,560,606	10,909,767	261,556	190,031
Seed .... Tons	1,406	2,145	34,138	53,086
Train, &c.......... Tuns	2,308	1,967	45,541	39,787
Turpentine .... Cwt.	91,974	76,167	99,965	78,411
Other articles .. Value £	..	..	83,313	77,687
Total value of oils ...	..	..	706,240	650,377

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............. Cwt.	5,639	9,612	3,553	8,103
Bark (tanners', &c.) „	31,305	36,349	12,001	13,946
Brimstone .... „	38,382	24,756	10,458	7,015
Chemicals...... Value £	..	..	102,740	149,258
Cochineal .... Cwt.	278	410	1,674	2,467
Cutch and gambier Tons	1,876	1,086	39,472	22,200
Dyes :—				
Aniline .... Value £	..	..	14,397	18,676
Alizarin ...... „	..	..	24,973	19,472
Other .... „	..	..	409	2,122
Indigo .... Cwt.	2,310	707	35,485	12,364
Nitrate of potash . „	30,170	26,982	25,889	22,724
Valonia .... Tons	3,424	3,245	47,379	41,436
Other articles... Value £	..	..	121,492	120,839
Total value of chemicals	..	..	439,922	440,622

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST AUGUST.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	7,924	3,712	15,949	6,965
Bristles.......... Lb.	493,855	224,852	81,358	30,683
Caoutchouc...... Cwt.	15,483	24,805	149,417	265,307
Gum :—				
Arabic......... „	6,137	8,124	13,962	16,154
Lac, &c......... „	7,117	4,844	26,595	22,855
Gutta-percha .... „	3,668	2,858	44,860	16,095
Hides, raw :—				
Dry............ „	24,898	31,193	64,142	75,019
Wet .... „	52,059	58,892	108,173	120,007
Ivory .... „	756	734	34,364	34,577
Manure :—				
Guano .... Tons	2,967	176	20,567	1,224
Bones.......... „	2,126	1,365	9,696	5,868
Nitrate of soda... „	5,568	10,498	47,200	92,894
Phosphate of lime „	45,535	40,156	107,551	65,658
Paraffin.......... Cwt.	33,081	72,501	50,798	70,562
Linen rags....... Tons	2,071	1,145	21,129	11,297
Esparto.......... „	18,333	15,130	88,969	67,481
Pulp of wood .... „	16,101	16,731	80,714	98,289
Rosin............ Cwt.	154,000	202,897	37,958	62,404
Tallow and stearin „	126,131	156,381	157,173	217,578
Tar ....Barrels	35,967	42,899	19,748	23,196

Imports of Raw Materials for Non-Textile Industries for Month ending 31st August—*continued.*

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Wood:—				
Hewn .... Loads	308,370	316,679	718,880	639,839
Sawn .... „	794,077	857,264	1,719,279	1,826,959
Staves .... „	13,850	17,097	55,735	52,305
Mahogany ..... Tons	6,334	3,007	59,583	26,312
Other articles.... Value £	..	..	934,644	932,120
Total value	..	..	4,668,354	4,781,048

Besides the above, drugs to the value of 72,504*l.* were imported, as against 65,253*l.* in August 1892.

Exports of Metals (other than Machinery) for Month ending 31st August.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	7,854	10,161	33,640	40,151
Copper:—				
Unwrought ..... „	68,936	35,879	160,608	85,011
Wrought........ „	26,780	25,874	79,379	73,912
Mixed metal .... „	20,197	21,977	59,056	51,881
Hardware ..... Value £	..	..	185,320	166,983
Implements....... „	..	..	100,644	95,809
Iron and steel..... Tons	259,625	281,832	1,880,174	1,779,846
Lead .... „	4,306	4,353	48,368	48,012
Plated wares... Value £	..	..	27,739	26,211
Telegraph wires „	..	..	29,755	176,859
Tin .... Cwt.	9,237	15,373	45,369	67,930
Zinc .... „	17,362	9,779	15,726	8,564
Other articles .. Value £	..	..	76,396	70,372
Total value	..	..	2,739,174	2,691,541

Exports of Drugs and Chemicals for Month ending 31st August.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali........... Cwt.	500,228	447,034	176,474	147,332
Bleaching materials „	150,624	87,050	59,807	35,781
Chemical manures. Tons	40,959	48,505	169,191	227,926
Medicines....... Value £	..	..	86,911	76,765
Other articles ... „	..	..	216,402	227,309
Total value	..	..	708,785	715,113

Exports of Miscellaneous Articles for Month ending 31st August.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	754,000	649,700	16,710	17,098
Military stores.. Value £	..	..	81,005	89,875
Candles.......... Lb.	1,726,100	1,445,300	31,488	26,949
Caoutchouc ..... Value £	..	..	103,629	107,979
Cement.......... Tons	43,032	36,948	77,569	63,707
Products of coal Value £	..	..	67,245	75,955
Earthenware ... „	..	..	186,432	157,134
Stoneware ...... „	..	..	10,314	12,612
Glass:—				
Plate........... Sq. Ft.	144,916	171,278	8,290	8,785
Flint........... Cwt.	8,538	6,834	20,265	16,038
Bottles......... „	66,614	56,361	33,073	28,031
Other kinds.... „	18,565	15,717	13,929	11,846
Leather:—				
Unwrought .... „	10,001	11,734	94,831	109,390
Wrought ..... Value £	..	..	40,932	33,569
Seed oil.......... Tons	4,679	4,934	91,292	108,843
Floorcloth ..... Sq. Yds.	1,282,700	1,583,700	59,334	65,117
Painters' materials Val. £	..	..	115,648	121,162
Paper .... Cwt.	79,072	68,628	131,159	113,081
Rags.............. Tons	4,054	3,318	26,666	19,638
Soap .... Cwt.	47,798	56,309	49,955	58,725
Total value	..	..	2,421,423	2,332,854

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, and MACHINERY.

Applications.

15,455. J. T. Thomson. A pump for producing low exhaustion by the use of any liquid, such as mercury or sulphuric acid, which has a very small vapour pressure, which pump can work either automatically or by hand. August 15.

15,484. E. A. Uehling and A. Steinbart. Improvements in and relating to pyrometers. Complete Specification. August 15.

15,488. J. Y. Smith. Improvements in method of and apparatus for promoting consumption of fuel. Complete Specification. August 15.

15,622. A. E. H. Field. An improvement in compound asbestos and other fibrous packings. August 17.

15,640. A. Burkart-Stalder. Improvements in apparatus for attaining a smokeless combustion and a high temperature. Complete Specification. Filed August 17. Date applied for January 17, 1893, being date of application in Switzerland.

15,724. J. Harper. An improved apparatus for assisting in the drying of hops. August 19.

15,843. C. J. Lundstrom, D. H. Burrell, and E. J. Burrell. Improvements in centrifugal liquid separators. Complete Specification. August 21.

15,946. P. Colligan. Improvements in the means or apparatus for cooling beer and other liquids. August 23.

16,063. G. Morris and W. Edney. *See* Class XVII.

16,151. P. J. Worsley, W. Windus, and B. Bracey. *See* Class VII.

16,163. C. Hodson. *See* Class XVII.

16,164. C. Hodson. An improved apparatus for drying cacao beans and the like. August 28.

16,198. W. C. Currie and W. E. Rowlands. An improvement in apparatus for drying animal and other matters. August 28.

16,439. E. Shaw. An improved method of removing liquids from solutions. September 1.

16,869. J. Gamgee. Improvements in vapour condensers or devaporators. September 7.

17,193. J. F. M. Pollock and W. Leach. Improvements in machinery for making or forming compressed blocks, such as bricks, block fuel, soap, and the like. September 13.

17,262. E. Partington and S. Bamforth. Improvements in taps and cocks for use with corrosive liquids. Complete Specification. September 14.

17,380. C. E. Miles. Improved means for evaporating liquids. September 15.

17,403. W. B. Cowan. A new or improved triturating and emulsifying machine. September 15.

Complete Specifications Accepted.*

1892.

15,880. A. Dauber. Improvements in calcining furnaces. August 30.

18,325. F. T. Bond. An appliance for making infusions or extracts of vegetable or other matters. September 20.

18,793. F. J. R. Carulla. Apparatus for concentrating and evaporating liquids. August 23.

19,653. P. M. F. Laurent. A method and apparatus for use in the manufacture of ice. September 6.

19,789. A. Boake and F. G. A. Roberts. Improvements in vessels for containing sulphur dioxide. August 30.

1893.

14,902. J. Kremer. Actinometer and method of measuring the chemical effect of light. September 13.

II.—FUEL, GAS, AND LIGHT.

Applications.

15,432. R. H. Laird and W. H. Laird. Improved apparatus for vaporising oil. August 14.

15,515. C. D. Abel.—From the Gas Motoren Fabrik Deutz, Germany. Improved construction of gas producers. August 15.

16,220. R. Nobel. Improvements in the method of burning and controlling the combustion of solid fuel, and in hearths or furnaces therefor. August 28.

16,232. A. E. Dinsmore. Improvements connected with gas-making apparatus. August 29.

16,538. R. Fegan. Improvements in the manufacture of briquettes for fuel. September 2.

Complete Specifications Accepted.

1892.

18,581. D. Terrace. An improved apparatus or appliance for heating inclined gas retorts. August 23.

18,904. J. Hodges. *See* Class III.

19,078. L. Chapman. Apparatus for the production of oxygen and nitrogen from atmospheric air. August 30.

20,341. P. A. Fichet and R. Heurtey. Improvements in the production and the use of gaseous fuels. August 30.

20,710. L. Van Vestraut. An improved apparatus for charging inclined gas retorts. September 20.

1893.

6688. B. D. Healey. An improved system of utilising the heated gases from refuse-destructor furnaces. September 6.

13,482. H. H. Lake.—From A. C. Humphreys. Improvements in apparatus for the manufacture of gas. August 23.

13,890. J. Hamer. An improved fire-lighter for use with petroleum or other oil. August 30.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Application.

16,769. F. W. Clark. An improved method or process for the extraction of naphthalene and other hydrocarbons from coal-tar and similar substances. September 6.

Complete Specification Accepted.

1892.

18,904. J. Hodges. Improvements in the treatment of paraffin scale and other crude paraffins. August 23.

IV.—COLOURING MATTERS AND DYES.

Applications.

6035A. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters. Filed September 14. Date applied for March 21, 1893.

15,444. S. Pitt.—From L. Cassella and Co., Germany. The production of new acetnaphthylenediamine sulpho acids and of colouring matters derived therefrom. August 14.

15,509. R. G. Williams. Improvements in colouring matters. August 15.

15,698. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of azo colouring matters from diamidodibenzimidazols. August 18.

16,199. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of dihydroxynaphthalene and amido-naphthol sulpho acids and of dyes derived therefrom. August 28.

16,308. J. Fury. Improvements in dyes for staining leather. August 30.

16,370. B. Willcox.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new acid colouring matters. August 30.

16,780. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters and materials therefor. September 6.

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* *See* Note (*) on previous page.

17,141. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of sulpho-acids of the naphthalene series. September 12.

17,472. B. Willcox.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new colouring matters and leuco-compounds related to the indigo series, and of new materials therefor. September 16.

Complete Specifications Accepted.

1892.

17,770. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new azo colouring matters, and processes for dyeing and printing therewith. September 6.

18,081. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Reduction of green and blue to blue-green colouring matters of the triphenylmethan series. August 23.

18,721. R. J. Friswell and F. H. Leeds. Manufacture of copyable inks. August 23.

18,762. H. S. Elworthy. An improved method of and apparatus for oxidising indigo liquor. September 20.

19,557. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new colouring matters. September 13.

19,743. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new azo colouring matters. September 13.

19,820. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. A new manufacture of red colouring matter. September 20.

19,891. Brooke, Simpson, Spiller, Limited, and A. G. Green. Manufacture of azo colouring matters. September 20.

1893.

12,704. J. Imray.—From L. D. Huguenin and Co. Production of new unsymmetrical diamido bases and manufacture of dyes therefrom. August 30.

12,928. P. Monnet and M. C. Traub. Production of a diamidophenolester and its acid derivatives. August 23.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

15,945. A. F. B. Gomess. A new and improved process for the treatment of textile vegetable fibres (more especially those of the urtica family). August 23.

16,179. W. Littlewood and I. Ingham. Improvements in the method and apparatus for colour classing and designing for the manufacture of textile goods. August 28.

16,635. E. A. Schmitt and G. Elbinghaus. *See* Class XIX.

16,698. E. J. Goodwin. Improved treatment of textile fabrics and production of material suitable for use as tracing cloth. September 5.

16,958. W. Thomson. Improved process for rendering fabrics waterproof. September 9.

Complete Specification Accepted.

1892.

19,737. H. W. Godfrey, C. F. Leake, and C. E. Lucas. Manufacture of floor-cloth. September 6.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

15,531. G. A. J. Schott.—From E. Laube, Switzerland, and H. Resch, Germany. Improvements in the method of bleaching cotton cloths and other materials, and in apparatus employed therein. August 16.

15,829. O. Imray.—From F. Erbau and L. Specht, Germany. Process for dyeing textile material in cops or spools with alizarine and other mordant dyes. August 21.

16,038. T. P. Miller. Improvements in apparatus for treating fibrous materials, yarns, or threads with mordanting, preparing, dyeing, or other liquids. August 25.

16,551. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in dyeing with paranitraniline on fabrics grounded with beta-naphthol. September 2.

Complete Specifications Accepted.

1892.

14,943. C. A. Sahlstrom and E. Parr. Improvements in the bleaching of wool, hair, silk, cotton, flax, and other animal and vegetable fabrics and fibres, paper, pulp, and the like. August 23.

15,082. F. Obermayer. An improved process of dyeing animal fibres and fabrics, horn, feathers, leather, and albuminous substances generally. August 30.

21,714. F. W. Hayward, A. S. King, and A. W. Loveland. Improved means and apparatus for surfacing paper or other material with colour, gum, oil, varnish, or the like. September 13.

1893.

13,902. E. Gessler. A new or improved apparatus for the treatment of textile fibres or yarns or the like with dyeing fluids and vapours. September 20.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

15,424. F. J. R. Carulla. Improvements in the manufacture of sulphur. August 14.

15,466. J. Cuninghame and J. Addie. A new or improved process for obtaining ammonium chloride and carbonate or bicarbonate of soda from blast-furnace or producer gases. August 15.

15,475. R. H. Leaker. Improvements in the manufacture of vinegar. August 15.

15,735. W. Paterson and J. Jack. Improvements in obtaining chlorine. August 19.

15,895. F. B. Hacker and P. S. Gilchrist. Improvements in apparatus for the manufacture of sulphuric acid. Complete Specification. August 22.

16,010. W. Brothers. Improvements in the manufacture of bicarbonate of ammonia. August 24.

16,046. J. Pedder. Improved method for effecting the decomposition of sodic sulphate. August 25.

16,151. P. J. Worsley, W. Windus, and B. Bracey. Improvements in or connected with pumping and absorbing chlorine gas, and apparatus for use therein. August 26.

16,652. A. Vogt and A. R. Scott. Improvements in obtaining chlorine. September 5.

16,760. A. Gordon and J. Gordon. Improved process and apparatus for the manufacture of cyanides. September 6.

17,002. S. Marasse. An improved method of manufacturing potassium salicylate and salicylic acid. Complete Specification. September 9.

17,054. C. D. Abel.—From C. Hirzel, Switzerland. Process and apparatus for obtaining common salt by the refrigeration of brine. Complete Specification. September 11.

17,173. G. T. Beilby. Improvement in the manufacture of cyanides. September 13.

17,220. C. A. J. H. Schroeder and H. E. R. Schroeder. *See* Class X.

Complete Specifications Accepted.

1892.

13,047. H. W. Wallis. Manufacture of chlorine. August 23.

17,911. P. M. Justice.—From E. G. Acheson. Improvements in and connected with carbonaceous compounds. August 30.

18,496. J. Morris. New or improved process for the production of crystals or crystalline masses. September 13.

18,598. F. P. Candy. Improvements in and in connection with the manufacture of iron sulphate, and of materials for use in the filtration and precipitation of sewage and polluted waters. September 6.

18,810. H. Steinem. Manufacture of carbonic acid gas. September 6.

18,900. C. H. W. Hœpfner. Improvements in the manufacture of cuprous oxide. September 20.

19,812. L. Mond. Improvements in obtaining ammonia, chlorine, and hydrochloric acid from ammonium chloride. September 13.

20,055. W. J. Fraser and L. McGregor Fraser. Manufacture of bleaching powder and like compounds, and apparatus therefor. September 20.

20,269. M. P. Hatschek. Improvements in the manufacture of sulphurous acid and its compounds, sulphites and bi-sulphites of lime, soda, and the like. September 13.

20,284. P. de Wilde, A. Reychler, and F. Hurter. Improvements in apparatus for the manufacture of chlorine. September 20.

1893.

12,074. A. Vogt and A. R. Scott. Improvements in obtaining chlorine. September 6.

12,426. A. Campbell and W. Boyd. Improvements in obtaining or reforming manganese peroxide for use in obtaining chlorine and otherwise. August 23.

12,604. Pierre Rogatien, Vicomte de Lambilly. An improved process of fixing atmospheric nitrogen, and of producing bicarbonate and formiate of ammonium, formic acid, and other formiates. September 6.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

15,441. M. Rosenthal and R. Walter. Improvements in the production of variously coloured designs, drawings, or pictures on porcelain, glass, or ceramic objects. August 14.

16,018. H. Ritter von Kralik and W. Ritter von Kralik. Improvements in the manufacture of rose-red glass. Complete Specification. August 24.

16,156. J. Gratton. New design for a potter's oven bottom. August 26.

17,495. P. B. W. Kershaw. Improvements in apparatus for making glass bottles or vessels. September 16.

17,496. P. B. W. Kershaw. Improvements in the process and means used therein for making glass bottles or vessels. September 16.

Complete Specifications Accepted.

1892.

16,252. P. Sievert. Improvements in glass furnaces. August 30.

18,135. L. H. Pearce. Improvements in the manufacture of blown glass articles. August 23.

1893.

13,838. W. Knapp. A process for the production of coloured pictures, writing, and the like on glass, porcelain, and enamel. September 13.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

15,496. The Adamant Co., Limited, and J. Wilkinson. A new or improved fireproof flooring. August 15.

15,822. C. Wildt. Improvements in or relating to the plastic decoration of surfaces. August 21.

16,415. W. A. Burr. Improvements in and connected with fireproof ceilings. August 31.

16,454. A. J. Boult.—From L. P. Hemmer, Germany. An improved material adapted for use as a substitute for wood, metal, stone, and other substances. Complete Specification. September 1.

16,470. T. C. Kitto. The ashpalt and lead cement paving. September 1.

16,678. W. C. May. Improvements in the preservation of clay and like materials in a plastic condition. September 5.

16,840. A. Cléry. Improvements in the manufacture of artificial stones. Complete Specification. September 7.

17,046. C. A. Allison.—From L. Rieser, Victoria. An improved process of and apparatus for preparing and seasoning timber. Complete Specification. September 11.

17,142. L. Grote. Improved manufacture of artificial stone. Complete Specification. September 12.

17,322. A. McLean and C. W. Wilson. Improvements relating to the manufacture of artificial stone. September 14.

Complete Specifications Accepted.

1892.

19,009. J. Thomlinson. Manufacture of non-efflorescent white cements from calcined sulphate of lime. August 30.

21,064. H. Lockwood. An improved composition for flooring or covering iron bridges, arches, tanks, and other structures. September 13.

23,416. G. Maxwell. An improved system of concrete construction. September 6.

1893.

4259. T. Potter. Improvements in the construction of fire-resisting floors. August 23.

13,079. A. Typlt. Process for making paving stones, patterned slabs, and the like. September 6.

13,080. A. Typlt. Mixture and process for producing artificial marble and other stone imitations. September 6.

13,357. G. M. Restall. An improved composition or mixture to be used for general decorative work. September 20.

X.—METALLURGY, MINING, Etc.

Applications.

15,454. W. Mills. Improvements in preparing non-volatile metals from their sulphates. August 15.

15,507. S. O. Cowper-Coles. Improved method of and apparatus for pickling metal articles. August 15.

15,551. T. Hampton. Improvements in the manufacture of steel. August 16.

15,569. L. Maddison. Improvements in the manufacture of iron and steel articles. August 16.

15.680. Y. B. Alzugaray.—From A. M. Alves da Neiga, France. Improvements in and connected with the manufacturing of aluminium-antimony alloys. August 18.

15,875. C. Allen and C. Davey. Improvements in apparatus for the manufacture of cast iron and steel. August 22.

15.949. O. Imray.—From B. T. Lacy, United States, and J. Storer, New South Wales. Improvements in dissolving, leaching, and filtering ores or minerals, and apparatus for that purpose. August 23.

16,014. A. Gutensohn. An improved process for recovering metal from metal ashes and the sweepings of metal works. August 24.

16,176. H. C. Bull. A method and apparatus for recovering gold from sea-water. August 28.

16,180. L. V. J. Lynen. Process and apparatus for the extraction of zinc. Complete Specification. August 28.

16,228. C. M. Pielsticker. Improvements in the extraction of gold and silver from ores. August 29.

16,369. G. Plumbly and W. Thomas. Improvements in extracting metals and in the apparatus employed therein. August 30.

16,417. J. P. van der Ploeg. A process for the extraction of gold and other precious metals from their ores, gold-tailings, and the like. August 31.

16,421. H. Schneider. Improvements in the manufacture of armour plates and the like, and apparatus therefor. August 31.

16,475. A. Lencauchez. Improvements relating to the production of homogeneous cast iron or steel, and to apparatus therefor. September 1.

16,561. C. Moldenhauer. A process for precipitating precious metals from solutions. September 2.

16,786. M. Body. An improved process for the chemical disaggregation of pyrites of complex composition with a view to rapid extraction of the metals contained therein, such as gold. silver, arsenic, antimony and tellurium. September 6.

16,857. A. Raze. Process for avoiding or considerably diminishing the choking and contraction of the mouth of the retort in the manufacture of the "Thomas" steel. Complete Specification. September 7.

16.996. A. V. Newton.—From A. Nobel, France. "Improvements in welding and soldering metals. September 9.

17.111. W. E. Case. Improvements in processes for the manufacture of aluminium compounds. Complete Specification. September 12.

17,220. C. A. J. H. Schroeder and H. E. R. Schroeder. Improved methods of recovering zinc from the waste products of galvanic batteries. Complete Specification. September 13.

Complete Specifications Accepted.

1892.

13.555. J. B. Torres. Improvements in the manufacture of alloys and in the purification of metals and alloys. August 30.

15,713. J. B. Alzugaray.—From J. B. Torres. Improvements in and connected with the reduction of antimony ores, alloys, and salts, and purification of the metal obtained therefrom. September 13.

16,408. G. F. Thomson. Improvements in or relating to the manufacture of iron and steel. September 13.

17,206. J. Colley and T. Twynam. Manufacture of ingot iron and steel. August 30.

17,694. J. W. Kynaston. Improvements in the extraction of bismuth, especially applicable to the treatment of the flue dust of copper works. September 20.

18,928. G. L. Morris and J. Williams. Improvements in machinery and appliances for coating metal sheets with tin, terne, and other metals or alloys. September 20.

19,727. H. J. Phillips. A process for the elimination of sulphur and phosphorus from molten iron or steel. September 13.

20,547. T. Harris and H. C. Sacré. *See* Class XIII.

21,162. R. Haddan.—From F. Singer and H. Barthel. An improved method of soldering aluminium and other metals, and an improved solder therefor. September 20.

1893.

11,955. E. Oddy, J. Crossley, E. Smith, and A. Smith. Improvements in the method of and apparatus for hardening and tempering, in continuous or other lengths, steel wire bright. August 23.

12,624. A. F. Seccombe. Apparatus for testing presence of and recovering float gold and other metals. August 30.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

15,476. L. Falero. Improvements in primary voltaic batteries. August 15.

15,610. F. G. Baily and M. Guthrie. Improvements in apparatus for the electrolytical decomposition of brine and other liquids. August 17.

15,617. F. G. Baily and M. Guthrie. Improvements in apparatus for the electrolytical decomposition of brine and other liquids. August 17.

15,669. N. Browne.—From A. Vogelsang, Germany. Apparatus for the electrolytic treatment of liquids. Complete Specification. August 18.

15,681. G. H. Roe and G. Sutro. Improvements in electric accumulators or storage batteries. Complete Specification. August 18.

15,906. D. Young.—From La Société Outhenin Chalandre Fils et Cie., France. Improvements in and relating to electrolytic apparatus. Complete Specification. August 22.

16,136. A. J. Boult.—From R. T. E. Hensel, Germany. Improvements in or relating to electrodes for primary and secondary batteries. Complete Specification. August 26.

16,265. G. Philippart and G. Lentz. Improvements in electrodes for secondary voltaic batteries. August 29.

16,307. J. Swinburne. Improvements in electric meters, dynamos, electrolysis of solutions, manufacture of sodium and sodium substitutes, manufacture of potassium cyanide, gold extraction, and recovery of tin from scrap. August 30.

16,630. B. Kitto and W. Muir. Improvements in obtaining zinc from solutions by electro-deposition. September 4.

16,851. A. Gentzsch. Improved insulating material for electrical purposes and method of producing same. September 7.

16,880. S. O. Cowper-Coles. Improvements relating to the coating of plates, wire, and other metal articles by electro-deposition to protect the same from corrosion, and apparatus therefor. September 7.

17,127. T. Craney. Improvements in electrolytic cells. Complete Specification. September 12.

17,221. C. A. J. H. Schroeder and H. E. R. Schroeder. New or improved galvanic batteries. Complete Specification. September 13.

17,466. W. Wright and J. B. Hamond. Improvements in the treatment of zinc produced by electrolysis. September 16.

Complete Specifications Accepted.

1892.

15,197. H. M. E. Andreoli. Improvements in electrolytic apparatus. August 23.

16,300. H. H. Frei. Improved method of and means for supplying electricity to the carbon electrodes employed in the electrolysis of fused electrolytes. September 13.

16,335B. E. M. Harrison. Improvements in magneto-electric generators. September 13.

17,099. H. T. Barnett. An improvement in carbon electrodes. September 13.

18,966. Siemens Bros. and Co., Lim.—From Siemens and Halske. Process for the electrolytic decomposition of compounds of metals and sulphur. August 23.

19,953. J. C. Richardson. Improvements relating to the construction of electrodes for electrolytical purposes. September 13.

20,348. R. J. Black. Improved electric battery cells. September 13.

1893.

2331. N. H. Edgerton. Improvements in secondary electric storage batteries or accumulators. September 6.

5694. J. C. Richardson. Improvements in apparatus for the electrolytic decomposition of solutions of chloride of sodium and potassium. September 20.

9296. T. Craney. Improvements in apparatus for the electrolysis of salt. August 23.

9965. A. Longsdon.—From F. Krupp. Improvements in or connected with the working and welding of metals by electricity. August 23.

11,579. W. P. Thompson.—From C. L. Coffin, United States. A new or improved method of, and apparatus for, electrically heating or welding metal. August 23.

13,858. A. Heil. A galvanic element. September 6.

13,911. W. P. Thompson.—From C. L. Coffin. An improved method of and apparatus for heating, welding, or working metals electrically. September 6.

14,910. P. Jensen.—From A. Sinding-Larsen. A method of and apparatus for electrolytical decomposition while using quicksilver as cathode. September 13.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

15,618. Read, Holliday, and Sons, Lim., and T. Holliday. Improvements in the manufacture of soap. August 17.

16,145. J. Alvarez. Soap for toilet purposes. August 26.

16,201. Read, Holliday, and Sons, Lim., and T. Holliday. Improvements in the manufacture of soap. August 28.

16,689. J. Schicht. An improved cleansing agent. Complete Specification. September 5.

16,987. W. Spindler and C. Stautz. Improvements in extracting oil from oil-containing plants and fruits, and in the production of fodder from the residual matter. September 9.

17,309. A. J. Inston. Improvements in recovering grease from waste suds which have been used in washing wool, hair, or other fibre. September 14.

Complete Specifications Accepted.

1892.

16,954. A. G. Petty. Improvements in the steam treatment of oils and fats for purifying or distilling purposes. September 20.

1893.

8367. W. H. Wayland. *See* Class XVI.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

15,500. J. Y. Johnson.—From the Virginia Phosphate and Paint Co., United States. Improvements in titanic mineral compositions and industrial application thereof. August 15.

15,686. C. U. King and R. V. Jellicoe. An improved material or compound adapted for use as a varnish, as a substitute for india-rubber, gutta-percha, and like substances, and for other purposes, and the process for its production. August 18.

15,751. W. V. Wilson. Improvements in the treatment of sulphate of lead for use in the preparation of paints. August 19.

15,881. Z. Joseph de la Royère. An improved varnish for woodwork. August 22.

16,638. C. H. M. Lyte. An improved process for the production of iron oxide for use as a pigment. September 4.

16,703. J. V. Walton. Improvements in apparatus employed in the manufacture of white lead. September 5.

16,800. T. W. Elliott. A new or improved composition for coating iron and steel. September 7.

17,118. G. H. Richards. A new or improved composition or compound and means or apparatus for applying same. September 12.

17,119. G. H. Richards. A new or improved composition or compound. September 12.

17,159. W. V. Wilson and W. B. Priest. The manufacture or production of paints. September 12.

17,331. A. M. C. Mary. Improvements in processes for the production of white lead. September 14.

17,477. J. Anderson, jun. Improvements in treating rubber waste for the separation of foreign substances therefrom; also applicable to other purposes. September 16.

Complete Specifications Accepted.

1892.

20,547. T. Harris and H. C. Sacré. The utilisation of a certain waste oxide of iron in the manufacture of paints and pigments, and for other purposes. September 13.

1893.

11,369. A. Gentzsch, J. Goldschmidt, and E. R. von Scanavi. An improved electric insulating compound and process of preparing same. August 23.

13,702. W. P. Thompson.—From Sohler and Burger. Improved composition or preparation for protecting metals from rust. August 30.

13,925. A. Beck. An improved varnish or composition applicable as a protective coating for wood, iron, and the like. August 23.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

APPLICATIONS.

15,898. H. H. Lake.—From G. Sachsenröder, Germany. Improvements relating to the manufacture of a substitute for leather. August 22.

15,937. H. H. Lake.—From G. Sachsenröder, Germany. Improvements relating to the manufacture of a substitute for leather. August 23.

16,783. J. D. de Joseph. Improvements in or connected with tanning hides and skins. Filed September 6. Date applied for March 6, 1893, being date of application in Italy.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

21,551. T. Cowburn. Improved process of and apparatus for tanning and cleaning hides and skins. September 20.

1893.

11,693. H. O. Band. An improvement in parchment. September 13.

XV.—AGRICULTURE AND MANURES.

APPLICATIONS.

17,235. G. F. Redfern.—From J. Hensel and F. Spiethoff, Germany. Improvement in the manufacture of mineral manure. September 13.

17,338. S. Wyatt. A method for reclaiming and preparing the mud in our rivers for agricultural manure. September 15.

XVI.—SUGARS, STARCHES, GUMS, ETC.

COMPLETE SPECIFICATIONS ACCEPTED.

1893.

3302. S. Pratt. Improvements in the treatment of starch containing substances for use in brewing, distilling, the manufacture of glucose, and in similar operations. September 13.

8367. W. H. Wayland. An improved apparatus and process for purifying sugar, saccharine, and the like; also applicable to oils, alcohol, and other liquids which need purifying. September 13.

14,394. J. N. S. Williams Improvements in defecating or purifying saccharine liquids, and in apparatus therefor. August 30.

15,300. W. Smith.—From H. Kidd. Improvements in continuous subsiding or settling apparatus for sugar-cane juice. September 20.

15,304. W. Smith.—From H. Kidd. Improvements in apparatus for treating shreaded or comminuted sugar canes preparatorily to crushing. September 20.

XVII.—BREWING, WINES, SPIRITS, ETC.

APPLICATIONS.

15,499. F. Chavauty. New or improved manufacture of grape and other fruit wine. August 15.

15,842. H. H. Lake.—From O. E. Nycander, Germany. Improvements relating to the collection of alcohol, carbonic, lactic, and other acids produced in the manufacture of spirits and yeast, and to apparatus therefor. August 21.

15,946. P. Colligan. *See* Class I.

16,063. G. Morris and W. Edney. An improved still or apparatus for distilling spirits and all kinds of other liquids. August 25.

16,163. C. Hodson. Improvements in and connected with steam pans for boiling sugar molasses, or for other similar purposes. August 28.

16,420. F. E. V. Baines. Improvements in the treatment of rice or other grain for the production therefrom of a material suitable for use in brewing and for other purposes. August 31.

16,692. F. H. Collins. Improvements in apparatus for regulating the temperature of fermenting liquids. September 5.

17,275. W. S. Squire. Improvements in the manufacture of yeast. September 14.

17,406. J. Bruce. Improvements in the manufacture of yeast. September 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

16,563. W. Rohowsky. A new or improved process or manufacture of non-injurious beverages from liquids containing alcohol. September 20.

18,370. A. T. Harris. Harris's patent rectifier. September 13.

1893.

8367. W. H. Wayland. *See* Class XVI.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

APPLICATIONS.

A.—Chemistry of Foods.

15,434. H. B. Briggs. Improvement in the manufacture of condensed milk preparations. August 14.

15,435. H. B. Briggs. Improvement in the manufacture of condensed milk preparations, invalids' and children's foods. August 14.

15,595. W. Knebel and F. E. Sahlfeld. A fish extract or essence, and in utilising the residual or waste products resulting from the production of the same. August 17.

15,714. J. Y. Johnson. From C. F. Boehringer and Soehne, Germany. Improvements in the manufacture of compounds for alimentary and medicinal purposes. August 18.

15,757. J. Effront. Improved method and means for preserving food and other substances. August 19.

15,761. J. Fordred. Improvements in the sterilisation, preservation, and condensation of milk and cream. August 19.

15,762. J. Fordred. Improvements in the treatment of eggs. August 19.

15,764. J. Fordred. Improvements in the preparation of soluble foods in a concentrated form. August 19.

16,407. P. Rabbidge. An improved mode of preserving food. August 31.

16,458. W. Brothers. Improved baking powder. September 1.

16,476. J. Struthers. Improvement in apparatus for heating, cooling, and preserving milk and other liquids. September 1.

17,205. J. C. W. Stanley. Improvements in or relating to the treatment of fish and fish offal, and in apparatus therefor. September 13.

17,268. J. J. Adkins. Desiccated hop fodder and litter. September 14.

B.—Sanitary Chemistry.

15,914. S. Quilliam. New or improved sanitary material. August 23.

16,171. J. W. Lodge. Improvements in machinery and means for (and in the method of) mixing, converting, utilising, reducing, or destroying towns' refuse, stable litter, tanners' and dyeworks' refuse, domestic coal ashes, and gas-coke breeze, and the generation of steam thereby. August 28.

16,222. R. C. Sayer. Improvements in sanitation. Complete Specification. August 29.

16,368. J. Hanson. Improvements in and apparatus for treating town refuse, or excrementitious or like matter, and obtaining useful products therefrom. August 30.

16,522. G. Jarmain. Improvements in the treatment of sewage and waste waters. September 2.

16,948. J. Bannehr and W. Chattaway. Improvements in the ventilation of sewers, and in treating the foul gases generated therein, and apparatus therefor. September 8.

17,026. G. Sheffield, W. J. Clapp, and W. Sandbrook. Improvements in or relating to the process for carrying away and consuming of smoke and fumes and other obnoxious gases and smells from furnaces, boilers, ovens, factories, works, steamships, and ships various, or fires, as well as other purposes. September 11.

C.—Disinfectants.

15,914. S. Quilliam. *See* Class XVIII., *B.*

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

18,064. J. Berlit. New or improved manufacture of a substance or composition suitable for use as a substitute for cocoa. September 13.

21,623. G. D. Dennis. An improved process of preserving dried vegetables. September 20.

1893.

12,030. E. de Pass. From P. G. Biron. A new process of preserving alimentary substances. August 30.

13,021. G. W. Richards and J. W. Hodgson. Improvements in the manufacture or production of articles of food for human consumption. August 30.

14,252. F. A. Kleeman. An improved method of and apparatus for pasteurising or sterilising milk and other fluids. September 20.

B.—Sanitary Chemistry.

1892.

17,006. W. D Scott-Moncrieff. Improvements in or relating to the treatment of sewage. September 13.

18,317. J. Watts. Improvements in apparatus for generating and applying fumes, smoke, or vapours for disinfecting, deodorising, or fumigating purposes, or for the testing of pipes or passages by what is known as the smoke test, or for analogous purposes. August 23.

18,598. F. P. Candy. *See* Class VII.

19,198. R. Stanley. An improved method for the purification of sewage waters and waters from chemical and other manufactures. September 13.

19,247. W. D. Scott-Moncrieff. Improvements in or relating to the treatment of sewage. August 30.

19,587. F. P. Candy. Improvements in the treatment of sewage and polluted waters, and in connection with the manufacture of materials for use in the treatment of sewage and polluted waters. September 6.

19,829. L. Archbutt and R. M. Deeley. Improvements in apparatus for purifying water. September 6.

19,830. R. M. Deeley and L. Archbutt. Apparatus for purifying water. September 13.

19,866. J. Hanson. Improvements in means or apparatus for cooling and purifying liquids discharged from works and the like. September 13.

1893.

14,245. W. Horsfall. Improvements in furnaces for the destruction of town refuse. September 6.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

15,830. O. Imray.—From V. B. Banker and August de Bary, Germany. An improvement in the manufacture of waterproof paper material. Complete Specification. August 21.

16,635. E. A. Schmitt and G. Elbinghaus. Improvements in rendering paper and textile goods waterproof. September 4.

16,854. E. Mense. Improvements in the manufacture of wood pulp and the like. September 7.

16,947. A. Yockney. Improvements in the manufacture or treatment of paper. September 8.

17,005. A. Beckwith. Improvements in the manufacture of paper. September 9.

Complete Specifications Accepted.

1892.

15,720. A. Brin. An improved process of and apparatus for treating peat for the manufacture of paper pulp. August 23.

1893.

5178. E. Gelinek and W. Gelinek. Improved process and apparatus for manufacturing plastic articles from paper pulp. August 30.

14,191. J. P. Cornett. Improvements in or connected with the manufacture of pulp for paper making. September 6.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

15,763. J. Fordred. Improvements in the preparation of cordials and medical comforts in a concentrated form. August 19.

15,767. F. H. Verdun. An improved process for treating camphor and other substances of the like kind, so as to preserve indefinitely their odour and antiseptic and other qualities. Complete Specification. August 19.

16,218. M. Freund. The manufacture and production of narceïne-esters and homo-narceïne esters and their salts. August 28.

16,589. B. Willcox.—From C. F. Boehringer and Soehne, Germany. Process for obtaining an iron albumen derivative from animal organs. September 4.

16,708. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of chemical compounds. September 5.

16,949. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of caffeinesulphonates. September 8.

Complete Specifications Accepted.

1892.

20,498. C. D. Abel.—From The Haarmann and Reimer Vanillin-Fabrik. Manufacture of β-cymidine—

$(CH_3.NH_2.C_3H_7)(1 : 2 : 4)$

from the oximes of certain camphor species. September 20.

1893.

11,380. J. Wetter.—From J. D. Riedel and Co. Manufacture of neutral aluminium salicylate and of a soluble compound of the same. September 6.

XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

Applications.

15,473. J. B. Brooks and J. H. P. Gillard. Improvements in photographic positives and in sensitive emulsions therefor. August 15.

15,621. C. F. Cross and W. Nelson. An improvement in photography. August 17.

16,354. E. Albert. Improvements in the production of photographic negatives. August 30.

Complete Specifications Accepted.

1892.

15,956. E. H. Hardy. New or improved process and apparatus for the tentative exposure and development of pictures obtained by photography. August 30.

17,768. R. G. Williams. Improved solutions for toning photographic prints. September 20.

1893.

13,373. J. W. Fawcett. Improved means for regulating the rays of light passing through photographic lenses. August 30.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

15,566. O. Imray.—From the Westfalisch Anhaltischen Sprengstoff Actien Gesellschaft in Coswig, Germany. Manufacture of explosives. Complete Specification. August 16.

15,620. H. J. Pain. Improvements in pyrotechnic devices. August 17.

15,865. F. G. du Pont and P. S. du Pont. Improvements in and relating to the manufacture of smokeless explosives. Complete Specification. August 22.

15,866. F. G. du Pont and P. S. du Pont. Improvements in and relating to the manufacture of smokeless explosives. Complete Specification. August 22.

15,867. F. G. du Pont. Improvements in and relating to the manufacture of smokeless explosives. Complete Specification. August 22.

15,997. T. Malson, S. R. Malson, W. A. Malson, and E. Smith. Improved electric high-tension fuse head for use in blasting. Complete Specification. August 24.

16,056. G. W. Thomas. Improvements in matches, fuzees, and the like. August 25.

16,391. B. Piffard. Improvements in the manufacture of gunpowder. August 31.

16,609. H. H. Lake.—From W. Adams, jun., New South Wales. Improvements in the manufacture of high explosives. Complete Specification. September 4.

16,863. M. A. Wier. Improvements in or connected with fuzes or shell exploders. September 7.

17,061. J. P. O'Donnell. An improved detonating railway signal. Complete Specification. September 11.

17,076. J. Martin. Improvements in or relating to matches. September 11.

17,321. A. V. Newton. — From A. Nobel, France. Improvements in the manufacture of explosive compounds. September 14.

17,386. A. V. Newton. — From A. Nobel, France. Improvements in explosive compounds. September 15.

PATENT UNCLASSIFIABLE.

Application.

15,453. F. Chaplet. Manufacture or production of new substances of extreme hardness. August 14.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL

OF THE

Society of Chemical Industry:

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NOTICES.

Patent Law Committee.

With this number will be found the report of a Committee of the Society formed to consider the whole question of the Patent Laws. This report has been received and adopted by the Council, which has ordered it to be laid before the various sections with a view to elicit an early discussion of the points therein raised. In order that advantage may be taken of next session of Parliament to raise the subject, the reports of discussions and the resolutions formulated should be sent to the General Secretary not later than February 1st, 1894.

Foreign and Colonial Members are reminded that the subscription of 25*s.* for 1894, payable on January 1st next, should be sent in good time to the Treasurer, in order to ensure continuity in the receipt of the Society's Journal. Any changes of address to appear in the new List of Members now in course of preparation, should reach the General Secretary not later than January 15th, 1894.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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SESSION 1893–94.

Nov. 6th:—
Mr. J. Scarisbrick. "Spirit Assaying by Weight."
Mr. W. P. Dreaper. "Estimation of Alizarin and Allied Colouring Matters."
Dec. 4th:—
Adjourned Discussion on Mr. H. G. Watel's paper (see Journal, 1893, 491).
Mr. Watson Smith. "Artificial Indigo."
1894:—
Jan. 8th.—Discussion on the state of the Patent Law.
Feb. 5th:—
Mr. W. P. Dreaper. "Theory of Dyeing." Part I. "Ingrain Colours."
Mr. H. Harris. "Copper Mines of Singhbhoom."

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Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893–94.

Nov. 1st.—Mr. Eustace Carey. "Some Observations on the Organisation and Management of a Chemical Works."

Manchester Section.

Chemical Theatre, Owens College.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.
Committee:

G. H. Bailey.
F. H. Bowman.
R. F. Carpenter.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
P. Hart.
J. M. Irving.
E. Knecht.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
C. Truby.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893–94.

Nov. 3rd:—
Mr. I. Levinstein. "The Chemical Industries; with Notes on the Progress in the Manufacture of Artificial Indigo and Indigo Carmine." (Illustrated by experiments.)
Discussions on "The Flash-Point of Mineral Oils" and "The Burning of Liquid Fuel, and its Value as compared with Coal."
Mr. Wm. Marshall. "A New Dye-Bath Arrangement for Experimental Dyeing."

Newcastle Section.

Chairman: A. Allhusen.
Vice-Chairman: John Pattinson.
Committee:

P. P. Bedson.
G. T. France.
T. W. Hogg.
T. W. Lovibond.
W. Martyn.
John Morrison.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
W. A. Rowell.
John Watson.

Hon. Local Secretary and Treasurer:
Dr. J. T. Dunn, The School, Gateshead.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893–94.

Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

Chairman: J. M. C. Paton.

Vice-Chairman: C. Spackman.

Committee:

L. Archbutt.
F. J. R. Carulla.
F. Clowes.
J. B. Coleman.
C. H. Field.
H. Forth.
J. O'Sullivan.
S. J. Pentecost.
H. J. Staples.
C. Taylor.
G. J. Ward.

Treasurer: J. T. Wood.

Hon. Local Secretary:
R. L. Whiteley, University College, Nottingham.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893-94.

Yorkshire Section.

Chairman: A. Smithells.

Vice-Chairman: T. Fairley.

Committee:

J. E. Bedford.
F. Branson.
J. B. Cohen.
J. J. Hummel.
J. Lewkowitsch.
W. Mackay.
C. Rawson.
F. W. Richardson.
Jas. Sharp.
G. W. Slatter.
G. Ward.
T. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

SESSION 1893-94.

Nov. 6th.—Chairman's Inaugural Address.
Dec. 4th.—Mr. C. Rawson, F.I.C., F.C.S. "The Utilisation of Town Refuse."

Glasgow and Scottish Section.

Chairman: C. A. Fawsitt.

Vice-Chairman: E. J. Mills.

Committee:

G. Beilby.
W. J. Chrystal.
J. Clark.
C. J. Ellis.
G. G. Henderson.
R. A. Inglis.
R. Irvine.
J. Falconer King.
W. I. Macadam.
J. S. Macarthur.
T. L. Patterson.
J. Pattison.
J. B. Readman.
E. C. C. Stanford.
D. R. Steuart.
R. R. Tatlock.

Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Members who desire to read Papers, exhibit Apparatus, &c., or introduce Discussions during Session 1893—94 are requested to give early notice to the Hon Local Secretary in order that the programme may be arranged.

SESSION 1893-94.

DATES OF MEETINGS.

Glasgow:—November 7th; January 9th; March 6th; May 1st.
Edinburgh:—December 5th; February 6th; April 3rd.

Obituary.

C. W. HEATON, F.I.C., F.C.S.

LECTURER IN CHEMISTRY IN CHARING CROSS HOSPITAL, MEMBER OF THE SOCIETY OF CHEMICAL INDUSTRY.

A WIDE circle of friends and former pupils were pained to see the announcement of the death of Mr. C. W. Heaton, which took place on the 11th of September last.

Mr. Heaton commenced his studies in the laboratory of Dugald Campbell, afterwards continuing them under Dr. Stenhouse in the laboratory of St. Bartholomew's Hospital, where he was Fellow Assistant with Professor Kekulé, Dr. Attfield, and the late Professor Tuson, of the Royal Veterinary College, Camden Town; with the last-named two he enjoyed a life-long friendship. He subsequently acted as Assistant and Demonstrator in the Royal Veterinary College and at Charing Cross Hospital, and he finally succeeded to the post of Lecturer in the latter institution in 1862, a post which he held up to the time of his death. He undertook with conspicuous success the teaching of chemistry at Repton School, Tunbridge School, and Epsom College. Mr. Heaton was Examiner in Chemistry to the Royal College of Physicians and to the Royal College of Veterinary Surgeons, was Treasurer to the Society of Public Analysts, and filled the office of Public Analyst to the parish of St. Martin-in-the-Fields. He was also Lecturer to the London School of Medicine for Women. His literary works included contributions chiefly to the *Saturday Review*, to the *Lancet*, and to other scientific journals, as well as to various art journals. He re-edited and almost re-wrote "Stöckhardt's Chemistry," a text-book still in favour with students of medicine and others. He was connected with many important investigations of a technico-chemical character, and was interested to the last in the improved purification of coal-gas and of the recovery of sulphur therefrom. Mr. Heaton's personal character was such as to secure for him the high and universal esteem and respect of his brother chemists, whilst his pupils will ever remember him as a generous, kind, and painstaking teacher. In private life he was a most genial companion.

At the time of his decease he was in his 58th year.

Journal and Patent* Literature.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

On Freezing-Machines in which Sulphurous Acid is Employed. F. Freytag. Dingl. Polyt. J. **74**, 145—148.

In 1876 Prof. R. Pictet, of Geneva, drew attention to the use of absolutely dry sulphurous anhydride as a cooling material. Freezing-machines in which this substance is used consist as usual of a (double-acting) compressor, an evaporator, condenser, &c.; compared with others in which ammonia is used, they have the not unimportant advantage that no lubricant is required in the compressor. The compressor must be surrounded by a jacket in which cooling-water circulates. The evaporator usually consists of two horizontal parallel copper cylinders connected beneath by U-shaped tubes. The condenser consists of a cylinder with vertical copper tubes through which cooling-water circulates.

Tests of a new type of such machine, made at the Geneva Engineering Works, were undertaken last year by the director (T. Turettini) and the engineer (H. Faucher). The machine used was the smallest type of those built on Pictet's system, and was designed to produce 100 kilos. of ice per hour. The tests appear to have been made with all care, and the detailed results are given in two tables. The engineer deduces the following conclusions from the tests:—

(1.) Anhydrous sulphurous acid (SO_2) does not attack metals and is not inflammable. (2.) The entire absence of any lubricant in the compressor is a great practical advantage and tends to simplify certain details in the construction of the machine. (3.) At a temperature of − 50° C. the vapour pressure of sulphurous acid is only 3·96 kilos. per sq. cm., whereas that of ammonia is 10·30 kilos. per sq. cm. It follows that in the machines in which SO_2 is used, the packing holds better than in machines in which ammonia is used. (4.) When the salt-solution is used at a temperature of − 9°, the effective yield per indicated horse-power is 28 kilos. of ice. This assumes that a fair-sized machine, producing 2,800 "units of cold" per hour, is used. (5.) The salt-solution being at the same temperature (− 9°), the consumption of condenser-water used is 11 litres per 100 units of cold or per kilo. of ice. (6.) A machine designed to produce 120,000 cold-units was found (in Gruber's brewery at Melun) to consume 25 kilos. of sulphurous acid during a working period of 18 successive months. (7.) Pictet's machines can also be worked at very low temperatures; thus with the salt-solution at a temperature of − 22°, 1,720 cold-units were produced per indicated horse-power per hour.

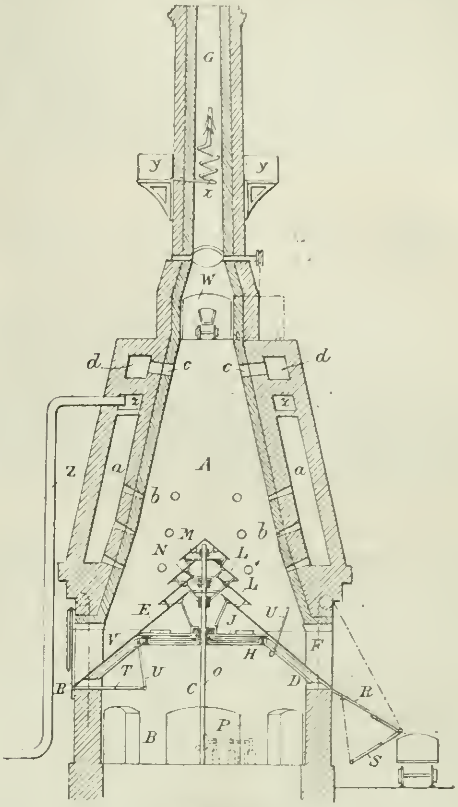
The material in freezing-machines has hitherto been reduced by compression from the gaseous to the liquid form, and then re-converted into the gaseous state by expansion; in which latter operation the cold is produced. C. Zenker, of Breslau, proposes (Ger. Pat. No. 62,035) to replace the latter operation by allowing anhydrous sulphurous acid to escape in the form of fine spray.—D. E. J.

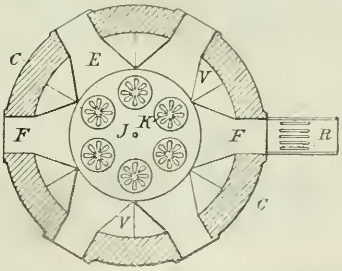
PATENTS.

Improvements in Calcining Furnaces. A Dauber, Bochum, Westphalia, Germany. Eng. Pat. 15,880, September 5, 1892.

The improvements contemplated in this invention, which refer principally to the admission, heating, and regulating of the air supply, and to the withdrawal and classification of the calcined materials, can best be described in connection with the annexed illustrations.

The furnace consists of a conical shaft A carried on a circular pedestal and pillars B, and provided with six outlets F above the delivery cone E. The shaft is surmounted by the chimney G. The short beams D with iron ring H support the cone E, as also the table or plate J with the regulating air valves K. Above E are the caps L and M, connected by arms N to a vertical shaft, by means of which they may be rotated. The outlets F are closed by hinged doors R, which, when let down, serve also as riddles for the finer materials by means of longitudinal slits left in them, which slits are closed when doors are in the upright position through the counter plates S swinging into place opposite the slits. As the doors R are opened the bars U are pushed up through the cone E across the openings F in order to prevent the calcined materials from rushing down too quickly. The conical shaft A is surrounded by a jacket *a* which receives gas through the pipe and channel Z for heating purposes, the gas entering the furnace through the tuyères *b*. The raw material and the fuel are fed in at the top of the shaft at W, and the hot gases may either be carried away through the channel *d* or pass through the chimney G, where they may heat coil pipe X connected with the water cistern Y and thus produce steam serving for increasing the draught of the chimney.—B.





Improvements in Apparatus for Concentrating and Evaporating Liquids. F. J. R. Carulla, Derby. Eng. Pat. 18,793, October 20, 1892.

The object of the invention is the equalisation of heat as applied to the bottom of lead vessels or pans used in the concentration or evaporation of liquids. Such pans are generally placed on platforms constructed of iron plates which cover the furnace and flues, the lead bottom of the pan being in contact with the iron. Lead being easily fusible and a bad conductor of heat, is in danger of melting through the accidental overheating of the iron plates at any particular spot. The improvement consists in inserting between the iron platform and lead bottom of the pan a sheet or layer of another metal being a better conductor of heat than either lead or iron, such as copper, for instance. This sandwiched layer of metal carries away a portion of heat from any overheated spot, and conducts it for use at some other place more or less distant from the affected point.—B.

Improvements in Filtering Apparatus. J. H. Minto, Anfield. Eng. Pat. 20,139, November 8, 1892.

This filter consists of a closed cylindrical vessel with another perforated cylinder inside containing charcoal. The inner cylinder is surrounded by a sheath of asbestos or other filtering material. The water enters first the inner charcoal cylinder, at one end passes through its perforated sides into the annulus formed of asbestos, thence reaching the body of the main vessel, where it can be drawn off. The inlet cock is fitted with several passages to allow of the reversal of the current for the purpose of cleaning the filtering materials and clearing out the vessel.—B.

Improvements in Apparatus for subjecting Liquids or Matters in Suspension to the Action of Air or other Gases or Vapours. G. Burdekin, jun., St. Helens. Eng. Pat. 20,319, November 10, 1892.

When a gas is distributed by means of perforated pipes under the surface of a liquid containing solids in suspension, the perforations are apt to become choked and require frequent cleaning. Moreover, there is a considerable waste of power through the friction of the gases in the orifices. To obviate these defects a gas distributor is constructed, (as shown in Figs. 1 and 2 in sectional elevation and plan respectively) in which the gas is conveyed to the distributor A by a pipe connected with the flanged portion D, and then escapes along the wide spiral passages C, in a direction more or less tangential. A circular motion is thus imparted to the liquid under treatment, causing the bubbles of gas to break up and act more effectively upon the liquid. The wide spiral passages C prevent choking up, and also reduce the friction to a minimum. The distributor may be used for the treatment of liquids containing solid matters in suspension which are obtained in the Weldon process, the ammonia-soda process, the Chance sulphur-recovery process, and the like.—E. G. C.

Fig. 1.

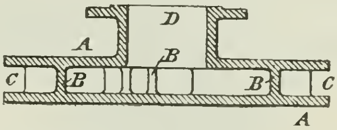
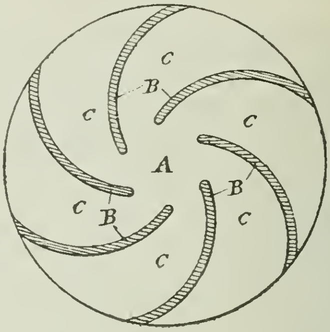


Fig. 2.



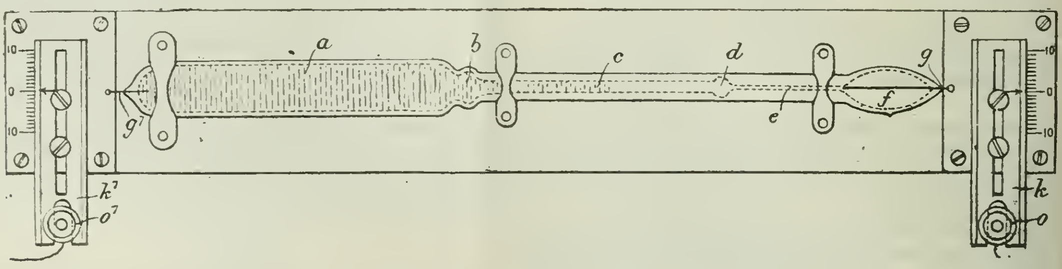
Gas Distributor.

Improved Method of and Apparatus for Filtering Liquids. J. Feraud, Paris. Eng. Pat. 5073, March 8, 1893.

In this filter certain fibrous materials, such as purified and sterilised fibres of cellulose, wool, asbestos, &c., or either of them, with which may be incorporated powdered substances for decolorising or disinfecting purposes, are mixed with the first portion of the liquid to be filtered. On reaching the permeable surfaces within the filter the water passes through, leaving the fibrous materials to adhere to the surfaces in felted or matted layers, thus forming the proper filtering material for the remaining liquid.—B.

Improvements in Thermostats. H. S. Tunnard, Rugby, and A. M. Keays, Sutton. Eng. Pat. 6754, March 30, 1893.

The figure is an elevation of the thermostat, which is of the thermometer type, having a cylindrical bulb a, expansion chambers b, d, and f, connected by the tubes c, e of variable bore. Platinum wires g, g^1 are fused into the glass at each end, and are connected in circuit with a battery and an alarm bell, so that whenever the temperature is sufficient to cause the mercury to fill the expansion chamber f, the circuit is completed, causing the bell to ring. The copper plates k^1, k, carrying the binding screws o, o^1, serve to adjust the instrument in the appliance whose temperature it is required to regulate. The apparatus is adapted for use in incubators and such like appliances.



Thermostat.

—E. G. C.

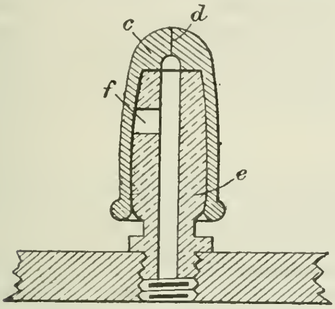
A New or Improved Heat Non-Conducting Composition. H. Birkbeck, London. From H. C. Michell, Toronto, Canada. Eng. Pat. 10,762, June 1, 1893.

See under IX., *page* 835.

A Closing Device for Vessels to be used for Sterilising, Pasteurising, and Preserving. G. Brandau, Witzenhausen, Germany. Eng. Pat. 13,532, July 12, 1893.

The invention relates to a device for sealing vessels in which substances are to be maintained in a germ-freed condition. It consists of an india-rubber cap of variable size.

The cap is provided with a slit in its thickened end, and is applied, in the case of the example given, to the neck of a bottle, having one or more lateral holes, or to a nozzle such as *e*, having holes *f*, the slit being so formed as to act as a valve opening to internal, but closing to external pressure, the part of the cap covering the holes *f* acting as an indicator of diminished internal pressure, and the whole forming a perfectly air-tight closure.—L. de K.



Closing Device for Vessels.

An Improved Varnish or Composition applicable as a Protective Coating for Wood, Iron, and the like. A. Beck, Vienna, Austria. Eng. Pat. 13,925, July 18, 1893.

See under XIII., *page* 848.

Improvements in Condensers, Refrigerators, and the like. T. K. Barclay, Glasgow. Eng. Pat. 14,181, July 22, 1893.

To effect the rapid and economical cooling of vapours, worts, chemicals, and the like, the refrigerator or condenser tubes, through which the vapours or liquids pass, contain twisted metal spirals. These spirals cause the stream of vapour or liquid to break up and become more effectively acted upon by the cold water, or other cooling medium surrounding the tubes. In a modified arrangement the condenser tubes are themselves corrugated.

—E. G. C.

II.—FUEL, GAS, AND LIGHT.

Remarks on the Specific Heat of Carbon. H. Le Chatelier. Comptes rend. **116**, 1051—1052.

Referring to recent experiments on boron by MM. Moissan and Gautier, the writer points out that the specific heat of carbon, like that of boron, is not in accord with the law of Dulong and Petit. M. Monckman has already remarked that the experiments of Weber on the specific heats of carbon do not point to a law tending towards a fixed value, as is often affirmed. On the contrary, those experiments indicate a continuous increase up to 250°; at the temperature of 250° the law of variation undergoes an abrupt change, and a similar change is noticed for all the other properties of carbon at the same temperature, electric conductivity, dilatation, thermo-electric power.

Recent experiments undertaken by engineers of the Paris Gas Company fully bear out the deductions of Monckman. These experiments show that the specific heat of graphite increases from 250° to 1,000° in a manner rigorously proportional to the temperature, and that the coefficient of increase is much more than would appear from Weber's experiments. The specific heat can be represented by the formulæ—

From 250° to 1,000°.....$C = 3 \cdot 54 + 0 \cdot 00246\, t.$
From 0° to 250° ....$C = 1 \cdot 92 + 0 \cdot 0077\, t.$

—D. E. J.

Combustion of Carbon in Air. R. Ernst. Chem. Zeit. 1893, **17**, Rep. p. 2.

Dry air was passed through a heated tube packed with carbon and the combustion gases investigated. The author finds that carbon dioxide begins to be formed at 400° C., at which temperature the products of combustion also contain a little carbonic oxide. Under the experimental conditions the yield of carbon dioxide increases rapidly to a maximum of 20 per cent. at 700° C., the whole of the oxygen having entered into combination, and only small quantities of carbon monoxide being present. Above 700° C. more carbon monoxide and less dioxide are formed, until at 995° C. carbon monoxide and the nitrogen of the air are the sole products. It is therefore not possible to prepare large quantities of carbon monoxide by leading air slowly over a long layer of carbon at a relatively low temperature.

According to the foregoing observations a temperature of about 1,000° is necessary for the production of generator gas in order to ensure the absence of carbon dioxide from the product. At this temperature carbon dioxide is not first formed and subsequently reduced to carbon monoxide, for if that were so some carbon dioxide would also be formed in the presence of excess of air; besides this, experiments in which pure carbon dioxide was passed over heated carbon, show that the reduction to monoxide is not complete.

These observations explain the well-known fact that incandescent carbon burns without a flame at a moderate temperature (about 700° C.), whereas at a higher temperature (about 1,000° C.) it exhibits a flame. In the latter case carbon monoxide is formed, which, in the presence of a sufficiency of air, burns to carbon dioxide.—A. R. L.

The Composition of Furnace Gases. H. W. Jürisch. Chem. Ind. **16**, 1893, 211.

In his work on the manufacture of sulphuric acid (Stuttgart, 1893, 99) the author describes a new and rapid process of determining the composition of furnace gases, which at the same time indicates the changes in the volume of gases. The method is based on the following consideration:—Supposing that in a certain pneumatic process 100 litres of in-going atmospheric air are reduced to a gaseous residue of R litres, wherein the 79 litres of in-going inert nitrogen gas are unchanged, but only x litres of oxygen remain, whilst $(21 - x)$ litres of oxygen have disappeared from the gases in such wise that $R = 79 + x$; provided that in the gas residue the x litres of oxygen constitute v (the percentage by volume) of the same, the following ratio is invariably obtained:—

$$(79 + x) : x = 100 : v, \text{ and } x = \frac{79\,v}{100 - v}$$

In this proportion v is obtained by direct observation in the course of the determination of the percentage of oxygen in the residual gases. For the values from $v = 0$ to $v = 21$ the following values are found for x :—

v.	x.	v.	x.
0	0·0000	11	9·7340
1	0·7980	12	10·7727
2	1·6122	13	11·8127
3	2·4433	14	12·8605
4	3·2917	15	13·9412
5	4·1579	16	15·0476
6	5·0425	17	16·1807
6·4	5·4017	18	17·3415
7	5·9462	19	18·5309
8	6·8696	20	19·7500
9	7·8132	21	21·0000
10	8·7778		

—D. B.

Manufacture of Illuminating Gas in America. W. Hempel, Journ. für Gasbeleuchtung, **36**, 465—470, 492—493.

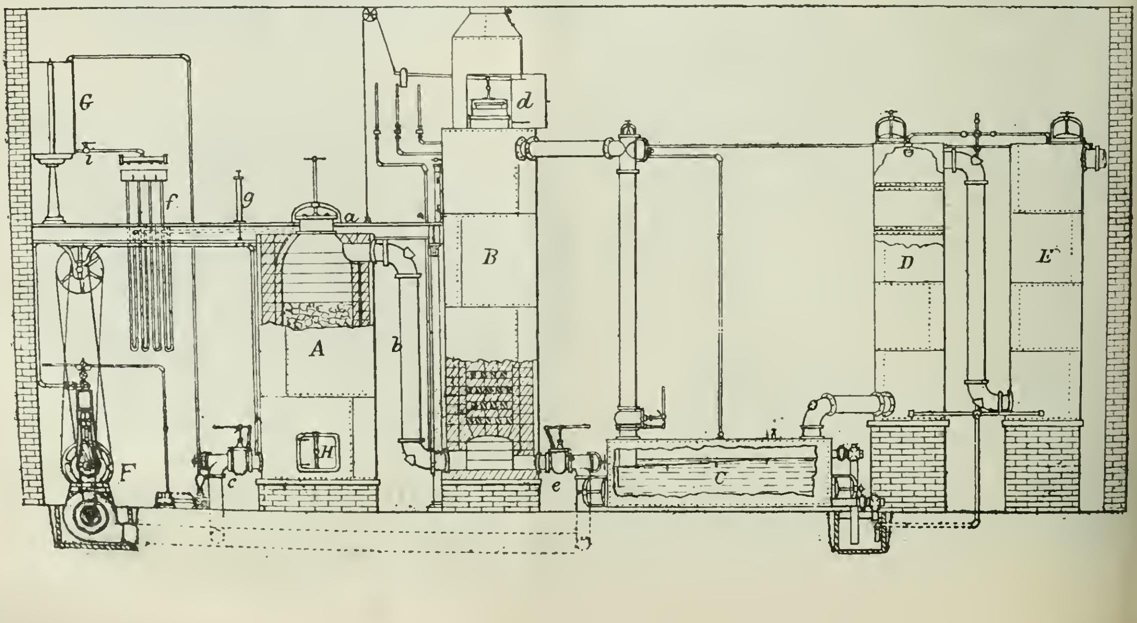
Owing to various natural circumstances, certain methods of manufacturing illuminating gas are largely employed in different parts of America, whilst their use in Europe is comparatively infrequent. Of these methods, various processes involving the production of water-gas are of great importance. For the most part these are developments of the original method of Tessié du Motay, who was the first to employ a generator containing carbonaceous matter into which air (to heat up by combustion) and steam (to produce water-gas) were alternately admitted, thus converting into a practical manufacture the older laboratory method of heating carbon inside a tube by an external fire, and passing steam through the tube. American anthracite contains about 4 per cent. of ash, and is a material extremely well adapted for employment in this way; the use of water-gas, pure and simple (*i.e.*, non-carburised), as an illuminating agent (by the intervention of magnesia combs, &c.) is, however, much less frequent in the United States than the employment of the gas carburetted either by a cold process of enriching by means of volatile hydrocarbons, or by some hot process where naphtha, &c. is heated so as to gasify it, either in a separate vessel or in the same plant as serves for the production of the water-gas; *i.e.*, some variety of process essentially consisting of a combination of oil-gas and water-gas manufacture. The author describes a number of such processes seen by him at work during a recent visit to America. The New York Gas Co. employ, under the name of "Tessié du Motay Processes," a system in which water-gas is first made from anthracite and steam, then purified in lime tanks, and finally carburetted by passing through a chest heated externally by boiling water, and fitted inside with shelves, over which naphtha flows; the resulting mixture of water-gas and naphtha vapour is then led through specially arranged retorts to bring about decomposition, and again purified before storage. The gas thus ultimately obtained has the composition—

Carbon dioxide	3·1
Heavy hydrocarbons	15·6
Carbon monoxide	25·2
Hydrogen	28·3
Marsh gas	26·6
Nitrogen	1·2
	100·0

It has good illuminating power, and is made with a smaller consumption of naphtha than is requisite in the processes subsequently described.

Fig. 1 represents "Lowe's water-gas" plant, in which the naphtha decomposition is carried out simultaneously with the production of water-gas. A is the generator, filled with anthracite through the manhole *a*. A fan F sends a current of air into the generator through the valve *c*; the escaping gases pass through the pipe *b* into the superheater B, filled with stacked firebricks; when the gases contain enough carbon monoxide to burn, air is also blown in at the base of the superheater through the valve *e*, the products of combustion escaping into the open at the top through *d*. When the requisite temperature is attained, *c*, *d*, and *e* are closed and the fan nearly stopped, a very gentle current being still maintained through small orifices in *c* and *e*, purposely arranged to prevent back-rush of water-gas into the air-main, which otherwise might cause explosion subsequently. Steam is then turned on at the base of the generator, and a stream of naphtha at the top, supplied from the tank G by means of a series of distributing tubes; the mixture of hydrogen, carbon monoxide, and a little carbon dioxide formed in the generator, vaporises the

Fig. 1.



naphtha, and the mixed gases act on one another in the superheater, ultimately producing an illuminating gas of high quality when the steam and naphtha supplies are properly proportioned. The gas is washed in the purifier C and the two towers D and E, and stored. The composition is indicated by the following analyses:—I., sample taken two minutes after commencing blowing; II., nine minutes; and III., 12 minutes after commencement. The steaming operation is continued for 20 minutes, when the steam is shut off, more anthracite filled in through the manhole, and the cycle of operations recommenced.

—	I.	II.	III.	More completely purified Samples.
Carbon dioxide..........	3·8	3·3	3·0	0·3—0·5
Heavy hydrocarbons....	13·1	25·1	24·6	14—15
Oxygen.................	0·6	0	0·2	..
Carbon monoxide.......	25·7	18·3	18·8	27—28
Hydrogen..............	31·8	28·1	26·5	24—27
Marsh gas..............	20·8	21·7	23·2	26—27
Nitrogen...............	4·2	3·5	3·7	3—4
	100·0	100·0	100·0	

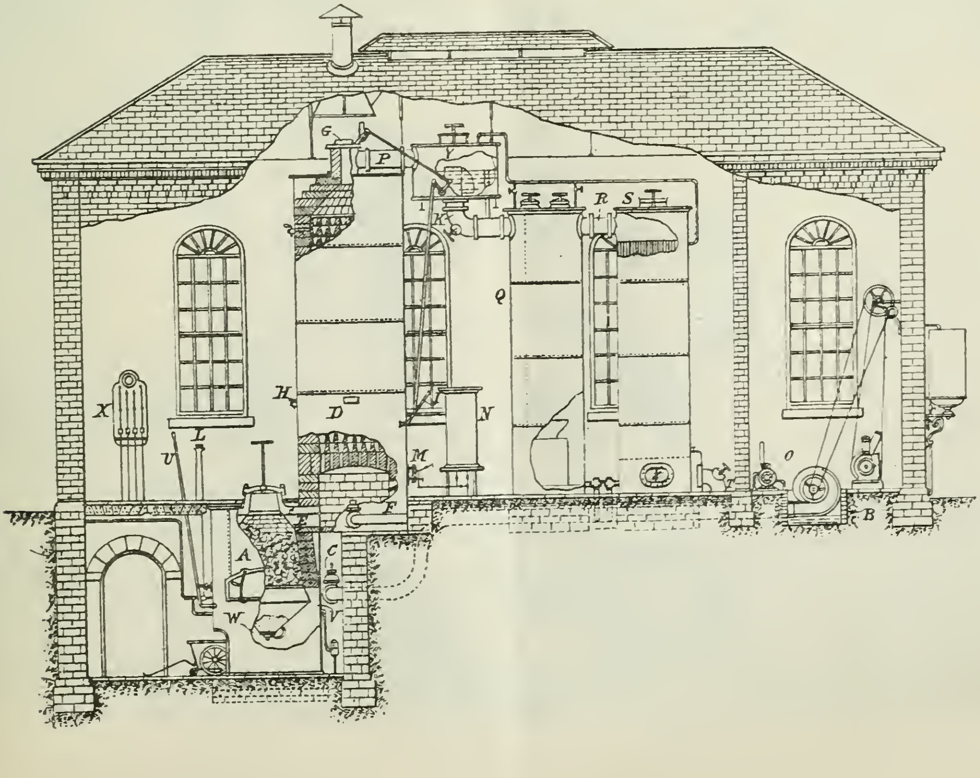
Every few hours (6 to 12) the doors H at the base of generator are opened and the anthracite residues raked out. The combustion is not allowed to go on so far as to produce a fusible clinker; the rakings-out are burnt off completely under the steam boilers, a considerable proportion of unconsumed carbon being retained in the cinders.

Gas thus made obviously contains a large percentage of carbon monoxide; accordingly, in some states where European conservative notions still prevail to some extent, *e.g.*, Massachusetts, the general adoption of gas of this description was seriously delayed until experience had shown that accidents through its enhanced poisonous qualities were not materially more frequent than with ordinary coal-gas. The mixed oil- and water-gas possesses a strongly marked odour, so that leakages and escapes are readily detected. Most American so-called "water-gas" is really of this mixed character.

The "Granger water-gas process" principally differs from Lowe's in that the generator is placed at a lower level, beneath the floor (Fig. 2), so that the long downpipe (*b*, Fig. 1) connecting the generator and the superheater is no longer requisite. The naphtha is forced in under considerable pressure at the base of the superheater, which is considered to facilitate its gasification. All the cocks and valves are connected together by suitable rods and links, so as to work simultaneously, and thus avoid chance of accidents through opening or shutting a wrong valve. Hanlon and Leadley have arranged the plant indicated by Figs. 3 and 4, adapted for the use of bituminous coal instead of anthracite, the decomposing chambers B, B^1 containing perforated shelves on which iron scrap rests. The function of this iron is supposed to be that whilst steam in contact therewith produces hydrogen and oxide of iron, the latter is again reduced by the carbon monoxide formed during the heating-up stage, so that ultimately a smaller proportion of carbon monoxide is contained in the illuminating gas produced; the following analysis of gas thus prepared at Passaic, however, does not bear out this idea of diminution of carbon monoxide. In this case anthracite was employed instead of bituminous coal. Annexed is the composition of gas made by the Granger process.

The weak point in the Hanlon and Leadley process seems to be that when cold bituminous coal is put into the hot generator (in nuts), even after 10 minutes the distillation of gas is not complete, whilst the fragments are not sufficiently hot to react properly with the steam; accordingly, heat and time are both wasted. To operate economically, an ordinary gas retort, after the distillation is finished, would appear to be a preferable vessel.

Fig. 2.



——	Hanlon and Leadley.	Granger.
Carbon dioxide	2·6	0·14
Heavy hydrocarbons	6·3	12·82
Oxygen	..	0·06
Carbon monoxide	31·3	28·26
Marsh gas	11·6	18·88
Hydrogen	42·8	37·20
Nitrogen	5·0	2·64
	99·6	100·00

The so-called "Lime-gas process" worked by the Equitable Gas Co., is essentially the same as Lowe's, with the difference that the superheater is filled with lumps of lime. After freeing from carbon dioxide, gas thus made had the composition—

Carbon dioxide	Nil
Heavy hydrocarbons	17·7
Carbon monoxide	18·2
Marsh gas	30·7
Hydrogen	28·1
Nitrogen	5·3
	100·00

Experiments were made by the author to see if possibly marsh gas could be converted into ethylene or other heavy hydrocarbon by the action of lime under these conditions, but the results were wholly negative.

The "Wood-gas process" is worked at the Mutual Gas-works in New York. Oysters grilled over charcoal are consumed in very large quantities all over Eastern America, so that the manufacture of the requisite charcoal is a fairly large industry. In the distillation of the wood the retorts are so arranged that the evolved steam and vapours are made to traverse a considerable layer of red-hot charcoal; so that the aqueous vapour and carbon dioxide, &c., originally present in the products of destructive distillation become decomposed into water-gas, which is subsequently carburetted.

Fig. 5 represents the plant used in McKenzie's process at Garden City, Long Island. A steam-blast injector C forces air into the generator A containing anthracite, the products of combustion passing through the pipe G to the outlet, the valves E and F being respectively open and shut; the naphtha contained in the vertical boiler in thus highly heated. E is then closed and F opened, whilst simultaneously the air supply is shut off and a cock opened admitting naphtha into the generator, so that water-gas and oil-gas are prepared together, and pass on to the storage gasometer through F. The gas thus produced at Garden City had a low illuminating power, and was readily extinguished by blowing out, indicating deficiency of hydrogen.

Throughout the Eastern States, iron oxide is but little used as sulphuretted hydrogen absorbent, lime purifiers being almost universal. The foul lime, &c. is got rid of by the simple method of throwing into the sea. The cost of coal-gas is 18 Pf. per cubic metre, whilst "water-gas" made by Lowe's process only costs 5·3 Pf., employing 0·7 litre of naphtha and 0·75 kilo. of anthracite. The older "Tessié du Motay process" above described costs 7·6 Pf. per cubic metre (100 Pf. = 1 shilling).

The conditions obtaining in Europe as to illuminating gas manufacture are so different from those in America that it is very doubtful whether any advantage would accrue by attempting to introduce any of these processes here. Water-gas, pure and simple (not carburetted), is manufactured in Europe by greatly improved processes, whilst petroleum is much dearer; in winter, however, when a much greater demand exists, it may be advantageous to use water-gas plant modified so as to carburise the product by means of refuse tar oils, &c.; for this purpose it will probably prove advantageous to discharge the red-hot coke from the ordinary gas retorts direct into the water-gas generators. A point that might well engage the attention of gas makers is the production of gas carbon (graphite) for electrical purposes, the shape of the retorts being so modified as to permit of the preparation therein of large plates of graphite suitable for electrodes, &c., so as to convert into a source of profit what is now in general a considerable working inconvenience.

In the course of discussion on the foregoing paper it was pointed out by H. Dicke that in some parts of America non-carburised water-gas was largely used; thus in Chicago alone the Fahnehjelm Light Co. were supplying gas for 25,000 burners using magnesia combs. Dr. Kraemer stated that the production of Lowe's "water-gas" had made

Fig. 3.

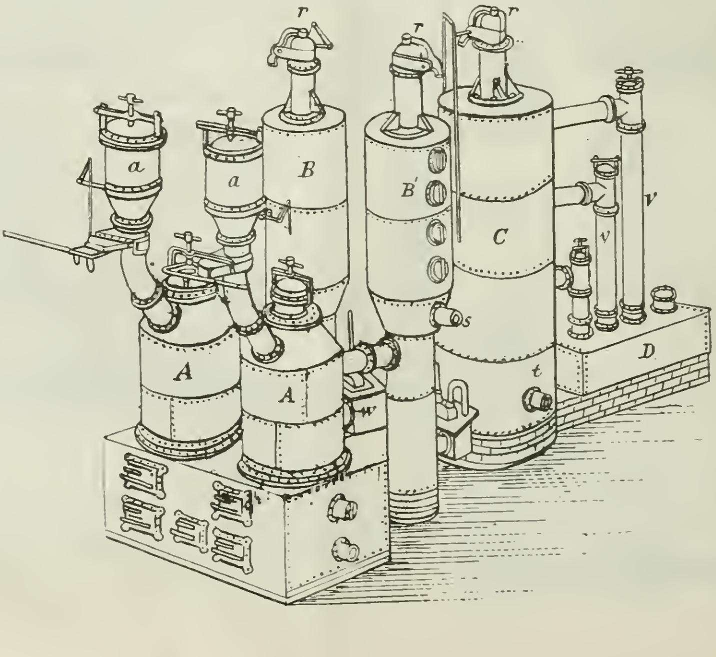


Fig. 4.

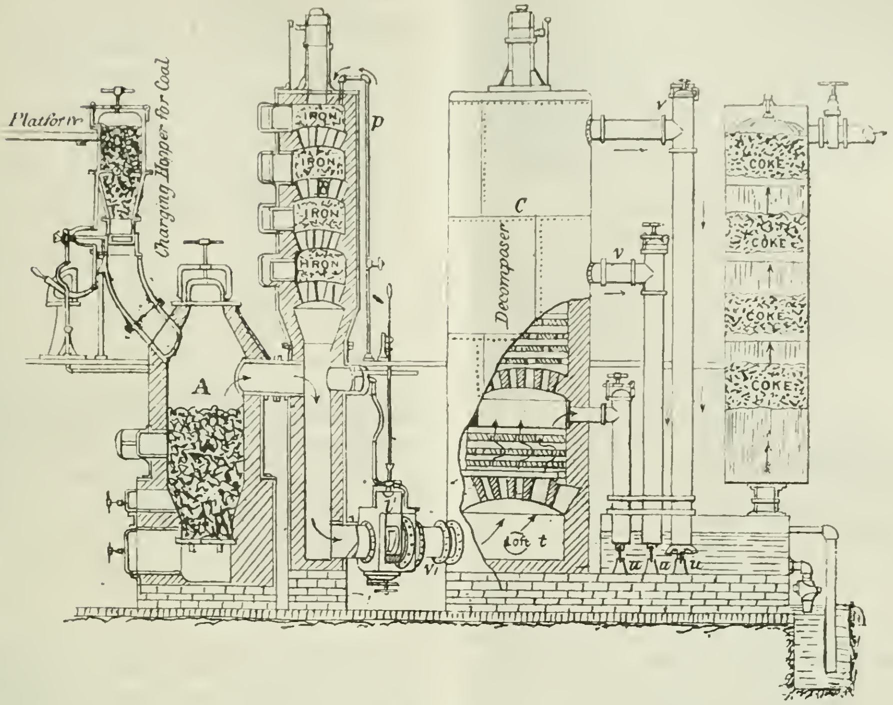
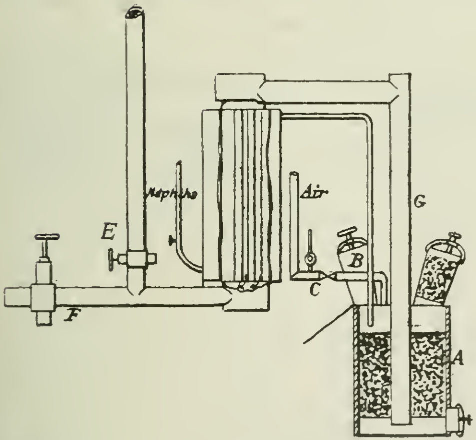


Fig. 5.



considerably more progress in England than in Germany, because of the high duties charged on petroleum imports in the latter country; should, however, these duties be greatly lowered or abolished, Lowe's "water-gas" would probably be largely employed in Germany.—C. R. A. W.

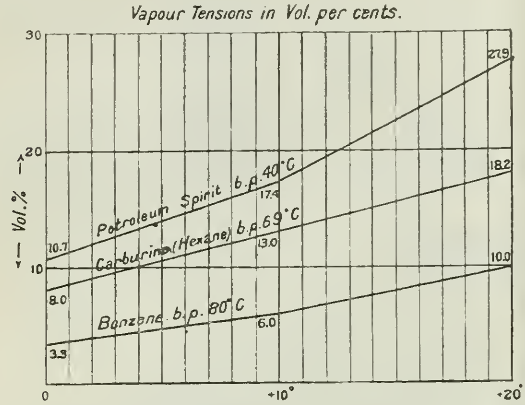
The Carburetting of Illuminating Gas. H. Bunte.

Journ. für Gasbeleuchtung, 36, 442—449.

The volume of volatile hydrocarbon vapour taken up by a given quantity of gas depends on the tension of the vapour. The figure indicates the percentage volume taken up at temperatures between 0° and 20° C. of three kinds of hydrocarbon, viz., "gasoline" (boiling at 40° — essentially pentane); "carburine" (boiling at 69°—chiefly hexane); and benzene (boiling at 80°). If more vapour is present than can be permanently retained when the temperature is reduced to a given extent, the surplus condenses as a liquid. In the case of benzene the following table represents the maximum quantity of hydrocarbon capable of being permanently retained vaporous at different temperatures; 1 litre of vapour weighing 3·4866 grms. at 0° and 760 mm:—

Temperature.	Tension in mm. of Mercury.	Percentage Volume of Vapour.	Grms. Benzene per Cubic Metre.	Difference.
− 20	5·79	0·76	26·5	13·9
− 15	8·82	1·17	40·4	18·9
− 10	12·92	1·70	59·3	24·7
− 5	18·33	2·41	84·0	32·1
± 0	25·31	3·33	116·1	40·4
+ 5	34·17	4·49	156·5	51·0
+ 10	45·25	5·95	207·5	62·7
+ 15	58·93	7·75	270·2	76·7
+ 20	75·65	9·95	346·9	83·1
+ 25	95·91	12·62	440·0	

Ordinary coal-gas contains from 1·0 to 1·3 per cent. by volume of benzene vapour, *i.e.*, 35 to 40 grms. per cubic metre at 0° and 760 mm., or about one-third of the saturating quantity under these conditions; even admitting that underground pipes, &c. in winter are often at a temperature below 0° (say − 5° to − 10°), it still results that the quantity of benzene already present is considerably below the saturating amount, even in the coldest weather, so that it is quite practicable to carburet gas much further with benzene under these conditions. Hence for all-the-year-round work benzene is readily admissible as a carburetting agent; *à fortiori*, still more volatile substances may be employed, such as the lightest petroleum spirit, *e.g.*, "gasoline." On the other hand, the effect on the illuminating power of a gas flame of the admixture with the gas used of the vapour of volatile hydrocarbons, depends not only on the nature of the hydrocarbons, but also on that of the gas; *e.g.*, according as ordinary coal-gas is employed, consisting essentially of marsh gas and hydrogen with a little carbon monoxide, or water-gas, chiefly composed of hydrogen and carbon monoxide. Moreover, the kind of burner used affects the result; as also does the rate of supply, even when the burner is the same; *e.g.*, an Argand burner constructed to burn 150 litres per hour of a particular gas, gives a greatly decreased illuminating power if only 120 litres per hour are supplied. Thus, experiments made with the Karlsruhe gas supply yielded the following results as regards the quantity of hydrocarbons condensed in the liquid form on cooling to various temperatures, and the corresponding diminution in illuminating power when the gas was burned at the rate of 150 litres per hour in fishtail and Argand burners respectively :-



Temperature.	Grms. of Hydrocarbon condensed per Cubic Metre of Gas.	Diminution in Illuminating Power (Percentage).		
		Doubly perforated ("Fishtail") Burner.		Argand Burner.
° C.		° C.		
0°	0	..	..	..
− 3°	0	..	0	0
− 5°	0	..	0	0
− 6°	0·23	..	..	2·3
−10°	3·8	−10°.5	..	3·8
−13°	9·9	−11°.0	16	..
−14°	11·1	..	..	..
−15°	13·1	−15°.0	37	17
−16°	13·8	−15°.5	..	18
−17°	14·0	−16°.25	46	..

Hence an Argand burner is more economical as regards light production than a fishtail burner with gas of poor quality, *i.e.*, containing but little hydrocarbon vapour.

The hydrocarbons thus removed by condensation had roughly the following composition :—

	Per Cent.
Olefines	5
Benzene	50
Toluene	25
Higher homologues	20
	100

The original gas before chilling averaged 40 to 42 grms. of hydrocarbons per cubic metre, and when burnt at the rate of 150 litres per hour possessed an illuminating power of 26 Hefner lights.[*] In another series of experiments the same gas was deprived as far as possible of hydrocarbon vapours by means of a fuming sulphuric acid scrubber, and then carburetted with various known hydrocarbons, with the following results :—

Carburetter employed.	Illuminating Power at 150 Litres per Hour in Hefner Lights.	Quantity of Carburetter used per 100 Hefner Lights.		Doubly perforated or fishtail Burner.	
		Argand Burner.	Fantail Burner.	Illuminating Power at 150 Litres in Hefner Lights.	Quantity of Carburetter per 100 Hefner Lights.
Aromatic Hydrocarbons, C_nH_{2n-6}.					
		Grms.			Grms.
Benzene, b.p. 80°	17 20 25	30 37 47	45	5 7 16	127 90 80
Toluene, b.p. 111°	19	32	51	37	62
Petroleum Hydrocarbons, C_nH_{2n+2}.					
Pentane, b.p. 35°—40°	17 28	160 150	190	8 15	467 333
Hexane, b.p. 65°—70°	28	..	170	..	..
Petroleum ether, b.p. 75°—80°	15 24 32	90 100 140	160	..	..
Unsaturated Hydrocarbons, C_nH_{2n}.					
Ethylene	15 31 ..	83 136 ..	.. 232 ..	2 14 24	620 260 210
Amylene	25	90	120	7 32 68	140 150 130

---

[*] A "Hefner light" represents about 0·886 English "Standard candle."

The cooled gas used in these experiments possessed before carburetting an illuminating power of only two or three candles, due to small quantities of benzene and ethylene, &c., still remaining, and to marsh gas; obviously the quantity of carburetting fluid requisite to bring up the illuminating power to a given higher amount varies widely according to the nature of the hydrocarbon used and the kind of burner employed; in calculating the cost of carburetting, therefore, these points must be taken into consideration; it may be in certain cases that a more costly hydrocarbon is really the cheapest on account of the smaller quantity requisite.

In addition to cold carburetting methods where the gas is enriched by means of the vapours of volatile fluids previously prepared separate, various hot processes are in use for effecting similar results, more especially methods where the gas laden with petroleum vapours is passed through red-hot tubes, &c., so as to produce aromatic hydrocarbons by decomposition and hydrogen removal; or where substances are distilled capable of giving off highly illuminating gas, which is then admixed with the poorer gas; such substances as petroleum residues, cannel, bog-head shale, &c., are often thus employed, being usually intermixed and distilled along with the rest of the materials employed, or less frequently distilled in separate vessels. The following calculations (in German currency) represent the relative cost of various enriching agents thus employed, as compared with carburetting with gasoline and crude benzene:—

Carburetting Agent.	Cannel Coal.	Thuringian Gas Oil.	Crude Petroleum.	Petroleum Spirit, Gasoline.	Crude Benzene.
a. Output of gas per 100 kilos.—in cubic metres	35	55	67	..	..
b. Illuminating power at 150 litres per hour—in Hefner lights	42	43	55	..	..
Product, *a* × *b*	1,470	2,365	3,685	..	..
100 kilos. yield, Hefner light—hours	9,800	15,800	24,600	62,500	167,000
Kilos. requisite for 100 Hefner light—hours	1·02	0·633	0·407	0·16	0·06
Requisite per 1 Hefner light and 100 cubic metres	6·8	4·23	2·71	1·07	0·40
100 kilos. cost—in marks	4·40	12	Untaxed* 9·35 Taxed 15·35	25	45
100 Hefner light—hours cost in Pf.	4·5	7·6	3·8 6·2	4·0	2·7
1 Hefner light per 100 cubic metres—costs in Pf.	29·9	50·7	25·4 41·6	26·7	18·0

* In Germany high import duties are charged upon crude petroleum and the products of its distillation.

Benzene thus comes out very advantageously; in connection with which it is to be remembered that although an increased demand for benzene as a carburetting agent would necessarily involve a higher price, yet other sources of benzene exist, in addition to coal-tar, which have not as yet been fully developed; more especially the tars produced in the Pintsch system of distilling fatty matters, &c. for railway carriage illumination, and those produced in coke ovens supplemented by scrubbers for absorbing benzene vapour from the escaping gases.—C. R. A. W.

The Employment of Russian Solar Oils as Illuminants. K. J. Lissenko. Zap. imp. russk. techn. obszcz. 1893, **27**, 1; and Chem. Zeit. Rep. 1893, 159—160.

In continuation of his earlier researches (Chem. Zeit. Rep. 1892, 221; and Chem. Zeit. 1893, 506), the author points out that the chief aim of solar lamp manufacturers is to supply the flame with the maximum possible volume of air. It has been shown, however, that even in good lamps the volume of air available is from two to four times in excess of that required for the combustion of the oil. The real object to be sought for is, therefore, to utilise the available oxygen as completely as possible. To do this the current of air should be diverted in such a manner that the flame is not cooled excessively; and, further, the air should be properly forewarmed. These objects may be partially attained by placing the air-conducting apertures lower, and by increasing the length of the lamp-glass. The most important item, however, undoubtedly is to supply the flame with a sufficient quantity of oil. The amount of oil supplied to the flame in a given time depends on the rate at which the oil rises in the wick, and on the size and consistence of the latter. According to the author, solar oil travels in the wick much slower than paraffin oil, and it is therefore necessary to employ a large and especially a soft, loose wick in order that an adequate volume of oil may be conveyed to the flame. For example, a lamp constructed by Makaroff consumed 29 grms. of oil per hour. If a wick were employed capable of drawing up in the lower 5 cm. of its length 1·6 grms. of oil in 3·6 minutes, the lamp would burn badly so soon as the difference of level between the flame and surface of the oil reached 5 cm., for then the hourly flow of oil to the flame would only be 27 grms. $\left(\frac{1\cdot6 \times 60}{3\cdot6}\right)$. On the other hand, a loose, thick wick (5 cm. drawing up 2·8 grms. of oil in 3¾ minutes) would still act properly; for $\frac{2\cdot8 \times 60}{3\cdot75} = 45$ grms. hourly flow of oil. Even if the difference of level increased to 7 cm. the lamp would still burn satisfactorily (7 cm. of wick drawing up 4·02 grms. of oil in 8·3 minutes; $\frac{4\cdot02 \times 60}{8\cdot3} = 29$ grms.).

After this, however, the flame would decrease in size. It is obvious, therefore, that a shallow, flat reservoir for the oil is to be recommended. As a matter of fact, in lamps so constructed the oil may be consumed almost to the last drop without sensible diminution in illuminating power.

As regards the possibility of obtaining a perfectly white light from solar oil, this has been practically realised in the lamps designed by Kuhmberg and Siemaschko.

—H. T. P.

The Employment of Benzoline Vapour as a Motive Power in Engines. L. J. Meiro. Zap. imp. russk. techn. obszcz. 1893, **27**, 84; and Chem. Zeit. Rep. 1893, 158.

In order to elucidate the practicability of displacing steam by benzoline (light paraffin) vapour as motive power, the author has determined the vapour tension of benzoline at different temperatures, and also on a small scale the practical conditions of working. It appears that variations in vapour tension, due to differences in specific gravity and boiling point, exhibited by different samples of commercial benzoline, are only noticeable at low temperatures. Thus, one sample (sp. gr. 0·71) exerted a pressure of 0·065 kilo. per sq. cm. at 29° C.; whilst another sample (sp. gr. 0·715) only yielded the same pressure at 43° C. At temperatures above 85° these differences disappeared, the pressure being in each case (at 85° C.) about two atmospheres. The evaporating power of a small boiler was measured and found to be 1·9 kilos. of oil per 1 sq. cm. of heating surface under a pressure of $1\frac{1}{2}$ to 2 atmospheres (specific gravity of benzoline 0·724).

The author states that benzoline is employed to some extent in the boilers of marine engines, and he claims that a considerable saving of fuel is thus effected, owing to the small specific heat of benzoline as compared with water. As regards the risk of explosions, this is probably not greater than in ordinary cases, especially when it is considered that there is no likelihood of boiler incrustation (and the consequent risk of burning the plates) resulting from the use of benzoline; and further, that a sufficiently high pressure is producible at a comparatively low temperature.—H. T. P.

Improved Mode of using Gas Purifiers. W. Zobel. Journ. für Gasbeleuchtung 1893, **36**, 29.

The purification of gas depends greatly on the rate of supply of gas, so that when through stress of increased production the rate of passage of gas through purifiers is too rapid, defective purification results. To obviate the necessity of putting up larger plant the author proposes to lead the gas into a given purifer by two inlets, one at the top and the other at the bottom, the conjoined streams passing out at the middle; in this way the rate of passage over the various layers of purifying material is halved, without diminishing the total flow of gas, and absorption of impurities is rendered possible to an extent impracticable in the ordinary way, notwithstanding the longer layer of purifying surface then traversed.—C. R. A. W.

The Chemical Composition of the Incandescent Substance in Auer's new Incandescent Lamps. Journ. für Gasbeleuchtung, 1893, **36**, 41; and Chem. Zeit. Rep. 1893, **17**, 35.

The incandescent substances consist chiefly of the oxides of the metals of the cerium and zirconium groups. The following are the principal minerals employed for obtaining these substances:—*Monazite,* which contains up to 70 per cent. of the oxides of cerium, lanthanum, and didymium combined with phosphoric and silicic acids, and occurring as *thorite* and *orangite,* when it contains thorium oxide. *Gadolinite* and *orthite* contain in addition to the above cerium metals, 35—45 per cent. of yttrium earths, together with zirconium silicate. The oxides of the above-mentioned elements are separated from these and other minerals and dissolved in the form of their nitrates. The cotton wick or mantle is then impregnated with this solution, and after drying is fixed in a suitable support. After burning off the cotton a thin tissue of the oxides remains in the well-known form of the Auer burner. The colour of the light varies with the particular oxide or mixture of oxides used, being either white, yellow, orange, or green. The following table has been published by McKean:—

100 Parts of the Incandescent Substance contain Oxides of the Metals								Colour of the Light.
Cerium.	Didymium.	Erbium.	Lanthanum.	Niobium.	Thorium.	Yttrium.	Zirconium.	
..	..	..	40	..	20	..	40	White
..	..	..	60	..	..	..	40	„
..	..	..	..	..	80	20	..	„
2	..	..	40	..	28	..	30	Yellow
3	..	..	50	..	..	..	47	„
..	3	..	40	..	30	..	27	Orange-yellow
..	..	..	50	10	40	..	..	„
..	..	30	20	..	50	..	..	Green

It is most important that the salts employed be free from iron, as the presence of this metal materially impairs both the luminosity and durability of the mantles. As regards the intensity of the light emitted, McKean gives the following comparative values of the more important incandescent metallic oxides with a burner using 85 litres of gas per hour under a pressure of 25 mm. (*i.e.*, about 30 cub. ft. per hour, at a pressure of about 1 in.):—

Oxide of	Photometric Value.	Colour of the Light.
Thorium	31·56	Bluish-white
Lanthanum	28·32	White
Yttrium..........................	22·96	Yellowish-white
Zirconium.......................	15·36	White
Cerium	5·02	Reddish

The best effect appears to be obtained by employing a mixture containing two-thirds thorium and one-third yttrium oxide. The life of the mantle also appears to depend upon the composition, and it would seem that after prolonged use some variation in the quantities of the constituents takes place, but only a few experiments have been made in this direction.—T. A. L.

Gas Substitutes. Vivian B. Lewes. Abstract of paper read October 2, 1893, before the Soc. of Engineers.

The author commenced by pointing out that although during the past 100 years many attempts had been made to introduce substitutes for coal-gas as an illuminant, none of them had so far been practically successful in this country. The substitutes which had been proposed might be classed as follows: —

1. Oil-gas produced by decomposing liquid hydrocarbons.
2. Air-gas, consisting either of air carburetted with the vapours of highly volatile hydrocarbons, or else mixtures of oil-gas and air.
3. Carburetted water-gas.

In reviewing the various processes for making oil-gas, the author specially dwelt upon the Patterson and Young plants, the last of which is used in some gasworks for the enrichment of poor coal-gas, and it was shown that the difficulty in burning an oil-gas by itself, and also the cost of its production, would prevent its ever being a competitor of coal-gas.

In the second class of substitutes it was pointed out that there are several considerations which would prevent such systems being adopted, excepting in a few small installations, as for successful carburetting of air it would be necessary to have a very volatile hydrocarbon of constant and uniform composition, which would render the process too expensive for ordinary working, whilst the action of the nitrogen of the air upon the illuminating value of the gas is so serious that it makes such processes wasteful in the extreme.

The third and most important class of coal-gas substitutes are now for the first time being successfully introduced into England, as although water-gas was first discovered by Fontana in the last century, the making and carburetting it for an illuminating gas has only been perfectly solved during the last 20 years, and although it successfully competes with coal-gas in America, where oil for enrichment is cheap and gas coal dear, it is only made with a limited amount of success in this country, where the conditions are entirely different.

The author then reviewed the most successful of the American processes for making carburetted water-gas, and pointed out the chief objections to be urged against them, and concluded his paper by pointing out the directions in which it seems probable and possible to so modify the American methods of manufacture as to make a gas suitable for use in this country, and free from the chief objections that can be urged against the American methods of manufacture.

In order to do this, he proposed doing away with the large external superheating chambers, which form so important a part of the American plants, and instead of converting the hydrocarbons used for carburetting water-gas into permanent gases by passing the oil vapours over large heated surfaces of baffle plates or bricks, to rather decompose these oils by injecting them along with superheated steam directly into the incandescent fuel which was being utilised for the generation of the water-gas, by which means he claimed that he was able to protect the oil from decomposition, it being stated that the steam decomposing in contact with the incandescent fuel, surrounded each particle of the hydrocarbon with an atmosphere of water-gas, and so diluted and protected it that it could be rendered perfectly permanent as a gas without over decomposition. At the same time the author advocated the simultaneous manufacture in the apparatus of hydrogen, which, by diluting the water-gas, reduced to a very great extent the proportion of poisonous carbon monoxide which it contains.

PATENTS.

Improvements relating to Apparatus for the Manufacture of Water-Gas. A. G. Glasgow, Westminster. Eng. Pat. 19,753, November 2, 1892.

This invention consists of mechanism for operating the valves controlling the direction in which the steam and gas pass through the producer, by means of a single hand wheel. The producer has two gas outlets, one at the top and the other at the bottom, each fitted with a valve moved by a rack and pinion. The two pinion shafts are geared together by sprocket wheels and a chain-belt. To the pinion shaft of the upper valve is attached a hand wheel, which, when rotated in one direction, opens the top and closes the bottom valve, and *vice versâ* when rotated the other way. The gearing is so arranged that the two valves balance each other. The two steam inlets are also controlled by the same hand wheel, by connecting the rack of the lower valve to the lever of a three-way cock by means of a link. Thus, when the rack is raised or lowered by turning the hand wheel, the lever of the three-way cock is thrown over to one side or to the other, and thus admits steam either to the top or bottom of the producer.—R. B. P.

Improvements in and connected with the working of Gas Producers. P. A. Fichet and R. Heurtey, both of Paris. Eng. Pat. 20,341, November 10, 1892.

To prevent the cooling action of steam when admitted with air into gas producers, the utilisation of the heat in the gas, before combustion, to produce the steam and superheat the mixture of steam and air, is claimed. It is stated that by this superheating more steam can be injected, and a gas richer in hydrogen obtained than is usual. The "industrial" applications of this gas, "and especially the use of gas so enriched with hydrogen for the engines provided with poor gas," is also claimed. Methods for carrying out the invention are described.—R. B. P.

Improvements in Apparatus employed in the Manufacture of Gas. G. Winstanley, Coventry. Eng. Pat. 12,990, July 3, 1893.

The hydraulic main, which forms the subject of this invention, is of trapezoidal section, the sides being perpendicular, the top horizontal, and the bottom inclined.

A partition plate running the whole length of the main, and reaching from the cover to within a short distance of the bottom, divides it into two longitudinal compartments. Of these, the one over the higher part of the inclined bottom is divided up into several chambers by partition plates running across it.

Each of these chambers is connected by a pipe with a retort, and replaces the usual "dip pipe," the escape orifice being sealed by the contained tar and liquor in the usual manner. On the opposite side, *i.e.*, the deeper side, of the main is a square pipe, with the inside of which the tar take-off pipe is connected, which permits the removal of the heavier tar and thereby reduces the resistance to the flow of gas from the retorts. Suitable openings, with covers secured by a kind of bayonet joint, are provided, so giving access to the interior of the hydraulic main.—R. B. P.

Improvements in Central Valves for Gas Purifiers. J. Hearne and W. J. Strong, both of New York, U.S.A. Eng. Pat. 13,487, July 11, 1893.

This valve is arranged so that the gas may be conducted into any number of purifiers, or cut off from one or all of them without interfering with its flow through the valve. The valve consists essentially of three parts:—(1.) The main shell which is cylindrical, and divided up into a series of compartments by concentric and radial partitions. It has also a series of branch pipes leading to and from the purifiers, and a main gas inlet and outlet. (2.) A cylindrical cover substantially the same as the main shell, but without the gas in- and outlets or the purifier branches. This cover is situated on the top of the main shell and can be rotated so as to bring the purifier inlets into the desired position with regard to the gas in- and outlet. (3.) A series of supplementary valves are situated on the top of the cover, the object of them being to make or cut off connection between adjacent compartments in the main shell and thus connect or disconnect any of the purifiers from the gas passing through the valve.—R. B. P.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

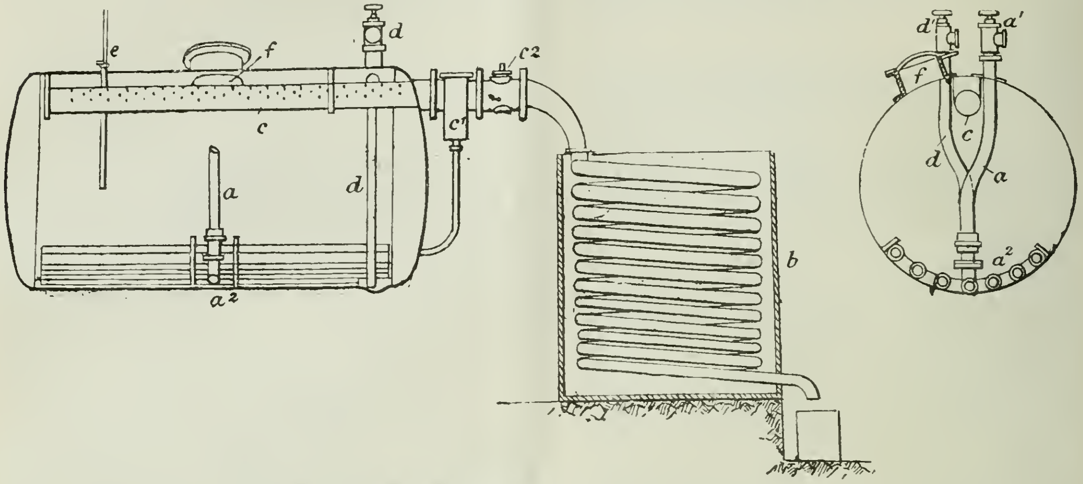
Crude Commercial Carbolic Acid. Drs. Stockmeier and Thurnauer. Chem. Zeit. **17**, 119 and 131.

See under XXIII., *page* 870.

PATENT.

Improvements in the Treatment of Paraffin Scale and other Crude Paraffins. J. Hodges, Battersea. Eng. Pat. 18,904, October 21, 1892.

The distillation of the paraffin scale, or the mixture of paraffins, is effected by "fire-heat" or preferably by the use of superheated steam with or without the aid of fire-heat, in a still, preferably of the form shown, and provided with a condenser *b* of any convenient form. The still is enclosed within a brickwork furnace so constructed that only the bottom of the still is exposed to the direct fire. The still is provided with a pipe *a*, with stop-valve a^1 for supplying steam, preferably superheated, terminating in a perforated coil a^2, by means of which the steam is uniformly distributed throughout the material, so that the distillation may be regularly maintained. The melted paraffin scale or mixture of paraffins having been introduced, the temperature is raised by means of the fire-heat, superheated steam passed in, and the temperature kept as low as is consistent with successful distillation. The oil and soft paraffins distil over, their vapours with the steam passing through the perforated pipe *c* to the condenser, c^1 being a trap from which any liquid passing with the steam and vapour, is caught and returned to the still, c^2 is a stop-valve, *d* is the charging pipe for paraffin or scale and for pumping out any residue, and d^1 is a stop-cock, *e* is a thermometer, and *f* the manhole. By collecting the different fractions separately, products of various melting points are obtained, which may be utilised for different purposes, or the fractions may be mixed and treated by other well-known methods for the further separation of the oil or softer material from the harder paraffin. The residue consisting of the harder paraffin in the scale, is decolorised by treatment with animal charcoal or purified in other ways, and is then available for candle making or for other purposes. This method is said to be more direct and to require less labour than any of the processes in ordinary use.—D. B.



IMPROVEMENTS IN TREATMENT OF PARAFFIN SCALE, &c.

IV.—COLOURING MATTERS AND DYES.

The Action of Light upon Dyed Colours. Report of Committee of British Association, 1893. Drawn up by J. J. Hummel. Chem. News, 1893, 157 and 170.

THE conclusions drawn from the results obtained are as follows : —

The experiments extend at present over too limited a number of colouring matters to enable one to draw fixed general conclusions, but it may be well already at this point to record the following observations :—

The most fugitive reds on wool and silk are the eosins and allied colours. Curiously enough, the introduction of the methoxy group, as in methyl-eosin, &c., increases the fastness, not of the colour as a whole, but of the pale faded tint which results after the first few weeks' exposure. As already stated, this tint remains practically unchanged even after a whole year's exposure.

With respect to the rosindulines, it is interesting to note that the G shades are very fugitive, while the B shades are moderately fast.

All basic reds belong to the more or less fugitive class, including, namely, the magentas, safranines, and rhodamines. The nature of the acid with which the colour base is combined seems to have no influence upon the fastness of the dyed colour.

Comparatively few (about 20) of the azo reds examined are fugitive, and these belong chiefly to the simple monazo colours.

The great bulk of the fast and moderately fast reds belong to the azo colours, the so-called secondary diazo colours being generally faster than the rest. It is evident, however, that the fastness of these azo colours depends, not only on the base which is azotised, but also upon the character of the naphthol sulphonic acid employed. This is especially noticeable in the chromotropes, in which a particular dioxynaphthalene disulphonic acid is employed, and all of which are remarkable for their fastness. The particular azo compound and phenol united together is also of importance.

With respect to the milling and cloth reds, it does not appear that the use of mordants with them increases their fastness to light.

The number of very fast reds is extremely limited, but it includes both natural and artificial dyes, namely, madder, cochineal, kermes, alizarin, and the chromotropes 2 R and 2 B. When it becomes possible to expose the Congo reds, one or two others will no doubt have to be added to the list of very fast artificial red dyes. In this connection it may be pointed out that certain reds obtained from the natural dyestuffs are fugitive, namely, those obtained from Lima-wood, Cam-wood, and the allied woods.

It is well to add that there are no sharp lines of division with respect to fastness to light among the various reds, and each of the five classes into which they have been here arbitrarily divided includes colours which differ from each other more or less in this respect.

The Preparation of Naphthidine. F. Reverdin and Ch. de la Harpe. Chem. Zeit. 16, 1892, 1687—1688.

NAPHTHIDINE, which is one of the three known diamido derivatives of αα-dinaphthyl, may be obtained, according to Nietzki and Goll, by the reduction of an acetic acid solution of azonaphthalene by means of zinc chloride. The authors succeeded in finding an easier method of preparation for this substance, and proceed as follows:—100 grms. α-naphthylamine are dissolved in 1,000 grms. of 88 per cent. sulphuric acid. The mixture is cooled down to 10 and a quantity of ferric oxide added equivalent to 55 grms. Fe_2O_3 and allowed to stand for 24 hours. The mass is then heated for 6—7 hours to 75° C., and finally for a few hours to 100° C. with continuous agitation. The product is poured into five litres of water, allowed to rest over night, and filtered. The residue consists of naphthidine sulphate, along with some naphthylamine sulphate and iron sulphate. The precipitate is washed with 2—3 litres of tepid water, and decomposed by means of caustic soda, in presence of one litre of water, filtered, redissolved in dilute hydrochloric acid, filtered, and reprecipitated with 120 grms. sodium sulphate. The sulphate thus obtained is reconverted into the base, which may be completely purified by dissolving in boiling alcohol and precipitating with a little water.

The mother-liquors contain a base which is in all likelihood an isomeric naphthidine. It may be isolated by neutralising three-quarters of the acid with caustic soda, precipitating with sodium acetate, washing, and redissolving in water and hydrochloric acid. The solution is treated with 50 grms. of sodium sulphate for the purpose of eliminating the sulphate of the previous naphthidine, filtered, and reprecipitated with sodium acetate. The yield of the first base (m. pt. 198°) is about 60 per cent. of the theoretical quantity, whilst of the second base 25 per cent. are obtained.

Attempts to utilise these bases for the production of dyes, gave only indifferent results.—H. A.

The Dyeing Properties of Ammoniacal Ruthenium Oxychloride. Nicolle and Cantacuzène. Ann. de l'Inst. Pasteur, **7**, 331; Chem. Zeit. Rep. **17**, 1893, 170.

See under Analyt. and Scient. Notes, *page* 872.

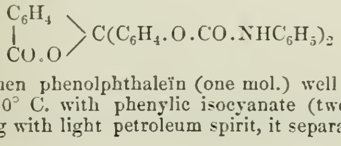
Azo Dyestuffs. F. Reverdin. Chem. Soc. of Geneva. From Chem. Zeit. **17**, 244.

A colour obtained by de la Harpe and the author, but not previously described in technical journals, is prepared by combining diazotised nitroamidosalicylic acid with β-naphthol. The dyestuff is almost insoluble in water, and is sent out commercially in the form of a paste, under the name of "*Vieux Rouge*" or "*Grenat.*" It dyes chrome mordanted wool, or cotton fibre, but the colour obtained is not satisfactory in its resistance to the action of light. In practice its application is confined to wool-dyeing. If the nitroamidosalicylic acid be replaced by amido-α-hydroxynaphthoic acid, a dye possessing similar properties is produced. The diazo-compound of this acid is fairly stable, not, however, equalling that of picraminic acid, which can be boiled without decomposition, and be crystallised from its hot solution—unusual stability for a diazo-compound.

A black dye has also been prepared, and it is best applied to wool, by dyeing with the azo-compound prepared from *p*-phenylenediamine disulphonic acid and α-naphthylamine; the fibre is then diazotised and combined with α-naphthylamine. By substituting β-naphthylamine or β-naphthol in the second instance, similar but slightly browner shades are produced.—W. P. D.

New Derivatives of Phenolphthaleïn and Fluoresceïn. A. Haller and A. Guyot. Comptes rend. **116**, 479—482.

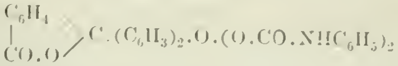
Phenolphthaleïn diphenylbicarbamate—



$$\begin{matrix} C_6H_4 \\ | \\ CO.O \end{matrix} \Big> C(C_6H_4.O.CO.NHC_6H_5)_2$$

is formed when phenolphthaleïn (one mol.) well dried, is heated to 130° C. with phenylic isocyanate (two mols.). After washing with light petroleum spirit, it separates from boiling benzene in fine white crystals melting at 135 C Boiling water has no action on it, but it is resolved into phenolphthaleïn and symmetrical diphenylcarbamide when treated with alkalis, or when heated above its fusion point.

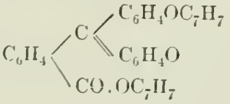
Fluoresceïn diphenylbicarbamate—



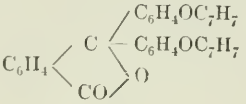
$$\begin{matrix} C_6H_4 \\ | \\ CO.O \end{matrix} \Big/ C.(C_6H_3)_2.O.(O.CO.NHC_6H_5)_2$$

obtained by a similar method to the above, crystallising in light yellow grains, easily discerned under the microscope. Ordinary solvents have but little effect on it, but it is fairly soluble in acetone. It melts at 195°, and splits up into fluoresceïn and phenylcarbamide.

Dibenzylphenolphthaleïn.—Phenolphthaleïn (one mol.) is treated with sodium (two atoms) under absolute alcohol, and the mixture treated with benzylchloride (two mols.). The residue after filtration is treated with ether, and crystallised from benzene and alcohol. It is blue in colour and melts at 150°; very slightly soluble in alcohol or ether, but dissolves in benzene. When heated with hydroxylamine hydrochloride and potash in a sealed tube to 100°, no oxamide is formed. From this fact it is probable that the constitutional formula is—



and not—



—W. P. D.

On the Spectra of Azo Colours. C. Grebe. Zeits. physikal. Chem. 1892, **10**, 673; and Chem. Zeit. Rep. 1893, **17**, 25.

The spectra of the solutions in sulphuric acid of about 107 azo colouring matters have been investigated in order to establish a relation between the spectrum and chemical constitution of the substance. The spectra consist almost without exception of two bands, which are more or less merged into one another. These bands are displaced from the violet towards the red end the higher the proportion of carbon, and the same phenomenon is observed when a hydroxyl or an amido group is introduced, whilst a sulphonic acid group causes an equally large displacement in the opposite direction.—T. A. L.

PATENTS.

Improvements in or relating to the Extraction of Tanning and Dyeing Materials. M. Heftler and G. Bénard, Paris, France. Eng. Pat. 20,677, November 15, 1892. Date claimed, under International Convention, May 17, 1892.

This invention relates to apparatus for the systematic extraction of dyeing and tanning materials, consisting in the present instance of a battery of closed, cylindrical vessels connected one with another. These are operated in the following manner:—To begin with, all the vessels (Nos. 1, 2, 3, 4, &c.) are filled with the wood, &c. to be extracted, and water is admitted into, for example, vessel 1. The water is heated to 100° C. and the liquor produced forced from this vessel into vessel 2 by the admission into it of water under pressure. The liquor in vessel 2 and the water in vessel 1 are now heated to 100° and then water is again admitted into vessel 1, forcing the liquor formed in it into vessel 2, and that from 2 into 3. This is continued, employing as many vessels as are necessary for the purpose, until the wood in vessel 1 has been exhausted, whereupon this vessel is disconnected from the battery and filled with fresh wood and then made the last of the series. Vessel 2 is next disconnected and re-charged, and so on with each of the vessels in turn.—E. B.

The Manufacture or Production of New Azo Colouring Matters, and Processes for Dyeing and Printing therewith. H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 17,770, October 5, 1892.

This is an extension of Eng. Pat. 5112 of 1892 (this Journal, 1893, 259) and of Eng. Pat. 15,636 of 1892 (this Journal, 1893, 754). The colouring matters described are obtained by combining one molecular proportion of a diazotised amido-carboxylic acid with one molecular proportion of an amido-cresol ether of the general formula $C_6H_3.CH_3.NH_2.OR$, in which the substituting groups are in the positions [1.2.4] or [1.3.4], and R may be methyl, ethyl, propyl, butyl, amyl, phenyl, or benzyl. The dyestuffs are of technical value, as they can be employed for dyeing mordanted wool and may also be used for printing on mordanted cotton. They can also be diazotised on the fibre and yield in this way very fast colours. The following method is given for the production of a claret-red colour on cotton, which stands soaping. The cotton is printed with a paste prepared from 100 kilos. of a 20 per cent. paste of the colouring matter from diazotised *m*-amidobenzoic acid and [1.2.4] *m*-amido-*p*-cresol ethyl ether, 200 litres of water, 640 kilos. of acetic acid starch tragacanth thickening, and 60 kilos. of chromium acetate of 20° B. After steaming for one hour, chalking, treating with malt, soaping, and washing, the printed cloth is immersed in a bath containing 10 kilos. of sodium nitrite which has been acidified, and kept agitated therein for 15—30 minutes. After having been well washed, the material is worked in a bath containing 20 kilos. of the sodium salt of β-naphthol, when the printed parts develop a claret-red. By using other developers the shades can be varied; for instance, α-naphthol gives a brownish-violet, 1·8-dihydroxynaphthalene a bluish-violet, ethyl-β-naphthylamine a violet, amidonaphthol ether a violet-black, and *m*-phenylenediamine a brown.—T. A. L.

Production of Green and Blue to Blue-Green Colouring Matters of the Triphenylmethane Series. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 18,081, October 10, 1892.

The green basic colouring matters produced according to this invention are obtained by condensing tertiary aromatic bases with the ethers of the di-alkylated *m*-hydroxy-*p*-amidobenzophenones by means of phosphorus oxychloride or similar substances. The basic greens so obtained may subsequently be converted into blue and bluish-green acid colouring matters by the action of sulphuric or fuming sulphuric acid. 10 kilos. of *m*-ethoxy-*p*-dimethyl-amidobenzophenone, 6·8 kilos. of methyldiphenylamine, and 10 kilos. of phosphorus oxychloride are heated in an enamelled or copper vessel to about 95° C. for three hours with constant agitation. Towards the end of the reaction the mixture becomes viscous, when it is stirred into 100 litres of cold water and heated to about 60° C. After standing 12 hours, the colouring matter which has separated out as hydrochloride is dried at 100° C. It forms an amorphous green mass readily soluble in alcohol, and as a neutral salt also soluble in water. In order to convert it into a sulphonic acid 10 kilos. are stirred at the ordinary temperature into 30 kilos. of sulphuric acid containing 20 per cent. of anhydride. The mixture is then poured into 500 litres of water. After liming and filtering, the solution of the calcium salt of the colouring matter is evaporated to dryness, or it may first be converted into sodium salt. Either of these salts forms a dark cherry-red mass very easily soluble in water to a blue solution. The addition of soda-lye causes a change to reddish-violet, whilst ammonia in excess does not affect the colour. The colouring matter dyes wool and silk from an acid bath a greenish-blue, which is fast to washing. —T. A. L.

Improvements in Machinery or Apparatus for Heating, Cleansing, Straining, and Pressing Indigo. H. S. Elworthy, Stratford, Essex. Eng. Pat. 18,665, October 18, 1892.

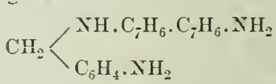
The inventor employs a closed hydro-extractor provided with steam and water jets and having an arrangement of "pockets" in the revolving drum, by which the indigo, after having been steamed and washed in the extractor, may be pressed into suitable slabs when the centrifugal machine is rotated at a high speed. A drawing accompanies the specification.—T. A. L.

Improvements in the Manufacture of Copyable Inks applicable for Printing Purposes. R. J. Friswell and F. H. Leeds, Stamford Hill. Eng. Pat. 18,721, October 19, 1892.

The use by printers of the usual forms of copyable inks made up with an aqueous vehicle being attended with considerable difficulties, the patentees propose the manufacture of an ink in which the aqueous vehicle is replaced by ordinary lithographic varnish. This ink will yield on treatment with damp paper in the copying press, six or eight copies. It is prepared by stirring lampblack or any other suitable pigment into a boiling aqueous solution of an aniline dye, chosen according to the required colour of the copy. The mixture is then evaporated to dryness and ground with lithographic varnish. As an example, one part of lampblack and one part of the dye known as "Dahlia" are mixed and dried and then ground in 10 parts of varnish, with or without the addition of driers.—D. B.

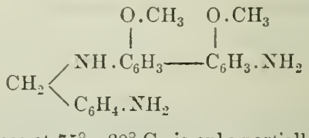
Production of New Unsymmetrical Diamido Bases, and Manufacture of Dyes therefrom. J. Imray, London. From L. Durand, Huguenin, and Co., Basle, Switzerland. Eng. Pat. 12,704, June 28, 1893.

This is an extension of Eng. Pat. 9360 of 1892 (this Journal, 1892, 809), which describes the formation of a new base by condensing equimolecular parts of formaldehyde, tolidine and tolidine hydrochloride, and the employment of this base for the production of colouring matters. In the present specification one molecule of aniline hydrochloride is substituted for the tolidine hydrochloride above mentioned, and the resulting base has the formula—



$$CH_2\left\langle\begin{array}{l}NH.C_7H_6.C_7H_6.NH_2\\ C_6H_4.NH_2\end{array}\right.$$

21·2 kilos. of tolidine, 13 kilos. of aniline hydrochloride, and 10 kilos. of alcohol are stirred together and mixed with 7·5 kilos. of a 40 per cent. solution of formaldehyde. The whole is then heated for 1—2 days on the water-bath, and forms a pale yellowish-green tough mass. It is purified by dissolving in dilute sulphuric acid, filtering, and precipitating the new base from the filtrate, when it forms a pale yellowish-green resinous mass. It melts at 50°—55° C., is readily soluble in hot alcohol and benzene, but almost insoluble in ether. The hydrochloride and sulphate are readily soluble in water. The nitrite required to diazotise it corresponds to two amido groups, and the tetrazo compound thus formed combines with naphthionic acid to form a red substantive cotton dye which dissolves in sulphuric acid with a violet-red colour, differing in this respect from the analogous dyestuff of Eng. Pat. 9360 of 1892, which dissolves in concentrated sulphuric acid with a bluish-violet colour. If the tolidine in the above example be replaced by 24·4 kilos. of dianisidine a compound is obtained having the formula—



$$CH_2\left\langle\begin{array}{l}NH.\overset{O.CH_3}{\overset{|}{C_6H_3}}\text{——}\overset{O.CH_3}{\overset{|}{C_6H_3}}.NH_2\\ C_6H_4.NH_2\end{array}\right.$$

This base fuses at 75°—80° C., is only partially soluble in hot alcohol, more readily in hot benzene, and is almost insoluble in ether. Its hydrochloride and sulphate are readily soluble in water, and it yields a colouring matter as follows:—The solution of the tetrazo-compound from 3·5 kilos. of the base, 8 kilos. of hydrochloric acid of 21° B., and 1·4 kilos. of sodium nitrite is poured into a solution containing 4·5 kilos. of α-naphthol-p-sulphonic acid and 6 kilos. of sodium carbonate. After standing some time the mixture is boiled and the dyestuff salted out. It forms when dry a bronzy-brown powder and dyes unmordanted cotton blue from an alkaline bath. The colouring matter dissolves in concentrated sulphuric acid with a greyish-blue colour.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

Connection between Tenacity of and Moisture present in Hemp and Flax. C. A. Lobry de Bruyn. Chem. Zeit. **17**, 172—173.

The breaking strains of strips of canvas, &c. (5 cm. broad, 40 long) were determined under different conditions when different amounts of moisture were present, with the result of showing that the drier the specimens the weaker they were. Thus in one series the following values were obtained:—

Moisture per Cent.	Breaking Strain in Kilos.
0	165
2·7	175
6·1	215
9·25	285
13·9	375
21·6	460

The German Government test for such fabrics used for military purposes is to examine the tenacity after remaining loose at least two hours in a room, the relative humidity of the air in which is 55—65 per cent. measured by Koppe-Saussure's hair hygrometer; the results thus obtained are obviously likely to be influenced considerably by the previous hygrometric state of the goods, which may or may not have attained that normally due to the moisture in the air of the testing room; which, again, may have altered during the two hours. Dry canvas when exposed to ordinary air absorbs moisture with such avidity that the temperature rises 6° or 7°.—C. R. A. W.

PATENT.

Improvements in Solutions for Waterproofing and Air-proofing Woven and other Fabrics, in Applying the Same, and in Apparatus therefor. F. Eckstein, London. Eng. Pat. 18,932, October 22, 1892.

See under XIII., *page* 849.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

PATENTS.

Improvements in and connected with Machinery for Dyeing and Scouring Yarn. J. M. Collins, Glasgow. Eng. Pat. 14,507, August 11, 1892.

The mechanism in question consists essentially of two sets of yarn-carrying rods, balanced on opposite sides of an overhead shaft, from which they are supported by chains passing over chain-wheels fixed on the same. Arrangements are made for alternately lowering and raising the rods, when the apparatus is in work, into and out of the dye-vessel; for causing the rods to revolve as they are raised from the vessel; and for enabling the direction of rotation of the rods to be reversed at will.—E. B.

Improvements in the Bleaching of Wool, Hair, Silk, Cotton, Flax, and other Animal and Vegetable Fabrics and Fibres, Paper Pulp, and the like. C. A. Sahlström, Lambeth, and E. Parr, Isleworth. Eng. Pat. 14,943, August 18, 1892.

The substance to be bleached is first treated with potassium permanganate solution until it acquires a deep coffee colour. To accelerate the action an electric current may be passed through the bath. The goods are next exposed to the action of sulphur dioxide, or passed into sulphurous acid solution, until all the precipitate is dissolved. The operation is completed by forcing a current of oxygen or ozonised oxygen through the material.—R. B. B.

An Improved Process of Dyeing Animal Fibres and Fabrics, Horn, Feathers, Leather, and Albuminous Substances generally. F. Obermayer, Vienna, Austria. Eng. Pat. 15,082, August 20, 1892.

This patent refers to a new process for dyeing animal fibres by diazotising the fibre and combining the diazo compound with phenols or amines. The application of the diazotising process to leather, horn, and feathers is claimed. For all animal fibres the nitrite solutions are to be very dilute, the time of application 12—24 hours, with, as far as possible, exclusion of light. The diazotised fibres are then treated with either:—(1) neutral aqueous solutions of phenols at 80° C.; (2) cold ammoniacal solutions of alkaline phenolates without excess of free alkali; (3) neutral salts of amines; or (4) acetic acid solutions of amines. It is stated that by employing such solutions the fibres remain uninjured. The resulting shades are reds, yellows, and browns. These amido azo compounds may be further diazotised and combined with phenols or amines, whereby new shades are obtained.

When the fibres dyed either by one or two diazotising processes are treated with certain metallic salts or oxidising agents, such as copper chloride, ferric chloride, zinc acetate, potassium bichromate, and sulphuric acid, &c., the shades are modified and in most cases rendered darker.

It is claimed that all the colours produced according to this patent are full and brilliant, and, with one or two exceptions, fast to soap.—R. B. B.

Improvements in Dyeing Wool and Woollen Fabrics with Sulphonic Acids of Alizarin Colouring Matters. O. Imray, London. From "The Farbwerke vormals Meister, Lucius und Brüning," Höchst a. Main, Germany. Eng. Pat. 15,310, August 25, 1892.

Woollen yarns and fabrics are dyed with the sulphonic acid derivatives of alizarin and its analogues by first applying these and then treating with mordanting salts, as alum, aluminium sulphate, ferrous sulphate, chrome alum, "fluorchrom," potassium and sodium dichromate, &c.

The following recipe exemplifies the manner of dyeing, according to this method, a fast red on military cloth (100 parts):—A bath is prepared of 4 parts of alizarin-red 1WS powder (the sodium salt of alizarin sulphonic acid) and 20 of sodium sulphate, and the whole heated to the boil. The cloth is entered into this while boiling, and is immersed in it for $\frac{3}{4}$ hour; then 4 parts of sulphuric acid are diluted with water and added to it, and the boiling is resumed for another $\frac{3}{4}$ hour. At the end of this time, a solution of 10 parts of alum is added, and the dyeing is finally completed by boiling $\frac{3}{4}$ hour longer.

The advantages of this process of dyeing over those hitherto practised with the alizarin colouring matters are declared to be extraordinary and of far-reaching importance for many branches of wool-dyeing. Thus, in addition to more loosely-woven and milled fabrics, strongly milled woollen and worsted stuffs, felt hats, fezes, &c., can by it be dyed with the alizarin colouring matters completely throughout their texture, a result unattainable by the methods hitherto adopted with the same colouring matters. This involves the advantage of securing the satisfactory application of the alizarin colouring matters to thick cloths, fezes, &c., and of thus enabling military cloths, &c. to be woven with undyed yarns and then to be dyed in the piece. Besides this, the method has the advantages of being more simple and economical than the "mordant and dye" and (simultaneous mordant and dye) "single bath" methods hitherto adopted with the alizarin colouring matters, little attention having to be paid to the heating of the bath (since this is maintained at the boil) and than when separate baths are employed for the "stuffing" and dyeing, permitting these to be used continuously.—E. B.

Improvements in Colouring, Printing, or Staining Paper or other Material, and Apparatus therefor. F. W. Hayward, Norwich. Eng. Pat. 16,016, September 7, 1892.

Paper is ornamented or printed in colours by passing it into a solution of a coal-tar dye or other suitable colouring matter, and then pressing it between an engraved and a plain roller. The dye solution is thus pressed into and through the paper by the parts of the rollers which would come into contact if the paper were not between them. The paper is next passed either between squeezing-rollers lapped with woollen thread, or into water and then between squeezing-rollers, according as the unpressed portions of the paper are to be left tinted or the dye is to be removed by them.

To produce a design on one side of the paper, the latter is moistened with the dye solution on one side only and then treated as described.

The effects may be varied by moistening the surface of the paper with a dye solution and then printing with a die or type.—E. B.

Improvements in the Preparation and Production of Aluminium Plates for Printing Purposes. O. C. Strecker, Mainz, Germany. Eng. Pat. 16,312, September 12, 1892.

Aluminium plates, after having been cleaned, levelled, and polished, are prepared for printing, after the manner of lithographic printing, in two ways. In one of them, "transfers," in chalk or ink, are applied to the plates, on which "facings" are then produced by the action of suitable acids; in the other method, the plates are first treated with the acids until their surfaces have assumed an opaque white appearance, then, after rinsing with a solution of alum or of acetic acid to enable the plates to take them, the "transfers" are applied, and the plates then subjected to a second treatment with acid, this time more concentrated than before. Acids suitable for this purpose are ortho- meta- and pyro-phosphoric and hydrofluoric acids. These form salts of aluminium which are insoluble in water and which, while attached to the plates, retain a sufficiency of water to prevent the adherence to the parts acted upon of the oily inks employed for colouring the other parts of the plates. An acid mixture such as is used in the process is composed, for example, of 10 parts of a solution of gum, 3 of a saturated solution of gallic acid, and 1 of a 20 per cent. solution of orthophosphoric acid.—E. B.

Improvements in and relating to Dyeing and Printing; specially applicable to Woollen Piece Goods and Yarns. W. Bell, Paisley. Eng. Pat. 18,787, October 20, 1892.

The patentee proposes to apply all those colours which require a mordant, *e.g.*, dyewoods, alizarins, &c., in a single bath together with potassium, sodium, or ammonium chromate or bichromate, and an organic acid, preferably oxalic acid.—R. B. B.

A New or Improved Process and Apparatus for Dyeing, Bleaching, and Boiling Textile Material. L. Ettl, Zwittau, Austria. Eng. Pat. 19,359, October 28, 1892.

The drum of a vertically-driven, centrifugal machine enclosed in an air-tight case, contains at its centre a perforated cylinder in which a screw-blade is fixed and over which a turbine is suspended. The material to be dyed, &c. is placed in the drum, and, after the air has been exhausted from the apparatus, the requisite liquor is admitted into it. The drum being set in motion, the liquor is projected into the space between the drum and the casing. Here it ascends until it meets the vanes of the turbine, which direct it into the central cylinder, whence it is again expelled through the mass of the material, an active and continuous circulation of the liquor thenceforth taking place.—E. B.

Improved Process of Producing a Fast Black Colour on Fibrous Substances. O. P. Amend, New York, U.S.A. Eng. Pat. 11,634, June 13, 1893. Date claimed, under International Convention, November 18, 1892.

A process of producing aniline black on textile materials, which consists in immersing them at a temperature of 20°—30° C. in a bath containing per kilogrm. of them about 40 grms. of chromic acid and 30 grms. of hydrochloric acid, with enough water to permit complete immersion of the materials; expressing from them the excess of this solution and then immersing them in a solution of 100 grms. (per kilogrm. of them) of aniline hydrochloride and a "proportionate amount" of ferric sulphate or other suitable oxidising salt, at the ordinary temperature, until the black has developed to "a certain shade," whereupon the materials are withdrawn and exposed to steam and air at a temperature of 80° C. in an aniline ageing-machine. A black is thus obtained which withstands all the tests required of the best blacks, and the fibres on which it is so produced are found to have an increased tenacity.

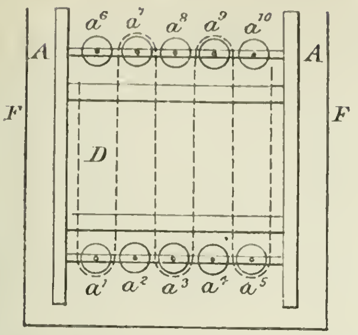
In the dyeing of aniline black on animal fibres, the inventor of this process claims to have discovered that chromic acid, when a sufficiency of it is employed, along with hydrochloric or acetic acid ("acids that will not produce a secondary oxidising reaction on the fibre;" sulphuric and nitric acids being considered by the inventor to have an oxidising action on animal fibres, and accordingly being debarred from use), partially oxidises such fibres and partially acts upon them in such manner that chromic acid-fibre compounds are formed. The latter, in the process of dyeing are decomposed by the aniline hydrochloride with the ultimate production of aniline black-dyed fibres and chromic chloride.

The above process of dyeing is applicable to fabrics composed of either animal or vegetable fibres.—E. B.

Improvements in Machines for Scouring and Dyeing Textile warps, and Yarns. F. Barraclough, Yeadon. Eng. Pat. 22,893, December 13, 1892.

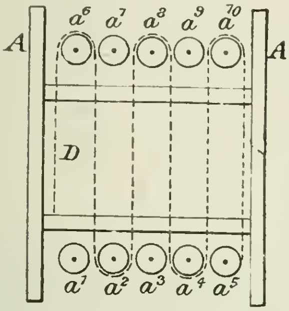
A four-sided frame A (see figures), fitted with a system of rollers, is constructed so that it can be moved from one cistern to another, as occasion may require, and can finally be used as a drying-frame, yarn which has been placed on it for the purpose of scouring or dyeing, thus not requiring to be removed therefrom until these operations are completed. The yarn is wrapped on the rollers, a^1 to a^{10}, so as to form an endless length, being carried from the front of the frame to the back, as illustrated by Fig. 1, and then returned to the

Fig. 1.



front again, as shown in Fig. 2, this being repeated until the whole of the yarn the frame is capable of holding has been spread on the rollers. The ends of the yarn are then fastened together and the frame placed in a rectangular cistern F (Fig. 1) to be scoured or dyed.

Fig. 2.



To guide the yarn in its passage over the rollers, a number of partitions, b^1 to b^5 (Fig. 3; shown in plan in Fig. 4), are fixed at right angles to the axes of the rollers, dividing the space between the two rows of rollers into the "drafts," c^1 to c^1, through which the yarn is passed successively by means of the guides, b^6, b^7 (two others, not shown, being placed at the opposite end of the frame), fixed obliquely at the ends of the frame.

Fig. 3.

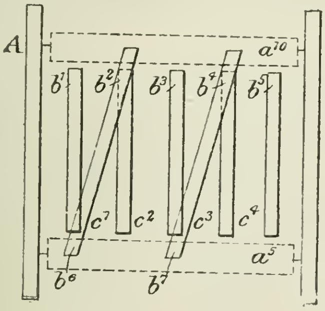
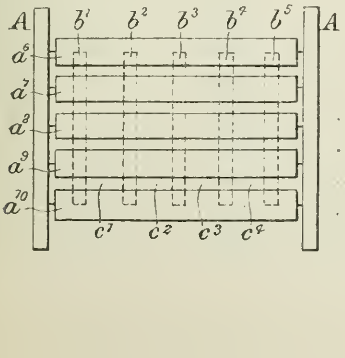


Fig. 4.



The rollers, a^1 to a^5, of the lower row run loosely in bushes in the frame, while those of the upper row, a^6 to a^{10}, are geared together by toothed wheels on their ends. Motion is imparted to the latter set of rollers, when scouring or dyeing.

—E. B.

Improvements relating to the Dyeing or Treating of Bobbins of Wool and other Textile Materials, and Apparatus therefor. E. Génard, Brussels, Belgium. Eng. Pat. 8430, April 26, 1893.

The holder upon which the bobbins are strung consists of a hollow tube perforated with numerous small holes. The holder and bobbins are placed in the dye-bath, the tube being connected with a pipe which serves for exit or supply. The dye or other solution makes its way through the wool into the central tube and so leaves the vessel, into which it may be again pumped and the operation made continuous. Or the liquor may be forced from the tube outwards through the wool into the dye-vessel.

The bobbin holder is provided with a moveable stopper which is so adjusted that no liquor can pass from the tube into the dye-bath without penetrating the wool.—R. B. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Manufacture of Sulphur in Sicily. Chem. Ind. **16**, 1893, 210.

The sulphur ores, which contain from 16 to 20 per cent. of sulphur, occur at a depth of 90—100 metres and assume a thickness of from 5 to 30 metres. The extraction of the sulphur was originally effected by a rough process of fusion, a heap of ore being set fire to, whereby the heat evolved from the burning of one portion was made to fuse the remainder. This caused a loss of 40 per cent. of sulphur. By conducting the fusion in a furnace known as the calcarone, the loss was reduced to 30 per cent. This furnace is 10 m. in diameter, and from $2\frac{1}{2}$ to 3 m. high. It is charged like a lime-kiln, the bottom being filled with a layer of large stones, and the intervening channels with brushwood, which is fired when the kiln is to be set in action. Upon this bed, lumps of the ore, diminishingin size towards the top, are placed, the top of the furnace being covered with a bed of fused ore. The furnace is then fired and burns for 8—10 days. At a temperature of 125° the sulphur begins to fuse, running down in a liquid state through the channels into receivers, whence it is transferred to wooden or iron moulds 75 cm. long, 25 cm. wide, and 20 cm. deep, in which it solidifies. The fusion is now generally effected in annular kilns containing six chambers, in which the loss of sulphur is reduced to 25 per cent.—D. B.

The Freezing Points of Sulphuric Acids of Varying Concentrations and the Sulphuric Acid Contents of the Frozen and the Liquid Portions. (From the laboratory of R. Pictet.) J. Thilo. Chem. Zeit. **16**, 1892, 1688—1689.

The necessary decrease of temperature is produced in three stages; the first stage, down to −100° C., by means of Pictet's solution (sulphurous acid and carbonic acid); the second, to −150° C., by means of liquid and gaseous nitrous oxide; the third, below −200°, by the use of liquid and gaseous air. The temperatures were estimated with alcohol thermometers, and the results so obtained are given in the following table:—

TABLE A.

FREEZING POINTS OF SULPHURIC ACIDS OF VARYING CONCENTRATIONS.

Formula.	H_2SO_4 per Cent. by Weight.	Specific Gravity.	Freezing Point ° C.
H_2SO_4	100·0	1·842	+10·5
..	95·2	1·834	−24·5
..	89·17	1·815	−47
..	88·88	1·813	−55
$H_2SO_4 + H_2O$	84·48	1·777	+ 3·5
..	83·82	1·772	+ 4·5
..	83·74	1·771	+ 5·
..	83·00	1·765	+ 8·
..	80·84	1·743	+ 2·5
..	80·00	1·734	+ 1·5
..	77·2	1·701	−14
..	74·85	1·673	−41
$H_2SO_4 + 2H_2O$..	73·03	1·659	−70
$H_2SO_4 + 4H_2O$..	57·65	1·476	−40
$H_2SO_4 + 6H_2O$..	47·57	1·373	−50
$H_2SO_4 + 8H_2O$..	40·50	1·311	−35
$H_2SO_4 + 10H_2O$..	35·25	1·268	−83
$H_2SO_4 + 11H_2O$..	33·11	1·249	−75
$H_2SO_4 + 12H_2O$..	31·21	1·233	−55
$H_2SO_4 + 13H_2O$..	29·52	1·219	−45
$H_2SO_4 + 14H_2O$..	28·00	1·207	−40

FREEZING POINTS OF SULPHURIC ACID—*cont.*

Formula.	H_2SO_4 per Cent. by Weight.	Specific Gravity.	Freezing Point ° C.
$H_2SO_4 + 15H_2O$..	26·63	1·196	−34
$H_2SO_4 + 16H_2O$..	25·39	1·187	−26·5
$H_2SO_4 + 18H_2O$..	23·22	1·170	−19
$H_2SO_4 + 20H_2O$..	21·49	1·157	−17
$H_2SO_4 + 25H_2O$..	17·88	1·129	− 8·5
$H_2SO_4 + 30H_2O$..	15·36	1·109	− 6·5
$H_2SO_4 + 40H_2O$..	11·98	1·084	− 4·5
$H_2SO_4 + 50H_2O$..	9·82	1·067	− 3·5
$H_2SO_4 + 75H_2O$..	6·77	1·045	0
$H_2SO_4 + 100H_2O$..	5·16	1·032	+ 2·5
$H_2SO_4 + 150H_2O$..	3·50	1·029	+ 3·0
$H_2SO_4 + 200H_2O$..	2·65	1·013	+ 4·0
$H_2SO_4 + 300H_2O$..	1·78	1·007	+ 4·5
$H_2SO_4 + 320H_2O$..	1·67	1·006	+ 3·5
$H_2SO_4 + 340H_2O$..	1·58	1·006	+ 2·5
$H_2SO_4 + 360H_2O$..	1·50	1·005	+ 1·5
$H_2SO_4 + 400H_2O$..	1·34	1·005	+ 1·0
$H_2SO_4 + 1000H_2O$.	0·54	1·001	− 0·5

The freezing points are represented by a curve of great irregularity, which repeatedly traverses the zero-line.

The frozen and liquid portions were separated by means of a vacuum, weighed, and titrated. The liquid part contained in most cases more sulphuric acid than the solid part, the proportion of sulphuric acid in the former increasing when refrigerating more dilute acids (up to a certain limit), and when lowering the temperature. The liquid and frozen parts contain only in rare cases the same amount of sulphuric acid, and these coincide with the points at which the curve of the freezing points is at a maximum or a minimum.

TABLE B.

TITRATION OF THE FROZEN AND OF THE LIQUID PARTS.

—	Grms.	Temperature ° C.	Formula.	H_2SO_4 Grms. in 1 Litre.	H_2SO_4 Per Cent. by Weight.	Specific Gravity.
Original solution..................	200	−24·5	.. ..	1,744	95·2	1·834
Frozen portion....................	157	−33	.. ..	1,744	95·2	1·834
Liquid portion	43		.. ..	1,744	95·2	1·834
Original solution..................	200	+3·5	$H_2SO_4 + H_2O$	1,500	84·48	1·777
Frozen portion....................	175	−10	„	1,500	84·48	1·777
Liquid portion....................	25		„	1,500	84·48	1·777
Original solution	261	+4·5	.. ..	1,485	83·82	1·772
Frozen portion....................	221	−20	.. ..	1,490	84·1	1·774
Liquid portion....................	103		.. ..	1,470	83·22	1·766
Original solution..................	357	+8	.. ..	1,465	83	1·765
Frozen portion....................	191	−20	.. ..	1,465	83	1·765
Liquid portion....................	166		.. ..	1,465	83	1·765
Original solution..................	265	+2·5	.. ..	1,409	80·84	1·743
Frozen portion	233	−26	.. ..	1,416	81·1	1·746
Liquid portion....................	17		.. ..	1,313	77·2	1·701

TITRATION OF THE FROZEN AND OF THE LIQUID PARTS—*cont.*

——	Grms.	Temperature ° C.	Formula.	H_2SO_4 Grms. in 1 Litre.	H_2SO_4 Per Cent. by Weight.	Specific Gravity.
Original solution	204	+1·5	.. ..	1,389	80·09	1·734
Frozen portion	128	−11	.. ..	1,401	80·5	1·750
Liquid portion	76		.. ..	1,371	79·4	1·725
Original solution	193	−14	.. ..	1,313	77·2	1·701
Frozen portion	128	−40	.. ..	1,333	78·0	1·710
Liquid portion	49		.. ..	1,259	75·1	1·676
Original solution	234	−41	.. ..	1,252	74·85	1·673
Frozen portion	58		.. ..	1,272	74·85	1·673
Liquid portion	176		.. ..	1,252	74·85	1·673
Original solution	46	−88	$H_2SO_4 + 10H_2O$	418	35·25	1·268
Frozen portion	11		,, ,,	418	35·25	1·268
Liquid portion	31		,, ,,	418	35·25	1·268
Original solution	190	−75	$H_2SO_4 + 11H_2O$	414	33·11	1·244
Frozen portion	9	−80	.. ..	.. ..	.. ..	.. ..
Liquid portion	181		.. ..	416	33·12	1·251
Original solution	191	−55	$H_2SO_4 + 12H_2O$	386	31·21	1·233
Frozen portion	2	−60	.. ..	.. ..	.. ..	.. ..
Liquid portion	189		.. ..	386	31·21	1·233
Original solution	190	−55	$H_2SO_4 + 12H_2O$	386	31·21	1·233
Frozen portion	133	−70	$H_2SO_4 + 12\ 13H_2O$	368	30·1	1·224
Liquid portion	57		$H_2SO_4 + 11H_2O$	414	33·1	1·250
Original solution	190	−55	$H_2SO_4 + 12H_2O$	386	31·21	1·233
Frozen portion	64	−80	$H_2SO_4 + 13,14H_2O$	353	29·0	1·215
Liquid portion	126		$H_2SO_4 + 11'12H_2O$	397	32·0	1·239
Original solution	197	−45	$H_2SO_4 + 13H_2O$	358	29·52	1·219
Frozen portion	136	−56	$H_2SO_4 + 14H_2O$	341	28·2	1·208
Liquid portion	61		$H_2SO_4 + 12H_2O$	392	31·7	1·237
Original solution	193	−10	$H_2SO_4 + 14H_2O$	338	28·0	1·207
Frozen portion	65	−56	$H_2SO_4 + 18H_2O$	277	23·0	1·173
Liquid portion	131		$H_2SO_4 + 12,13H_2O$	375	30·50	1·228
Original solution	194	−34	$H_2SO_4 + 15H_2O$	318	26·63	1·196
Frozen portion	116	−53	$H_2SO_4 + 17\ 18H_2O$	279	23·8	1·174
Liquid portion	78		$H_2SO_4 + 12,13H_2O$	370	30·2	1·225
Original solution	191	−23·5	$H_2SO_4 + 16H_2O$	301	25·39	1·187
Frozen portion	156	−63	$H_2SO_4 + 17H_2O$	284	24·13	1·177
Liquid portion	35		$H_2SO_4 + 12H_2O$	390	31·52	1·236
Original solution	201	−19	$H_2SO_4 + 18H_2O$	274	23·22	1·170
Frozen portion	119	−62	$H_2SO_4 + 21H_2O$	240	20·87	1·152
Liquid portion	82		$H_2SO_4 + 15H_2O$	316	26·45	1·195
Original solution	204	−17	$H_2SO_4 + 20H_2O$	247	21·40	1·157
Frozen portion	146	−63	$H_2SO_4 + 22H_2O$	218	19·13	1·139
Liquid portion	58		$H_2SO_4 + 16H_2O$	309	25·94	1·191
Original solution	191	−8·5	$H_2SO_4 + 25H_2O$	210	17·88	1·120
Frozen portion	155	−69	$H_2SO_4 + 26H_2O$	191	16·99	1·122
Liquid portion	36		$H_2SO_4 + 21H_2O$	235	20·48	1·149
Original solution	208	−6·5	$H_2SO_4 + 30H_2O$	171	15·36	1·109
Frozen portion	192	−52	$H_2SO_4 + 33H_2O$	154	14·00	1·100
Liquid portion	16		$H_2SO_7 + 14H_2O$	313	28·30	1·210

Titration of the Frozen and of the Liquid Parts—*cont.*

—	Grms.	Temperature. °C.	Formula.	H_2SO_4 Grms. in 1 Litre.	H_2SO_4 Per Cent. by Weight.	Specific Gravity.
Original solution	202	−4·5	$H_2SO_4 + 40H_2O$	132	11·98	1·084
Frozen portion	151	−15	$H_2SO_4 + 50H_2O$	105	9·8	1·067
Liquid portion	51		$H_2SO_4 + 24H_2O$	211	18·6	1·135
Original solution	217	−3·5	$H_2SO_4 + 50H_2O$	105	9·82	1·069
Frozen portion	162	−18	$H_2SO_4 + 90H_2O$	59	5·7	1·036
Liquid portion	55		$H_2SO_4 + 22H_2O$	228	19·92	1·145
Original solution	200	0	$H_2SO_4 + 75H_2O$	73	6·77	1·045
Frozen portion	157	−14	$H_2SO_4 + 170H_2O$	31	3·1	1·016
Liquid portion	43		$H_2SO_4 + 22H_2O$	228	19·92	1·145
Original solution	200	+2·5	$H_2SO_4 + 100H_2O$	52	5·16	1·032
Frozen portion	128	+1·5	$H_2SO_4 + 150H_2O$	33	3·3	1·018
Liquid portion	72		$H_2SO_4 + 65H_2O$	84	7·98	1·053
Original solution	196	+3	$H_2SO_4 + 150H_2O$	35	3·5	1·020
Frozen portion	121	−2	$H_2SO_4 + 300H_2O$	19	1·9	1·007
Liquid portion	75		$H_2SO_4 + 90H_2O$	59	5·7	1·036
Original solution	203	+4	$H_2SO_4 + 200H_2O$	27	2·65	1·013
Frozen portion	109	+2	$H_2SO_4 + 400H_2O$	14	1·4	1·005
Liquid portion	94		$H_2SO_4 + 130H_2O$	41	4·00	1·023
Original solution	200	+4·5	$H_2SO_4 + 300H_2O$	18	1·78	1·007
Frozen portion	168	−15	$H_2SO_4 + 500H_2O$	11	1·1	1·004
Liquid portion	32		$H_2SO_4 + 90H_2O$	57	5·53	1·035
Original solution	144	+3·5	$H_2SO_4 + 320H_2O$	17	1·67	1·006
Frozen portion	93	−14	$H_2SO_4 + 600H_2O$	9	0·9	1·003
Liquid portion	51		$H_2SO_4 + 170H_2O$	31	3·07	1·016
Original solution	155	+1·5	$H_2SO_4 + 360H_2O$	15	1·5	1·005
Frozen portion	91	−14	$H_2SO_4 + 600H_2O$	8	0·8	1·003
Liquid portion	64		$H_2SO_4 + 200H_2O$	25	2·5	1·012
Original solution	200	+ 1	$H_2SO_4 + 400H_2O$	13	1·34	1·005
Frozen portion	125	− 3	$H_2SO_4 + 600H_2O$	9	0·9	1·003
Liquid portion	75		$H_2SO_4 + 300H_2O$	18	1·8	1·007
Original solution	212	+0·5	$H_2SO_4 + 1000H_2O$	5·4	0·54	1·001
Frozen portion	133	−17	$H_2SO_4 + 200H_2O$	4·6	0·46	1·000
Liquid portion	79		$H_2SO_4 + 700H_2O$	7·1	0·71	1·003

In the column (Table B.) under "Temperature," the numbers given opposite the word "Original," signify the freezing points of the corresponding sulphuric acids as given in Table A. The numbers opposite the words "Frozen" and "Liquid" portions, signify the temperatures at which both portions may be separated from each other.

—H. A.

On the Pink Coloration of Calcium Chlorate Liquors.
E. Wagner. Chem. Zeit. **17**, 653.

Experiments made on this subject corroborate Bailey and Jones's conclusions (this Journal, 1893, 232—233) to the effect that pink-coloured liquors cannot be obtained when using materials free from manganese. The matter may be finally settled by the spectroscopic behaviour of "pink liquors," which in layers of 5 cm. thickness show the characteristic five permanganate absorption bands, Dγ, α, β, δ, and ε F.

Absorption Spectra of Red Calcium Chlorate Solutions.

Band	1γ	2α	3β	4δ	5ε
Position.					
(*a*.) Acc. to Vierordt	$D_{15}E$—$D_{30}E$	$D_{49\cdot5}E$—$D_{67}E$	$D_{92}E$—$F_{48}b$	$b_{18}F$—$b_{49}F$	$b_{78}F$—F_1G
(*b*.) In wave-lengths	λ579·9—570·5	λ558·4—λ547	λ532—λ523	λ513—λ502·5	λ493—484

—H. A.

The Technical Estimation of Boric Acid in Boronatrocalcites. G. A. le Roy. Chem. Rep. **17**, 163.

See under XXIII., *page* 867.

The Production of Chlorine by Means of Manganese Ore and Nitric Acid. G. Lunge and C. Pret. Zeits. f. ang. Chem. 1893, 99—106.

This paper is an investigation of a proposal made by Schloesing as far back as 1862, for the liberation of all the chlorine contained in hydrochloric acid. According to the usual method of treating manganese peroxide with hydrochloric acid, theoretically only one-half, and in practice, even only one-third, of the chlorine is obtained in the free state. Schloesing proposes to treat 1 mol. of manganese dioxide with 2 mols. of hydrochloric and 2 mols. of nitric acid, liberating the whole of the chlorine with formation of manganese nitrate. From this, both manganese dioxide and nitric acid may be recovered by heating the residue and by subsequent treatment of the gases evolved with air and water. Schloesing maintains that the liberation of the chlorine and the decomposition of the manganese nitrate proceed at two distinct and different temperatures; he obtained 90—96 per cent. of the chlorine in the free state, recovered 93·3 per cent. of the manganese, and 91 per cent. of his nitric acid. Regarding the importance recently gained of nitric acid-chlorine processes, the authors of this paper proposed to investigate Schloesing's process, asking themselves the following questions:—

(1.) Does the liberation of chlorine proceed independently of the decomposition of manganese nitrate? (2.) What excess of nitric acid is required? (3.) Is dilution with water advisable, and if so, to what extent? (4.) How much of the total chlorine can be obtained in the free state? (5.) How far is it possible to regenerate manganese dioxide? (6.) What is the function of the nitrosylchloride formed (if any)? (7.) To what extent is it possible to regenerate nitric acid from the oxides of nitrogen? (8.) Incidentally—the quantitative aspect of the conversion of nitrogen tetroxide into nitric acid, by means of air and water?

The experiments were made with pure materials, the hydrochloric acid being of sp. gr. 1·184, or 36·62 per cent., the nitric acid of sp. gr. 1·4245, or 69·735 per cent.; the manganese peroxide was prepared from neutralised still-liquors by precipitation with bleach, washing with hydrochloric acid and water, the product containing 91·48 per cent. manganese dioxide and 8·31 per cent. water. The experiments were carried out with 2 grms. of this artificial manganese and with the theoretical quantity of hydrochloric acid required by the reaction—

$$MnO_2 + 2HCl + 2HNO_3 = Mn(NO_3)_2 + 2H_2O + Cl_2,$$

and varying only the nitric acid and the water. The gases were evolved in a flask closed by means of a ground-in stopper, in which were fused a separating funnel for the admission of the acid and a gas delivery tube leading to several bottles and U-tubes charged with potassium iodide for the absorbtion of chlorine. The flask is heated in a glycerol bath. Reactions 1—6 in the following table were carried out in three stages; the temperate was first kept at 80° for half an hour and the chlorine evolved driven out by means of a current of air. The potassium iodide solutions were then renewed and the temperature raised to 110° and finally to 135°. The other experiments were carried out at the fixed temperatures named below.

Experiment.	HCl used.	HNO_3 used.	H_2O used.	Yield of Chlorine Per Cent.		
				At 80°.	At 110°.	At 135°.
1	Theoretical Quantity.	Theoretical quantity	$\frac{1}{10}$ of Vol. of $HCl + HNO_3$	72·9	80·5	—
2		Theoretical quantity + 25 per cent. excess.	$\frac{1}{7}$ of Vol. of $HCl + HNO_3$	75·9	82·3	88·1
3		Theoretical quantity + 50 per cent. excess.	„	76·8	86·9	95·1
4		„	„	77	86·8	95·0
5		Theoretical quantity + 75 per cent. excess.	„	78·6	88·3	98·3
6		„	„	81	90·7	99
7		„	„	Heated to 135° in one operation.		98·49
8		„	„	„		98·6
9		„	„	„		98·48
10		„	„	Heated to 120° in one operation.		94·2
11		„	„	„		94·8
12		„	„	Heated to 125° in one operation.		97·9
13		„	„	„		99
14		„	„	„		98·4

The results show that 98—99 per cent. of the chlorine of the hydrochloric acid may be obtained when using an excess of 75 per cent. of nitric acid. over the theoretical quantity, diluting with water to the extent of one seventh of the joint bulk of the acids and heating up to 135°.

The residues from these operations were heated to 250° and the manganese so formed, estimated with ferrous sulphate and permanganate. The results of four experiments show that 99·8, 99·2, 98·79, 97·5 per cent. of the originally used manganese, are recoverable, and that this part of Schloesing's process is perfectly satisfactory.

For the recovery of the nitric acid from the residual solutions the following process was finally adopted. The residues were evaporated down in a tubulated retort, this was then placed in an air-bath and its upright neck connected with a series of absorbing bottles, starting with an empty bottle cooled with water, a tower charged with glass beads and moistened with a constant stream of water, two Mitscherlich four-bulb U-tubes, four washbottles (all charged with water), and finally a flask charged with neutral litmus solution; a suction was maintained in the apparatus by means of a vacuum-jet. The tubulus of the retort was closed with a rubber stopper provided with two perforations, the one for a thermometer, the other for a bent tube which led into the top part of a test tube charged with standard caustic soda, and provided with another longer tube dipping into the solution. All air had to pass through this solution, and in case of back pressure the nitrous fumes were here effectually absorbed. Up to 88·4 and 90 per cent. of the nitric acid were thus recovered, whilst in a particular experiment only 90·3 per cent. of the originally used nitric acid was found in the residual mass. A loss of 9·7 per cent. of nitric acid in the first operation is here conclusively proved.

This loss of nitric acid may be due to nitrosylchloride, which is, according to Goldschmidt, the only product, besides chlorine, from the action of hydrochloric acid on nitric acid. The possibility of the presence of nitrosylchloride necessitated the investigation of its action on potassium iodide. Pure nitrosylchloride, prepared from nitrosulphonic acid and salt, was distilled in a current of carbonic acid into a flask containing potassium iodide, and the unabsorbed gases caught in a Städel apparatus over caustic soda; these gases were found to be completely absorbed by ferrous sulphate, thus proving the presence of pure nitric oxide. The iodine separated and the nitric oxide evolved were found to correspond to the quantities required by the equation $NOCl + KI = KCl + I + NO$, and this again proves that the action of free chlorine and of nitrosylchloride on potassium iodide is identical. Since, however, the yields of chlorine given in the table above too high, it became necessary to account for the chlorine present as nitrosylchlorine. In one of the experiments 98 per cent. of chlorine were recovered in potassium iodide by treatment at 135°; in this case out of 4·620 grms. nitric acid employed only 4·258 grms. of nitric acid was found in the residue, corresponding to a loss of 7·4 per cent., or to a volume of 123·4 cc. nitric oxide. But instead of the latter amount only a very small volume of gas was absorbed in ferrous sulphate, amounting in two cases to 19 cc. and 12 cc. nitric oxide instead of 123·5 cc. or 126·1 cc., as expected. Therefore, only about 1 per cent. of the chlorine could have been present as nitrosylchloride, and only a correspondingly small loss of nitre is due to its presence. The fact remains that 7·5—7·8 per cent. of the nitric acid used are lost in some form, whilst evolving chlorine, and another 2·5—8 per cent. are lost in the treatment of the manganese nitrate residues, the two sources making up a loss of 10—16 per cent. of nitric acid, and with this loss one would have to reckon on the large scale.

Finally the authors endeavoured to ascertain the extent to which nitric acid may be recovered from pure nitrogen peroxide. To this end weighed quantities of pure nitrogen tetroxide (fused into glass bulbs) were introduced into a flask and the gases liberated by breaking the bulb, were passed through a ten-bulb tube and five Drechsel bottles charged with water, for the purpose of condensing the nitric acid, and then through another ten-bulb tube and two wash bottles charged with acidified permanganate solution for the purpose of absorbing the nitric oxide, and finally through a neutral Litmus solution. A current of air was passed through the apparatus during the experiment. The contents of each wash bottle were tested separately, and the results embodied in the following table:—

Experiment.	N_2O_4 Grms. used.	Temp. ° of first Absorbing Vessel.	HNO_3 recovered in the Water, Expressed in Per Cent., N_2O_4						Total HNO_3 in the Water, in Per Cent. N_2O_4	NO absorbed in $KMnO_4$, Expressed in Per Cent. N_2O_4	Recovered as HNO_3 and NO, Expressed in Per Cent. N_2O_4	Experiment running Hours.
			I. 80 cc.	II. 50 cc.	III. 50 cc.	IV. 50 cc.	V. 50 cc.	VI. 80 cc.				
1	0·504	20	79·6	3·2 30 cc.	3·6	2·6	..	..	89·0	11·0	100·0	4½
2	0·411	3	83·5	3·7	1·8	1·6	..	..	90·6	9·7	100·3	4
3	0·7695	30	74·0	7·9	3·3	2·7	1·2	..	89·1	10·5	99·6	4
4	0·5533	40	74·93	8·78	3·0	1·51	0·78	..	89·0	6·2	95·2	3½
5	0·4939	40	75·6	9·3	3·5	1·7	1·0	0·6	91·7	7·0	98·7	3¾
6	0·4131	30	80·0	6·7	2·2	1·0	0·5	0·9	91·3	6·7	98·0	3
7	0·5765	20	80·6	5·1	2·8	1·8	1·4	1·3	93·0	6·0	99·0	3
8	0·6055	3	87·6	2·95	1·4	0·8	0·6	1·05	94·4	4·2	98·6	3
More air 9	0·9176	20	78·3	6·2	3·7	2·4	1·3	1·6	93·5	6·14	99·64	2
More air 10	0·8049	18	80·85	6·6 100 cc.	3·0 100 cc.	1·7 100 cc.	0·95 100 cc.	1·1	94·2	5·6	99·8	2

This table shows that there is no loss of nitrogen oxides, and also that the conversion into nitric acid is by no means complete, whatever be the excess of water and air used. Most of the acid condenses in the first ten-bulb tube, the lower its temperature the more acid (up to 80 per cent. of the total) is obtained. The recovery of the remaining 20 per cent. proceeds very slowly and there still remained in these experiments 4—11 per cent. of unconverted nitrogen oxides. The authors conclude that the oxidation of nitric oxide to nitric acid proceeds much more slowly than that of nitrous acid or nitrogen tetroxide, and requires larger surfaces. A rise of temperature in the first vessel to above 30° seemed slightly to impair the total amount of acid obtained, but not to such an extent as to warrant the erection of expensive cooling apparatus when working on the large scale. But the final wash-towers would have to be kept cool, possibly by running cold water down them.

Excess of air (experiment 9) or of water (experiment 10), does not seem to improve the process of recovery of nitric acid.—H. A.

Dissociation of Sodium Chloride in the Presence of a Heated Porous Partition. De Sanderval. Comptes rend. **116**, 641.

When a porous earthenware tube is heated in an external atmosphere containing vaporised sodium chloride, free chlorine is found in the interior of the tube, and the outer surface is glazed by the combination of the sodium with the silica, &c. After a time no more chlorine makes its way through, owing to stoppage of the pores. This latter phenomenon can be obviated by using a tube of other material such as carbon, and working in an atmosphere of carbonic anhydride.—W. P. D.

On the Basicity and Functions of Manganese Dioxide. G. Rousseau. Comptes rend. **116**, 1060—1062.

In its combinations with baryta and strontia, manganese dioxide appears to play the part of a dibasic acid, forming the compounds BaO, MnO_2 and SrO, MnO_2. On the other hand the existence of the oxide $Mn_3O_4 = 2MnO, MnO_2$ appears to indicate that under certain circumstances manganese dioxide possesses a larger saturation-capacity; it then behaves as a tetrabasic acid. The author's experiments have led him to an analogous conclusion. By heating to progressively increasing temperatures a mixture of chlorides of calcium and manganese with quicklime, he has obtained, successively, a trimanganite, CaO, $3MnO_2$, at about 600°, a dimanganite between 800° and 1000°; and lastly, the basic manganite 2CaO, MnO_2 at an orange-red heat. It will be observed that in this series the term CaO, MnO_2, corresponding to the compounds with baryta and strontia, is absent.

In subsequent experiments the author has systematically varied the alkalinity of the calcium chloride used as a flux, and has each time determined, not only the composition of the manganite formed, but also that of the oxychloride of calcium left at the bottom of the crucible after the experiment. He finds the manganese dioxide is able, under certain conditions, to saturate 2 molecules of a diatomic base such as lime; but it must not be concluded from this that it exhibits the character of a normal tetrabasic acid. In fact the 2 molecules do not enter into combination in the same manner; the dioxide of manganese may be compared with the alcohol acids; it is a dibasic acid with complex functions. But the author adds that the existence of the compound 2CaO, MnO_2, a derivative of the unknown hydrate $Mn(OH)_4$, confirms the tetravalency of manganese, which has already been indicated by the researches of Nicklès on the ethereal combinations of the tetrachloride of this metal and on the potassium fluomanganites.—D. E. J.

A Portable Holder for Sulphur Trioxide serving also for Distillation in the Laboratory. C. Hensgen. Chem. Zeit. 1893, 395.

See under XXIII., *page* 865.

Titration of Alkaline Liquids containing Chlorine. C. Ullmann. Chem. Zeit. **17**, 1208.

See under XXIII., *page* 867.

PATENTS.

Improvements in the Manufacture of Chlorine. H. W. Wallis, London. Eng. Pat. 13,047, July 15, 1892.

Gaseous hydrochloric acid is passed into contact with a layer of dry nitrate of a metal (preferably sodium), or through the nitrate in concentrated solution. The chlorine and nitrosyl chloride evolved are passed successively through absorbers containing sulphuric acid, weak hydrochloric acid, water, and powdered salt, as directed in Eng. Pat. 13,822, 1892 (this Journal, 1893, 354). When dry HCl is used, the ultimate products are sodium chloride (when sodium nitrate is used), chlorine, nitrosyl chloride, and water. But with strong aqueous hydrochloric acid, the temperature falls, the base is thrown down as chloride, and aqua regia may be separated. The aqua regia may then be treated to obtain chlorine and nitrosyl chloride as directed in the before-mentioned specification. To work on a continuous process, sulphuric acid and aqua regia are mixed, the evolved gases are passed on to sulphuric acid absorbers, and the liquors are passed into another heated vessel to complete the de-nitration and de-chlorination. The now dilute sulphuric acid is then concentrated, and is again mixed as before with aqua regia.—E. S.

Improvements in or relating to the Manufacture of Sulphuric Acid. J. Rice, Cattledown, Plymouth. Eng. Pat. 16,757, September 20, 1892.

The gases from the pyrites burners are led, on their way to the Glover tower, under a close chamber, on the floor of which the nitre pots are placed. There is a valved opening in the floor for admission to the chamber of sulphur dioxide; another in the side, the damper to which regulates passage of gases into the flue leading to the Glover tower; and a valve and passage on the top of the chamber for conducting the nitrous gases direct to the lead chambers in which the sulphuric acid is being made. Thus, the arrangement of the apparatus is such that some, all, or none of the nitrous gases may be led direct to the sulphuric acid chamber; or can be passed with the sulphur dioxide through the Glover tower. The advantages of this process and apparatus are indicated.—E. S.

Improvements in Means or Apparatus for Obtaining Brine from Rock Salt. T. W. Stuart, Newcastle-upon-Tyne. Eng. Pat. 18,016, October 10, 1892.

The object of the invention is to enable a bed of rock salt to be worked from the bottom up to any desired level, leaving the upper portion of the bed undissolved, and serving as a roof. A drive-pipe is passed into the bed of salt, and a bore-hole is then drilled from the surface of the bed to its bottom. The drill being withdrawn, a lining-tube, perforated for any desired distance from the bottom, is inserted, and inside this the suction tube of a pump correspondingly perforated. In the annular space between the two tubes is placed another tube, perforated at the bottom, in which is a float, supported by a cord passing over a pulley above the ground, and connected to an indicator. constructed to show the height of the brine in the well. A valved water supply pipe is also shown, by which water is admitted into the annular space between the well and tube, in such proportion that only the lower part of the bed of rock salt may be dissolved, the height to which the brine rises being ascertained by the float and its connected indicator. Where water or rock-head brine is found in making the well, the space between the inside of the bore-hole and the outside of the lining-pipe is filled up with cement. Subsidence of the surface is thus prevented or delayed.
—E. S.

Improvements in the Manufacture of Carbonic Acid Gas. H. Steinem, Clapton. Eng. Pat. 18,810, October 20, 1892.

Carbon dioxide obtained by combustion is purified by forcing it under a stated pressure into a vessel containing calcium chloride, where it is dried, and then into a suitable iron or other vessel containing pieces of charcoal of stated size, "saturated with green copperas and soda or other suitable alkali." The gas is then drawn by the compressor in the usual way and liquefied.—E. S.

Improvements in Vessels for Containing Sulphur Dioxide. A. Boake and F. G. A. Roberts, Stratford. Eng. Pat. 19,789, November 3, 1892.

The inventors have found that dry liquefied sulphur dioxide is practically without action upon tin or solder, and they construct light and portable vessels to contain the liquid gas, either of tinplate, joined with solder, or of sheet copper or brass similarly joined. Vessels of cylindrical shape are preferred, with a soldered longitudinal hooked seam, and with ends lapped, jointed, and soldered. Instead of a valve for emptying the vessel, a projecting lead or soft metal tube is soldered into one of the ends. The vessel is filled through this tube, which is then closed by squeezing and soldering. The pinched-in part of the tube may be cut off when it is desired to emit vapour or liquid from the vessel.
—E. S.

Improvements in Obtaining Chlorine. A. Vogt and A. R. Scott, Parkhead, N.B. Eng. Pat. 12,074, June 20, 1893.

The chlorine is obtained by the interaction of sulphuric and nitric acids upon hydrochloric acid. The weak sulphuric acid resulting from a previous working of the process is concentrated in a series of connected pans, from the last of which the strong acid is siphoned into a tank, and thence into a horizontal or slightly inclined covered channel apparatus, in which the flow is made tortuous by suitably placed partitions. A steam of nitric acid is delivered from a reservoir through a pipe and inlet trap, so as to flow on to the surface of the sulphuric acid with as little mixing as possible. Hydrochloric acid (preferably gaseous) is supplied at the inlet end of the apparatus, and partitions are arranged to allow the gases to flow alternately under and over each in succession. The chlorine and nitrogen compounds formed in the process are taken to the bottom of a tower down which sulphuric acid is passed to absorb the nitrogen compounds; then the gases are led to the bottom of a second tower down which water passes, to absorb hydrochloric acid, and the chlorine is freed from moisture by sulphuric acid in a third tower, whence it may be passed to lime chambers, or be used in any desired way. The channel apparatus is heated by flues to about 125° C. at the inlet end, and the temperature may diminish to 105° at the terminal part. The nitric acid may be added in a gaseous state if desired.

A supplementary channel apparatus is provided for receiving the partially weakened sulphuric acid from the main apparatus, the acid being still strong enough for dehydrating hydrochloric acid as it comes from the salt-decomposing furnace. The dried gas is passed through a measuring apparatus to be used as described, with a suitable proportion of nitric acid, and the now weakened sulphuric acid is taken to the concentrating pans first named.—E. S.

Improvements in Obtaining or Reforming Manganese Peroxide for Use in Obtaining Chlorine and otherwise. A. Campbell, Upton Park, Essex, and W. Boyd, Thornton, N.B. Eng. Pat. 12,426, June 24, 1893.

The manganous sulphate obtained as a bye-product in the manufacture of chlorine, or otherwise, is, according to one process, mixed in a state of solution of specified density with solution of an equivalent proportion of sodium carbonate, preferably that obtained from hydrogen-sodium carbonate by the process described in specification No. 21,071, 1890. The manganous carbonate obtained is freed from the sodium sulphate solution, and is converted into peroxide by the "Dunlop process," or by exposure to a current of heated air in a series of bogies having shelves and travelling through a tunnel or flue.

According to a second process, a concentrated solution of manganous sulphate is slowly run into a solution of caustic soda in a Weldon oxidiser, while air is blown through. The blowing is continued for some time after "neutrality has been reached." The sodium sulphate formed is separated. The oxidation is preferably effected in a rotational series of vessels.—E. S.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Methodical Moulding of Glass. Léon Appert. Comptes rend. **116**, 1073—1075.

By the ordinary process of moulding the necessary quantity of glass is cast into a metallic mould with the aid of an iron rod; a metal core having the internal form of the desired object, is then introduced as rapidly as possible; the glass is thus pressed into the space between the core and the mould and forms the object to be moulded.

This method has the disadvantage of enclosing the glass between two metal surfaces which, although heated to as high a temperature as possible, cool the glass and rapidly alter its plasticity, rendering it impossible to continue the operation.

The author has invented a process without this inconvenience, which he has called a *methodical process of moulding*.

In this process the moulding is effected by successive stages, so that the glass only touches as small a surface of metal at one time as possible. A metal mould is employed of sufficient strength to prevent deformation, and capable of being heated from the outside. This mould, open at its ends, is, when ready for use, closed at the lower end by a core of suitable shape and size. The glass is then poured into the mould, and the core is forced upwards. If the object is open at both ends the excess of glass is forced out of the mould and rests in a cool mass on the top of the core which is made to protrude from the mould; if the object is closed a knife of special form is used to remove the excess glass, leaving on the object only a small blister which is broken and ground smooth.

The writer claims the following advantages for his process:—

(1.) The process is purely a mechanical one, and does not require a skilled workman.

(2.) Glass of all kinds, even the commonest, can be used, and the objects may be for decorative purposes or of the most homely nature.

(3.) The objects may be of any size, either as to length or depth or as to cross section, which has been hitherto impossible.

(4.) The results obtained are superior to those obtained by blowing, from the points of view of form, strength, or cheapness.—D. E. J.

PATENTS.

Improvements in Glass Furnaces. P. Sievert. Döhlen, Germany. Eng. Pat. 16,252, September 10, 1892.

The device patented, consists of a passage connecting tanks containing molten glass, provided with bridges and partitions, past which the glass has to flow in passing from one tank to another, so that it is cooled during its journey to the required temperature. The method is said to avoid in a large measure the destructive action of the glass on the bridges and partitions, and to be generally applicable, *e.g.*, to the treatment of soluble glass.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

"Overburnt" Cement. L. Erdmenger. Thonind. Zeit. 1893, **17**, 238. Chem. Rep. 1893, **17**, 115.

Cement which has "fallen" and is dusty and inert contains, according to Le Chatelier, dicalcium silicate $2CaOSiO_2$ The author quotes experiments tending to show that the behaviour of such cement can be modified by quenching the clinker with water. The sample contained 61 per cent. of CaO. One portion (*a*) was allowed to disintegrate spontaneously; another (*b*) was quenched by a stream of water, which caused the clinker to remain sound; a third (*c*) was thrown while hot into cold water, and the granulated powder dried before grinding; a fourth (*d*) was a portion of the same batch of clinker which showed no tendency to disintegrate. The following are the results of the tests of these samples (1 cement, 3 sand):—

—	(*a*.)	(*b*.)	(*c*.)	(*d*.)
	Kilos. per Sq. Cm.			
Two days	4·5	8·3	8·0	9·0
Three days......	5·0	9·4	10·0	11·3
One week	8·0	15·0	17·3	17·1
Four weeks.....	13·7	22·7	24·1	25·2
Three months...	16·8	28·0	30·6	31·1

—B. B.

PATENTS.

Improvements in the Manufacture of Non-Efflorescent White Cements from Calcined Sulphate of Lime. J. Tomlinson, Carlisle. Eng. Pat. 19,009, October 22, 1892.

The patentee states that cements made by the addition of such substances as borax to sulphate of lime, are liable to suffer efflorescence, and claims the mode of preparation of a cement free from this tendency by the addition of 100 to 200 lb. of farinaceous material, *e.g.*, " ground wheat " to a ton of calcined sulphate of lime. The ingredients are ground separately, and mixed in the desired proportions.
—B. B.

A New or Improved Heat Non-conducting Composition. H. Birbeck, London. From H. C. Michell, Toronto, Canada. Eng. Pat. 10,762, June 1, 1893.

A mortar is made by mixing with boiling water, two parts each of mica and soap-stone, one part of molasses, and one-hundreth part of bicarbonate of soda. The composition is poured into a jacket surrounding the article to be coated and then allowed to set, a covering of wire cloth may be placed within the jacket for the purpose of holding the composition together. A waterproof coating of either mica, soapstone, and coal tar, or else ordinary paint, is used as a finishing coat.—E. G. C.

Process for making Paving Stones, Patterned Slabs, and the like. A. Typlt, Munich, Germany. Eng. Pat. 13,079, July 4, 1893.

8—9 parts by weight of waste granite, syenite, or basalt are mixed with 100 parts by weight of magnesia, and worked up with a solution of magnesium chloride (of 25°—30° B.) to a thick pulpy mass, which is cast with rigid moulds and allowed to harden, a process taking about 78 hours. The rigidity of the mould ensures the self-compression of the mass, as it expands in setting. Colouring matters, soluble in and unaffected by magnesium chloride solution, may be added.—B. B.

Mixture and Process for Producing Artificial Marble and other Stone Imitations. A. Typlt, Munich, Germany. Eng. Pat. 13,080, July 4, 1893.

100 parts by weight of magnesia are mixed to a thin pulp with magnesium chloride solution of 20°—25° B. 20 parts by weight of zinc oxide and 50 parts by weight of Carrara marble dust are incorporated, the mass coloured if desired, and cast on to a smooth plate. After hardening, a second coat of 50 parts by weight of magnesia, 10 of magnesium chloride solution, and 25 of sand or stone is added, and when this is set the composite plate is removed and washed free from soluble salts.—B. B.

X.—METALLURGY.

The Exhibit and Processes of the Canadian Copper Company, Chicago Exhibition. D. H. Browne. Eng. and Mining J., 1893, 289—90.

It will be noticed that the nickel occurs as pyrrhotite and the copper as chalcopyrite, both forming a breccia or conglomerate in a matrix of black diorite. The peculiar value of the diorite as flux in the smelting will be noted. It is doubtful whether any exact mineralogical combination of nickel can be found in the Sudbury ores, a long experience having shown that no two samples of picked ore carry the same percentage of nickel. The general concensus of opinion is that the nickel ore is simply a pyrrhotite in which nickel replaces iron in irregular amounts.

From the mines the ore is hoisted to rockhouses where it is roughly sorted, the rock being wheeled to a " dump " and the distinctively nickel ore or copper ore being piled at either side. A Blake crusher breaks the ore and allows it to fall through revolving screens, the coarse ore passing a 4-in., the medium or raggings a $1\frac{3}{4}$-in. and the fine ore a $\frac{3}{4}$-in. opening. The raggings and fine ore pass direct to their respective bins, while the coarse ore falls from the screens on washing tables. It is here passed under a spray of water, and while being carried onward by the jerking motion of the tables, is rapidly sorted by boys, who pick out any pieces in which nickel or copper seems to predominate, throwing these into respective bins, while the average mixed ore falls from the end of the tables into a larger hopper.

Samples of the ore from the three mines graded to coarse, raggings, and fines are shown in the show-case to the right as you enter the Ontario booth, while to the left samples of picked copper and picked nickel ore may be seen. Analysis of an average month's output from the three mines, and comparison with the picked nickel and picked copper ores will be found interesting.

—	Copper Cliff.	Evans.	Stobie.
Silica	13·44	24·55	12·50
Iron	39·02	35·18	47·25
Sulphur	25·25	18·27	25·26
Copper	4·31	1·43	1·92
Nickel	5·57	3·74	2·36
Alumina	4·49	8·02	3·30
Lime	2·28	2·06	1·48
Magnesia	0·95	1·67	0·80
Phosphorus	0·015	0·01	0·018
Manganese	0·09	0·08	0·09
Moisture	0·15	0·07	0·09
Total	96·575	95·08	95·068

As the iron is in part combined as silicate, part as pyrrhotite, and part as chalcopyrite, the balance of the analysis represents oxygen.

A month's output from the Evan's mine shows the results obtained by sorting the ore.

—	—	Copper.	Nickel.
Evan's mine, regular run mixed ore	Coarse	1·62	3·45
	Raggings	2·99	3·90
	Fines	3·78	5·04
Evan's mine, picked nickel ore	Coarse	0·58	5·13
	Raggings	1·14	4·87
	Fines	1·36	6·64
Evan's mine, picked copper ore	Coarse	11·74	1·80
	Raggings	11·15	2·46
	Fines	13·45	3·35

The ore is now taken to the roast yard, in which space is provided for roasting about a quarter of a million tons of ore per year. The company has usually about 50,000 or 60,000 tons of roasted ore on hand ahead of the smelters. On the roast yard as shown by a photograph in the exhibit, the coarse ore is piled to a height of 5 or 6 ft. on an 18-in. bed of cordwood; it is then covered with a layer of raggings, and finally topped and banked at the sides with 6 or 8 in. of fines. The piles hold from 600 to 1,800 tons of ore. Each roast heap burns from 6 to 10 weeks, during which operation the sulphur is lowered to about 7 per cent., the iron is in large part oxidized, and the diorite is thoroughly disintegrated by the swelling and oxidation of the ore. Samples of roasted ore are shown in the left-hand cases.

After the ore is thoroughly roasted it is taken to the smelters. These have been so often described that it will suffice to say that the furnaces are of the Herreschoff pattern, of boiler iron, water jacketed, about 9 ft. in height to charging door, of oval section 6 ft. 6 in. by 3 ft. 3 in., with 2 in. water space, and provided with an exterior, brick-lined, water-cooled forehearth or well. The capacity of each furnace is about 125 tons of ore or 15 tons of matte in 24 hours, two furnaces being always in operation. The matte is tapped into cast-iron conical matte pots, in which it is allowed to cool. The slag runs continuously over a slag lip at the top of the well, and during the winter is wheeled away in pots similar to those used for matte. In summer the slag is allowed to flow continuously from the well through an opening in the floor, where a powerful jet of water granulates it and carries it to the dump—a system devised by Mr. James McArthur, the general manager of the company.

The process of smelting is very economical, the ore furnishing in itself the exact ingredients necessary for fluxing; so that by skilful mixture of the ores the company has never been obliged to put a pound of extraneous flux into their furnaces. About 15 per cent. of Connellsville coke is used to reduce the ore to matte, or, in other words, one pound of coke makes one pound of cupola matte. The average grade of matte will yield the following results:—Copper, 20 to 25 per cent.; nickel, 18 to 23 per cent.; iron, 25 to 35 per cent.; sulphur, 20 to 30 per cent. From picked ore cupola matte is sometimes made as high as 52 per cent. of nickel; the grade is varied to suit the consumer, some desiring high copper and low nickel, and some low copper and high nickel. Any desired proportion of copper and nickel can be made from selected ores.

It is interesting to note that as the mines deepen the ore changes in character, from a distinctively copper ore at the surface to a distinctively nickel ore on the lower levels. Copper Cliff mine, for example, produced on the first level a chalcopyrite, in which the nickel was found by accident after large shipments had been made of the ore as a copper ore alone. On the fourth and fifth levels the ore contained about 4 per cent. of copper and 4·5 per cent. of nickel, while on the seventh level many slopes show an average of 0·5 per cent. of copper to 8 and 10 per cent. of nickel. As these levels are opened the cupola matte will be raised thereby to 25 or 30 per cent. of nickel.

The next step in the treatment is the refining of cupola matte. At the Canadian Copper Company's refinery at Sudbury, the matte, after remelting in cupolas, is run into Bessemer converters, similar to those used in the refining of copper. There are three converters in the refinery, one being always in use, while a second is being relined and a third is in readiness for a charge. The capacity of the Bessemer plant is about 25 tons of cupola matte supplied or 15 tons of Bessemer matte produced in 24 hours. In the converters the iron is almost entirely removed, the sulphur lowered to from 5 to 15 per cent., and the copper and nickel raised to about 45 and 40 per cent. respectively. As there are none of the usual flame reactions to guide the operation, the point at which to stop the blowing, after the iron has been removed and before the nickel has commenced to slag in undue amounts is one in which the skill of the furnace manager is best shown. As the converter slags rarely show over 2 per cent. of copper and 3·5 per cent. of nickel, and as the ratio of copper to nickel in thesupply is about 23 to 20 and in the product about 43 to 39, sufficient proof is given of the skill and judgment needed and practised in the Bessemer concentration of such an easily oxidizable metal as nickel. All converter slags are returned to the cupolas for remelting.

For convenience in handling, the converter matte is cast in slabs of 3 ft. square and about 3 in. thick, weighing about 1,500 lb. each. These slabs are lifted on the bougies by hydraulic cranes, which serve for handling the converters. A sample of Bessemer matte is shown in the left-hand show case. A fair average analysis of this is:—Copper, 43·36; nickel, 39·96; iron, 0·3; sulphur, 13·76; silver, 7 oz. per ton; gold, 0·1 to 0·2 oz. per ton; platinum 0·5 oz. per ton.

After Bessemerizing the matte, the process branches into two distinct parts. For the manufacture of copper-nickel alloys for use in German silver, the Bessemer matte, after roasting to remove all the sulphur, can be reduced direct to alloy, either by charcoal or by reducing gases. A refined copper-nickel alloy containing 50 per cent. of copper and 49 per cent. of nickel, with very small amounts of iron, silicon, and carbon, is produced direct from Bessemer matte. The economy to German silver manufacturers of purchasing a ready-made alloy, which melts at a low heat and requires simple addition of zinc, instead of buying the nickel and copper separately, is patent to any one. Samples of copper-nickel shot, bars, and ingots are shown. It will be noticed that this alloy, "50-50," as it is called, is almost undistinguishable from pure nickel. As its cost is much less than nickel, and its melting point much lower, and as it can be cast solid in any form desired, and furnishes a casting which works easily in the lathe or planer, yielding a silvery-white surface unchanged by air or moisture, this alloy is destined to have a large use in all hardware specialities where brass or nickel-plated iron is at present used. For the new bullet-casings now used in various British and continental rifles, a special alloy of 80 per cent. copper and 20 per cent. nickel is made.

The separation of nickel from copper is a process which has always been kept more or less of a trade secret, and for this reason the steps in the production of nickel oxide from Bessemerized matte are not shown.* Heretofore the usual process employed for the production of nickel from its oxide has been the direct reduction of this oxide, either loose or pressed into cubes, with charcoal in crucibles. This yields a product, which in the case of cube nickel is not strictly a homogeneous metal, but a loose sponge of metallic particles which retain all the impurities contained in the oxide, plus from ½ to 2 per cent. of carbon. The metal produced by the Canadian Copper Company in their refinery, near Cleveland, O., is, however, a solid metal, having been melted direct from the oxide and the carbon and silicon entirely removed. By direct melting alone can a metal free from carbon be produced. The casting of 4,500 lb. of nickel, which forms the capstone of the exhibit, was made at the Cleveland works. Its purity is shown by the presence of blow holes at the surface. Its composition is as follows:—Ni, 98·78; Fe, 0·301; S, 0·068; Cu, 0·76; Si, 0·19; Carbon, 00; Tin, 00. It is usual in nickel casting to add a small quantity of magnesium or aluminium to make a solid surface, but in this case it was not desirable to spoil an ingot already pure by the introduction of any foreign element whatever, so the casting has been left as it came from the mould.

The adaptability of pure nickel to solid castings is shown by the group of nickel anodes exhibited and by the letters forming the words "the Canadian Copper Company" in the front and rear cases. These letters are cast from pure nickel, the surfaces afterwards planed and polished. The anodes are particularly noticeable for their solidity and purity.

There are exhibited a sample of Vermillion platinum sand, and a tube containing about 100 grms. of sperrylite or arsenide of platinum—this is believed to be the largest amount of this unique mineral ever exhibited. It occurs in the surface sand at the Vermillion mine, on property owned by the Canadian Copper Company. The ore from the Vermillion mine will average 17·40 copper and 16·80 nickel and contains 9 oz. of platinum per ton. The yellow surface sand, which is a product of the decomposition of the underlying ore, contains 15·75 oz. platinum per ton.

All the matters produced by the Canadian Copper Company contain small amounts of silver, gold, and platinum. In electric refining of the Bessemer mattes comparatively large amounts of precious metals are found in the slimes or residues in the electric baths.

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* They have, however, been described in "The Mineral Industry" by Mr. Robert M. Thompson, president of the Orford Copper Company, where this work is carried on.

In connection with this subject of nickel a study should be made of the nickel steel armour plate and test bars shown by the Bethlehem Iron Company in the Transportation Building. This material was made from nickel supplied by the Canadian Copper Company. The remarkable tensile strength and ductility of nickel steel, as shown by the test bars and the wonderful behaviour of the nickel steel armour plate under shot tests, are witness of the valuable qualities conferred upon steel by the addition of a few per cent. of nickel. In Krupp's exhibit comparison of nickel steel armour plate with ordinary steel is afforded by two plates which have been subjected to nearly the same test. The ordinary compound armour is shattered in many directions, while the nickel steel seems to flow under the impact of shot, almost as copper does under a punch, without the slightest crack or fracture.

The following tests made on nickel steels, together with the report of the Bethlehem Iron Company by Mr. Maunsel White, in charge of the Bethlehem Iron Company's Chicago exhibit, will corroborate the above claims of nickel steel :—

Specimen from	Dimensions of Specimen.		Test per Sq. In.				—	Remarks.
	Size.	Length.	Tensile Strength.	Elastic limit.	Expansion.	Contraction.		
					Per Cent.	Per Cent.		
3¼ per cent. nickel steel:— Forged bars............	625	4	276,800	..	2·75	..	Special treatment	Forged from 6 in. ingot to ⅝ in. diameter with conical heads for holding.
	„	„	246,595	..	4·25	6·0	„ „	
	„	„	105,300	..	19·25	55·0	Annealed	Showing the effect of varying carbon.
1¼ in. round rolled bar .	564	4	142,800	74,000	13·0	28·2	.. ..	
	„	„	143,200	74,000	12·32	27·6	.. ..	
	„	„	117,600	64,000	17·0	46·0	.. ..	
	„	„	119,200	65,060	16·66	42·1	.. ..	
	„	„	91,600	51,000	22·25	53·2	.. ..	
	„	„	91,200	51,000	21·62	53·4	.. ..	
	„	„	85,200	53,000	21·82	49·5	.. ..	
	„	„	86,000	48,000	21·25	47·4	.. ..	
27 per cent. nickel steel:— 1¼ in. square bar rolled.	798	8	115,464	51,820	36·25	66·23	.. ..	
	„	„	112,600	60,000	37·87	62·82	.. ..	
	„	„	102,010	39,180	41·37	69·59	Annealed	Rolled down from 14 in. ingot to 1¼ in. square billet and turned to size.
	„	„	102,510	40,200	44·00	68·34	„	
1 in. round bar rolled ..	500	2	114,590	56,020	47·25	68·4	.. ..	
	„	„	115,610	59,080	45·25	62·3	.. ..	
	„	„	105,240	45,170	49·65	72·8	Annealed	Rolled down from 14 in. ingot to 1 in. round and turned to size.
	„	„	106,780	45,170	55·50	63·6	„	

Among the steel alloys that of nickel has shown itself to be possessed of some exceedingly valuable properties, these are, resistance to cracking, high elastic limit, and homogeneity. Resistance to cracking, a property to which the name of nonfissibility has been given, is shown more remarkably as the percentage of nickel increases. Bars of 27 per cent. nickel shown in the exhibit of the Bethlehem Iron Company, of South Bethlehem, Pa., at the Columbian Exposition, illustrate this property. The 1¼ in. square bar has been nicked ¼ in. deep and bent double on itself without further fracture than the splintering off, as it were, of the nickel portion. Sudden failure or rupture of this steel would be impossible ; it seems to possess the toughness of rawhide with the strength of steel. With this percentage of nickel the steel is practically non-corrodible and non-magnetic. The resistance to cracking shown by the lower percentages of nickel has been best illustrated in the many trials of nickel-steel armour.

The elastic limit rises in a very marked degree with the addition of about 3 per cent. of nickel, the other physical properties of the steel remaining unchanged or perhaps slightly increased.

In such places (shafts, axles, &c.) where failure is the result of the fatigue of the metal this higher elastic limit of nickel steel will tend to prolong indefinitely the life of the piece and at the same time, through its superior toughness, offer greater resistance to the sudden strains of shock. In lines of shafting this increased stiffness will materially assist in maintaining true alignment. The greater homogeneity of nickel steel is due to the tendency of nickel to check segration.

The Rœssler-Edelmann Process of Desilverising Lead with Aluminium and Zinc. Eng. and Mining J. 1893, 245.

In the process for desilverising lead by spelter there is obtained desilverised lead with about 0·6 per cent. of zinc on the one part and a mixture of lead with zinc and silver intermixed with oxides of zinc and lead, the so-called zinc-scum, on the other. By smelting this scum, only a part of the lead is removed, whilst a great deal of it remains in the zinc-scum with the oxides of zinc and lead, whence it cannot be removed by liquation even at red-heat. The oxides prevent the metallic particles from collecting and from liquating out of the mass ; a complete separation of lead from the zinc-silver alloy is therefore not obtainable. For working up this oxidised product containing zinc-silver with some lead, the "rich-scum" distillation has been used at most refining works. The result is a concentrated silver-lead for cupellation. The litharge must be reduced and the refined lead returned anew to the desilverising process.

The old process, therefore, comprises the following operations:—1. Softening of the base bullion ; 2. Desilverising the lead by a repeated addition of spelter and cooling the lead in the kettle from two to six times. The number of these operations depends on the contents of silver and of some impurities remaining in the lead; 3. Liquation of the zinc-scum; 4. Distillation of the concentrated zinc-scum; 5. Cupellation of silver-lead; 6. Reviving the litharge and other products of cupellation. 7. Desilverising the lead obtained by the reviving process.

The new Rœssler-Edelmann process being based upon the use of an alloy of zinc and aluminium for the desilverisation of lead offers, it is claimed, considerable advantages over the old process with ordinary zinc. The quantity of aluminium required does not exceed 0·5 per cent. of the spelter applied. This alloy is very little disposed to oxidation and retains its bright metallic surface even at red heat. The lead treated with such an alloy of aluminium-zinc remains likewise nearly completely bright on the surface. Lead rich in silver requires, of course, more spelter than lead poor therein; the quantity of spelter which dissolves in the lead rises with the temperature of the latter. Hitherto the temperature of the lead had to be kept as low as possible in order to restrict losses by oxidation. As the addition of the aluminium alloy nearly prevents oxidation the temperature may be raised as far as required without harm. It is, therefore, possible to saturate the silver-lead at one operation with the quantity required for extraction of the total contents in silver, separating the alloy of silver and zinc with some lead upon subsequent cooling of the kettle.

While hitherto for the desilverisation of lead with 0·5 or 1 per cent. of silver four to six additions of spelter were required, such lead can be desilverised at one operation down to 0·0004 per cent. of silver. This means a saving of labour of about 50 per cent. on one hand and an increase of capacity of the plant of 50 per cent. on the other. No modification of the ordinary plant is required for the process. The main advantage, however, is neither the saving of labour nor the increase of capacity of the plant, but the fact that the greatest part of the silver is collected in an alloy instead of in a mixture of oxides, from which it can be extracted only with considerable losses. The alloy of zinc-silver with lead, obtained by desilverising silver-lead with aluminium-zinc alloy is free of oxides, and therefore it can easily be delivered from a surplus of lead by liquation, by which operation an alloy is obtained containing about 20 to 40 per cent. of silver, 3 to 4 per cent. of lead, 1·5 to 2 per cent. of copper, and 76·5 to 54 per cent. of zinc, with small quantities of Al, Fe, As, Sb, and separating as a homogeneous and liquid mass from the lead, which latter is to be returned to the process.

This alloy is ladled at once into moulds, and then cast into anode plates for electrolysis. The electrolytic zinc is very pure; it consists of an average of 0·0099 per cent. Fe; 0·0114 per cent. Cu; 0·0341 per cent. Pb; traces of Ag, As, and Sb; 99·9446 per cent. Zn. This exceedingly pure metal commands, of course, a price much superior to that of ordinary spelter. The costs of the electrolysis are nearly covered by the higher value of the electrolytic zinc. The remainder of the anodes forms a slime rich in silver; it consists on an average of 80 to 74 per cent. of Ag; 10 to 12 per cent. of Pb; 1·5 to 5 per cent. of Cu; 0·2 to 0·5 per cent. of Zn, along with a certain proportion of As, Sb, and Fe as impurities. It is melted to fine silver.

From the description it is evident that cupellation is not needed. In place of it a short fining process on the test of the silver-slimes is substituted. As hardly any litharge and hearth is to be treated in the smelting furnaces, the losses of metal unavoidable there, are prevented. The quantity of lead to be desilverised is reduced, and a large yield of lead obtained at the first operation.

Segregation in Ingots of Iron and Steel. Paper read before the International Engineering Congress in Chicago. Eng. and Mining J. 1893, 244. A. Pourcel.

The phenomena of liquation in steel or iron ingots of all sizes, but naturally to greatest extent in the heaviest ingots, have been noticed ever since the commencement on a large scale of the Bessemer and open-hearth manufactures; but they have been studied with care during the last few years only. The English and the Americans were the first to publish the results of investigation upon phenomena of this class, to which they have given the name of "segregation."

According to Tchernoff (with whom this question was discussed at length in 1878, in connection with the cast steel plates of large dimensions designed for the Italian fleet, which were shown to him at Terre-Noire), Kalakoutsky called attention in 1866 to the lack of homogeneity in Bessemer ingots, especially when cast in sand. But the author's attention has been called to the phenomena of liquation in 1868 by a somewhat surprising fact which appeared in almost every one of a number of steel-rail ingots coming from the works of Messrs. Pierre and Emile Martin at Sireuil, to be rolled at Terre-Noire. In the heating or in the first groove of the rolls, a slice of from 6 to 10 cm. (2·4 to 3·9 ins.) separated itself from the head of each ingot. As a general consequence, the section of rail coming from the upper part of the ingot was weak, while the section from the bottom of the ingot endured admirably the tests required by the railway. These observations led the author's firm to adopt at Terre-Noire in 1870 a special treatment for Bessemer ingots intended to be forged into cannon. The metal was poured into a cast-iron ingot mould of hexagonal section and truncated pyramidal form and very thick walls, surmounted by a mould of heated sand. Thus, besides the weight of the metal required for the cannon-ingot, there was poured an additional weight half as great in an envelope previously brought to red heat in order to preserve its fluidity as long as possible after the solidification of the mass contained in the ingot-mould. This arrangement was always used at Terre-Noire in casting ingots of all weights for shaft forgings. It is evident that this does not absolutely avoid the partial liquations which takes place in the centre of the ingot, principally in the zones nearest to the part cast in sand, and serving as sinking heads; but this is an inconvenience without consequence for cannon, and of little importance for forge-shafts; since in the first case the non-homogenous material disappears in the boring of the piece; and, in the second case, finds itself in the region of the neutral fibers of the solid. The accident which occurred to the boilers of the "Livadia" gave rise to very lively discussion in England upon the causes of the lack of homogeneity in steel boiler plates. The specifications at that time adopted for boiler-plates could seldom be met by one plate in ten, so that, as a general rule, it was arranged to take the tensile test-pieces from the upper part of the plate and the tests for quenching from the lower part. It has been attempted to attribute to blow-holes, as principal cause, the defects observed in forged or rolled pieces, such as rails or plates of hard or soft steel, but principally soft steel.

M. Pourcel gives a number of instances showing great deviations in the composition of steel plates and ingots. The tables appended show some physical tests and chemical analyses of plates, and illustrating the differences in various portions of a plate. There seems to be no absolute rule by which the order of liquation or the results to be obtained can be determined. Various methods have been tried, but with very different results in different cases.

In his opinion, the injurious consequences of segregation must be suppressed by reducing, as far as possible, the elements subject to liquation. Upon the basic or neutral open-hearth, and starting with an initial bath of approximately pure materials, it is easy to obtain a metal containing not more than 0·1 per cent. of carbon; 0·02 phosphorus and traces of sulphur, with 0·10 of manganese. By adding 0·1 per cent. of aluminium, the metal can be cast quietly, and without altering its composition. Consequently, if from an ingot so cast and destined for boiler-plate, one-fourth to one-third of the upper part (in which the carbon and phosphorus may reach respectively 0·12 and 0·03, for example) be cut off, the remainder will be a block of approximately perfect homogeneity. Operating in this way, he has obtained, in a large establishment in the north-east of England, ingots from 2 to 3 tons, 18 ins. square, which, being first treated by the hydraulic press, and subsequently rolled into billets, were utilised almost without

APPENDIX I.

PHYSICAL TESTS.

Ordinary Soft Martin Steel Plate, 14 mm. (0·56 in.) thick.

No. of Test.	Elongation Per Cent. in 200 mm. (8 in.).		Resistance in Kilos. per sq. mm.†		Remarks on Fracture, &c.	
	Lengthwise.	Crosswise.	Lengthwise.	Crosswise.		
1	..	16·0	..	45·3	Granular; large flaw in centre.	Upper part.
2	..	17·0	..	44·9	" "	
3	..	17·0	..	45·0	Finely granular; flaw at one corner.	
4	..	18·0	..	45·6	Finely granular; serious flaw on one edge.	
5	18·5	..	46·5	..	" "	
*6	13·0	..	47·2	..	Finely granular; serious flaw on one corner.	
7	..	20·0	..	46·2	Normal; central part appears very hard.	
8	..	23·0	..	44·2	Beautiful necking; some blow-holes.	
*9	..	21·0	..	47·2	Piped; some hard spots in centre.	
10	..	22·5	..	44·7	Normal; fine white line.	
11	19·5	..	44·0	..	Piped; large white lines.	
12	14·5	..	43·3	..	Coarsely granular; serious flaw on one edge.	
*13	..	21·0	..	45·2	Normal.	Middle part.
14	..	23·5	..	44·0	"	
15	..	21·5	..	42·3	"	
16	..	23·0	..	44·5	Piped: much necking.	
17	17·5	..	43·6	..	Piped; some white lines.	
18	18·5	..	44·0	..	Piped; granular spot; several large white lines.	
19*	17·5	..	44·6	..	Normal; some white lines.	
20	20·0	..	44·9	..	Much necking; some blow-holes.	Lower part.
21	..	22·0	..	42·5	Normal; some blow-holes.	
22	..	23·5	..	40·7	Much necking; some blow-holes; slight flaw at centre.	
*23	..	22·5	..	41·5	Piped; some blow-holes.	
24	..	24·0	..	40·8	Much necking; some blow-holes.	
25	23·0	..	41·2	..	Much necking; fracture without flaw.	
26	21·0	..	41·6	..	Normal: large white line at centre.	
Average	18·8	20.9	44·1	44·0		

Boiler Plate, Martin Steel, 17 mm. (0·68 in.) thick.

No. of Test.	Elongation Per Cent. in 200 mm. (8 in.).		Resistance in Kilos. per sq. mm.†		Remarks on Fracture, &c.	
	Lengthwise.	Crosswise.	Lengthwise.	Crosswise.		
1	..	19·5	..	42·7	Irregular; many large white lines.	Upper part.
2	..	19·5	..	43·5	" "	
3	..	21·5	..	43·0	" "	
4	..	22·0	..	43·5	" "	
5	22·0	..	44·8	..	" "	
6	10·0	..	47·3	..	Irregular; half-grain half-fiber; centre hard.	
7	..	16·0	..	44·5	Irregular; two strong white lines.	
8	..	23·0	..	42·5	Fine white lines.	
9	..	17·5	..	45·5	Piped.	
10	..	24·5	..	42·6	"	
11	18·5	..	43·2	..	Many white lines at centre.	
12	11·5	..	40·7	..	Large flaw in centre; no necking.	
13	..	18·0	..	43·9	Normal.	Middle part.
14	..	23·5	..	44·6	Fine white lines.	
15	..	23·0	..	41·7	Piped; some white points.	
16	..	23·5	..	42·3	White line on one edge.	
17	25·0	..	40·0	..	Normal; fine impure lines.	
18	19·5	..	41·4	..	Many impure lines.	
19	13·0	..	46·9	..	Hachure of white lines.	
20	15·0	..	43·7	..	Normal; some impure lines.	Lower part.
21	..	27·0	..	40·1	" "	
22	..	25·0	..	39·4	Piped.	
23	..	18·0	..	40·4	Normal.	
24	..	31·0	..	38·7	Piped.	
25	23·5	..	38·6	..	"	
26	20·0	..	39·2	..	Piped: some white lines.	
Average	17·7	22·0	42·8	42·3		

* Planed.

† 1 kilo. per sq. mm. = 1,422·3 lbs. per square in.

waste in the manufacture of wire for telegraphic cables. Chrome-steel has already been tested; and when to a pure metal, like boiler-metal, 0·2 to 0·4 per cent. of chromium has been added, homogeneous blocks have been obtained, and the limit of elasticity has been raised notably—up to two-thirds of the breaking strain—without sensibly altering the elongation. In the direction of alloys there may be found various advantageous solutions of the problems involved in the manufacture of metals destined for civil constructions.

As a final conclusion of this summary survey, attention is called to the fact that tensile tests and mechanical tests in general may determine *a priori* the intrinsic qualities of a mass of fluid metal, but not those of a solid metallic block, whether before or after work has been done upon it.

Appendix II.

Chemical Analyses.

Ordinary soft Martin steel-plate, 14 mm. (0·56 in.) thick.

No	Part.	C.	Si.	S.	P.	Mn.
1	Mean ..	0·260	0·056	0·042	0·085	0·160
2	Interior	0·290	0·019	0·083	0·109	0·150
	Exterior	0·250	0·100	·0·025	0·057	0·150
5	Interior	0·270	0·149	0·038	0·078	0·150
	Exterior	0·240	0·028	0·020	0·060	0·150
6	Mean ..	0·270	0·019	0·038	3·093	0·170
8	Interior	0·270	0·028	0·040	0·078	0·150
	Exterior	0·260	0·037	0·022	0·065	0·150
12	Interior	0·270	Slag 0·043	0·046	0·077	0·150
	Exterior	0·220	0·065	0·022	0·062	9·150
14	Interior	0·260	Slag 0·028	0·026	0·078	0·160
	Exterior	0·230	0·093	0·028	0·060	0·150
15	Mean ..	0·240	0·084	0·035	0·057	0·160
16	Interior	0·250	0·075	0·030	6·076	0·160
	Exterior	0·250	0·028	0·027	0·068	0·160
17	Interior	0·260	Slag 0·046	0·054	0·073	0·180
	Exterior	0·230	Slag 0·084	0·642	0·060	0·150
19	Mean ..	0·260	0·170	0·048	0·685	0·150
20	Interior	0·200	0·028	0·030	0·067	0·160
	Exterior	0·240	Slag 0·035	0·018	0·058	0·160
22	Mean ..	0·220	0·046	0·032	0·075	0·160
23	Mean ..	0·250	0·075	0·038	0·070	0 150
24	Interior	0·220	0·093	0·018	0·063	0·150
	Exterior	0·200	0·046	0·019	0·057	0·150
25	Interior	0·230	0·037	0·028	0·074	0·150
	Exterior	0·230	Slag 0·065	0·022	0·068	0·160
26	Interior	0·250	0·074	0·020	0·060	0·150
	Exterior	0·210	0·130	0·015	0·049	0·150
	Mean ..	0·243	0·064	0·031	0·070	0.155

Remarks.

In the Table on the left (ordinary steel) Nos. 1 to 8 inclusive are from upper part; 12 to 19 inclusive from middle, and 20 to 26 inclusive from lower end of plate.

In the Table on the right (boiler plate) Nos. 1 to 12 inclusive are from upper part; 14 to 19 inclusive from middle, and 20 to 25 inclusive from lower end of plate.

Boiler-plate Martin steel, 17 mm. (0·68 in.) thick.

No.	Part.	C.	Si.	S.	P.	Mn.
1	Mean ..	0·250	0·032	0·043	0·080	0·100
2	Interior	0·320	0·096	0·070	0·077	0·100
	Exterior	0·180	0·056	0·030	0·049	0·100
5	Interior	0 028	0·023	0·048	0·065	0·100
	Exterior	0·210	0·028	0·022	0·057	0·100
6	Mean ..	0·280	0·028	0·058	0·073	0·100
8	Interior	0·250	0·035	0·030	0·067	0·100
	Exterior	0·220	0·032	0·020	0·063	0·100
12	Interior	0·280	0·032	0·040	0·078	0·110
	Exterior	0·210	0·046	0·026	0·065	0·090
14	Interior	0·240	0·016	0·042	0·091	0·100
	Exterior	0·210	0·046	0·028	0·060	0·090
15	Mean ..	0·240	0·028	0·028	0·065	0·100
16	Interior	0·250	0·028	0·038	0·078	0·100
	Exterior	0·200	0·046	0·020	0·049	0·090
17	Interior	0·220	Trice.	0·024	0·070	0·110
	Exterior	0·200	0·019	0·022	0·047	0·100
18	Interior	0·240	0·019	0·028	0·117	0·110
	Exterior	0·220	0·016	0·026	0·057	0·100
19	Mean ..	0·250	0·028	0·040	0·068	0·090
20	Interior	0·240	0·056	0·031	0·077	0·110
	Exterior	0·200	0·076	0·028	0·068	0·100
22	Mean ..	0·230	0·042	0·028	0·062	0·090
23	Mean ..	0·220	0·028	0·030	0·057	0·100
24	Interior	0·200	2·042	0·018	0·044	0·100
	Exterior	0·210	0·023	0·020	0·054	0·090
25	Interior	0·210	0·070	0·028	0·065	0·110
	Exterior	0·180	0·016	0·032	0·052	0·100
	Mean ..	0·229	0·0403	0·0305	0·0652	0·099

Note on Aluminium-Antimony Alloys, and on an Aluminium Antimonide. D. A. Roche, Monit. Scient. 1893, 269—270.

In direct opposition to the apparently generally accepted belief, the author finds that aluminium alloys readily with antimony in all proportions. The simplest method of preparing the alloys is simply to fuse the two metals together; combination takes place at a comparatively low temperature. Alloys containing but little antimony (below 5 per cent.) are greatly superior to aluminium in point of hardness, tenacity, and elasticity, and are at the same time very malleable. In colour they are not quite so white as aluminium, but give a much clearer and more silvery note when struck, and oppose a greater resistance to atmospheric corrosion. If the percentage of antimony be raised, the hardness also increases, but tenacity and elasticity diminish; and when the antimony present exceeds 10 per cent., the alloy crystallises in brilliant laminæ. The melting point and the ease with which moist air acts on the alloy, increase with the percentage of antimony present, and attain a maximum when its composition is:—Aluminium, 18·37 per cent.; antimony, 81·63 per cent. This alloy appears to be a true aluminium antimonide corresponding to the formula Al_2Sb_2. It forms a grey mass possessing an iridescent lustre, and yielding a greyish-black crystalline fracture. Its melting point appears to exceed that of soft steel, a remarkable fact considering the comparatively low fusing points of its components. The alloy is not attacked by dry air at ordinary temperatures. At high temperatures, antimony slowly volatilises, and in presence of air, the aluminium is oxidised. Under the influence of moist air or water, especially at more elevated temperatures, the alloy gradually crumbles to a black powder, and antimony hydride is given off. Caustic alkalis and hydrochloric acid attack the alloy with great energy, large quantities of antimony hydride mixed with hydrogen being evolved.

If the percentage of antimony be increased still further, the fusing point and corrodibility of the alloy again rapidly diminish.

Aluminium-antimony alloys readily combine with other metals forming complex alloys, some of which are susceptible of important industrial applications. For instance, aluminium - nickel - antimony or aluminium - tungsten - antimony alloys are remarkable for their great hardness, tenacity, and elasticity; the silver alloys with or without the addition of nickel or copper, take a very high polish; the alloys with iron and especially steel, with or without nickel, chromium, &c., possess an extremely fine grain absolutely free from flaws, and are extremely hard and tenacious.—H. T. P.

Primary Deposits of Platinum in the Urals. A. Inostranzeff. Comptes rend. **116**, 155—156.

The alluvial deposits of Nijny-Taguilsk on the western slope of the Urals, in the basins of the rivers Visim, Martiane, and Tchaouj have long been celebrated for the platinum they yield, consequently mount Solovieff, where these rivers rise, has for some time past been systematically prospected for the platinum reefs, from which the alluvial platinum has been derived; these researches, however, have proved unsuccessful; but, last summer an inclusion, 13 inches in diameter, was encountered by accident, it consisted of chrome iron and serpentine in alternate bands associated with a small quantity of dolomite and some disseminated angular fragments of "country rock." Visible grains of native platinum could be distinguished in the rocks of the inclusion by means of a lens, but even the rock in which no platinum grains could be seen was found to contain 0·0107 per cent. of that metal. The platinum is therefore present in microscopic accumulations. The country rock of mount Solovieff consists of angular grains of *olivine* cemented by clear green serpentine and besprinkled to a small extent with grains of chrome iron; it may be regarded as the variety of peridot known as *dunite;* this is sometimes massive when in contact with the including rocks, and at other times shattered and penetrated by the latter. Daubrée regards the finding of platinum in the rocks where it is invisible as an interesting new fact, whilst the above remarks about the general character of the rocks confirm observations made by him on specimens from Nijny-Taguilsk.—D. A. L.

New Method of Soldering Aluminium and Some other Metals. J. Novel. Comptes rend. **116**, 256—257.

By means of the alloys mentioned below, aluminium or other metals, such as iron, tin-plate, zinc, copper, brass, nickel, &c., can be rapidly and easily soldered, either with the brasing iron or blow-pipe. Aluminium can also be soldered to any of the above metals; the material is cheaper than any hitherto employed, gives a solid joint, and does not injure the metal by oxidation or otherwise.

Solder.	Composition.	Melting Point.
1	Unalloyed pure tin	250°
2	Tin 1,000, lead 50....................	280° to 300°
3	Tin 1,000, zinc 50....................	280° to 320°
4	Tin 1,000, copper 10 to 15	350° to 450°
5	Tin 1,000, nickel 10 to 15............	350° to 450°
6	Tin 900, copper 100, bismuth 2 to 3..	350° to 450°

The first three do not colour aluminium, and can be used for ornamental and artistic objects. Four and five are yellowish in colour, but have the advantage of higher melting point and greater strength and hardness, and suggest the possibility of using aluminium for various articles and purposes for which hammered, coated, or enamelled iron, tin-plate, copper, zinc, lead, &c., are now used. The last alloy can be made to assume any tint of yellow by varying the proportion of copper, and is therefore suitable for soldering aluminium bronzes; the proportion of bismuth is adjusted so as to keep the melting point suitable for the use of the brasing iron.—D. A. L.

Estimation of Silicon in Cast Iron. H. Rubricius. Chem. Zeit. **17**, 101.

See under XXIII., *page* 868.

The Determination of Chromium in Ferrochromium. J. Spüller and S. Kalman. Chem. Zeit. **17**, 1207.

See under XXIII., *page* 867.

Treatment of Sulphides at Broken Hill, N.S.W. Eng. and Mining J. **56**, 1893, 322.

In his semi-annual report, presented July 27th, Manager Howell discusses the vexed subject of the treatment of sulphides. He says that the present experiments and researches are to find, if possible, some cheaper and yet effective method of treating the ores under existing conditions at the mine. The ores are complex in character, and the lead, zinc, iron, copper, sulphur, and silver, the principal components, are so very intimately associated that they may be considered to a great extent as chemically combined, and no one direct treatment, like smelting, can break up this combination and liberate the valuable metals. The principal minerals, however, combine in very varying proportions in the same ore, and in any small piece of the ordinary sulphides the eye can detect particles of lead and zinc having respectively their own natural crystalline form, while side by side with these can be seen particles of the two minerals blended together in apparently chemical combination. Unfortunately, all the combinations carry nearly equal proportions of silver, so that a separation of the zinc and lead by any mechanical process leaves us with all the separated products valuable in silver. The experiments so far have been to ascertain to what extent concentration can be applied to the separation of the minerals, with a view of making one product high in lead and sufficiently low in zinc to be a good smelting material, leaving the other principal products which would be high in zinc and silica to be treated by some less expensive process for the recovery of the silver they contain. There have so far been put through the experimental plant about 300 tons of the different kinds of sulphides. The results as far as the concentration of a portion of the whole into a product high in lead and sufficiently low in zinc to make a good smelting material is concerned has proved satisfactory. From 24 per cent. to 31 per cent. of a concentrated material has been obtained, carrying over 60 per cent. lead, containing from 20 to 34 oz. of silver, and from 7 to 9 per cent. of zinc per ton, according to the varying contents of the above minerals in the crude ores. The great bulk of the remainder is a product high in zinc, silica, and garnet, and containing from 7 to 12 oz. of silver to the ton. This material is now being treated by a desulphurising and chloridising roasting in revolving cylinder furnaces for the purpose of chloridising the silver, to be subsequently extracted by hyposulphate of soda leaching. It is well known that this method is one of the cheapest by which silver can be extracted from its ores, and the important part of the operation is the chloridising of the silver, for by the leaching process the combination of silver and chlorine (chloride of silver) is the only one that can be successfully treated. It is difficult to chloridise the silver contained in a dense zinc blende to a high percentage, and so far results have been variable on the highly zinciferous tailings, but mixed with about one-third of low-grade silicious ores, the percentage of the silver chloridised was high and the results very favourable. Further experiments in this direction will be made. So far experiments with concentrating the sulphides have established two important facts; one is, that the concentrates obtained from the crude ore will pay for the cost of mining, crushing, concentrating, and smelting, and leave a very fair profit, without taking into account anything that may be made out of the residue or tailings. The other fact is, that with these high-lead concentrates there is no fear of a scarcity of lead fluxing ores for the successful treatment of all the kaolin and other semi-dry ores in the mine. The treatment of the ores by these methods will leave the great bulk of the zinc in the tailings in a concentrated form, to be afterward treated if it should be found that the extraction of zinc could be made profitable.

PATENTS.

Improvements relating to the Treatment of Ores and other Compounds containing Metals and Sulphur and to Apparatus therefor. H. R. Lewis, London, and C. Gelstharp, Newcastle-on-Tyne. Eng. Pat. 6567, April 5, 1892.

A shelf roasting furnace is employed and in the case of first-class ores, these are crushed or ground and passed through the furnace; the hot gases or vapours being utilised and disposed of in the usual way. After the bulk of the sulphur has been burnt off on the upper beds, common salt, sulphate of iron, or other sulphates or chlorides or free acids are introduced and thoroughly mixed with the mass, so that by the further roasting on the lower beds the metals present may be converted into chlorides or sulphates. Finally the mass is drawn out from the furnace and smelted or leached, and the metals precipitated by the ordinary processes.

In treating second-class ores, &c., a shelf-roaster is employed with a chamber or fireplace adjoining the beds or shelves which is kept filled with hot coke or other carbonaceous matter, or with peroxide of iron, according as it is intended to manufacture free sulphur or sulphuric anhydride. With this chamber another is connected filled with chequered or pigeon-holed brickwork; these chambers are so placed as to be kept hot by the heat developed by the combustion of the sulphur in the ores treated. After most of the sulphur is burnt off, the residue is mixed with common salt, &c., and further roasted on the lower shelves, just as with the richer ores. Fig. 1 represents the front view of a pair of improved furnaces constructed for carrying out these operations, one being shown in elevation, the other in vertical section. Figs. 2 and 3 show the transverse sections across the lines x x and x^1 x^1 respectively in Fig. 1. Fig. 4 indicates the arrangement of and mode of working the cooling tubes and chambers, the condensers, and the vitriol chambers. a a^1 represent the beds or shelves so arranged that the gases from the two lower shelves pass away by the flue l, and those from the upper shelves by the flue g, provided with a damper g^1; the ores are introduced by the hopper m, and after roasting on the upper shelves and intermixing with salt, &c., are passed to the lower shelves through the plugholes f f, finally emerging from the furnace through the similar openings c c into a vault d, whence they are withdrawn through the doors e e. During their passage through the furnace they are raked from time to time by means of rabbles introduced through the working doors b b b, or by mechanical appliances. h is the chamber

Fig. 1.

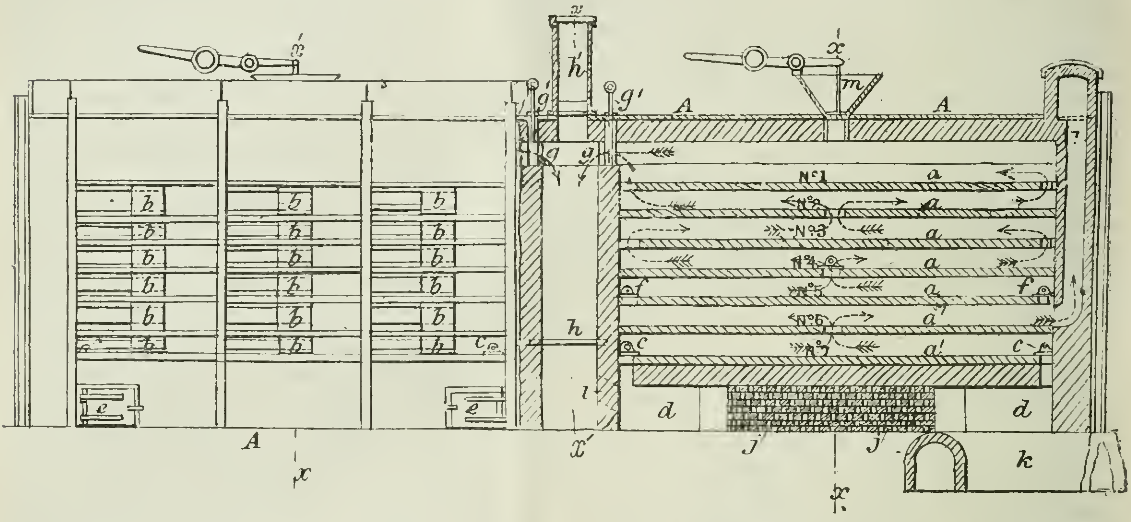


Fig. 2.

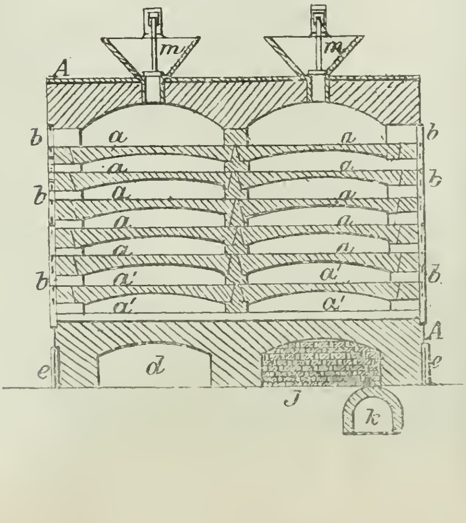


Fig. 3.

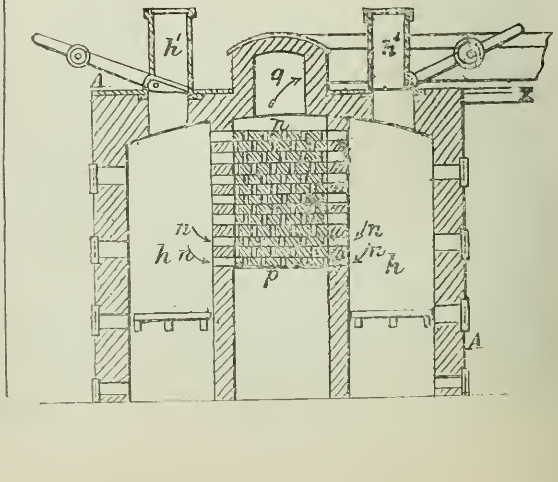
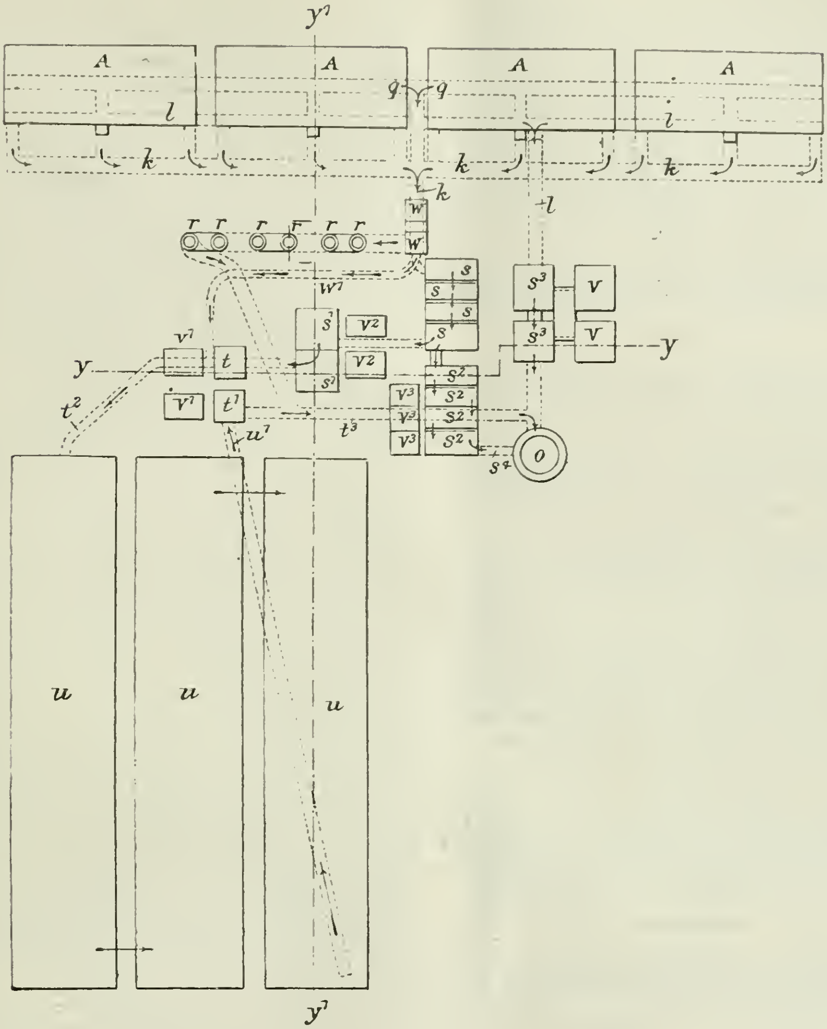


Fig. 4.



containing coke or peroxide of iron, into which fresh coke is introduced as required through h^1; j is the checquered brickwork under the lowest shelves, through which the gases pass, after traversing h, into the flue k leading to the coolers and vitriol chambers, &c. For certain kinds of ores the shelves a a^1 are made hollow, so that coal-gas or petroleum may be burnt in them to maintain the required temperature. In Fig. 4, r r represent water-cooled tubes through which the emergent gases are passed to condense sulphuric anhydride when this is made; s s are cooling chambers for depositing volatilised metals, &c. In certain cases these are filled with horizontal or sloping shelves, whereon the moistened ore is placed so as to be acted on by the sulphurous acid. s^1 s^1 are brick or coke condensers, moistened when necessary by a stream of water or sulphuric acid. t is a kind of Glover tower, down which nitrous vitriol from the chambers passes, whilst the sulphurous acid, &c. from the coolers passes up. u u u are the chambers, and t^1 a Gay-Lussac tower for denitrating the exit gases before they pass to the chimney o. If sufficient draught is not obtained by means of the chimney alone, exhaust fans may be used. s^2 s^2 are further cooling chambers for the collection of free sulphur when this is prepared by means of the coke chamber; s^3 s^3 condensers through which the gases from the lower shelves pass for the purpose of condensing hydrochloric acid, volatilised metallic chlorides, &c.; v v, v^1 v^1, v^2 v^2, and v^3 v^3 are tanks for receiving the acid liquors, &c., respectively condensed in the different condensers, &c. above mentioned.—C. R. A. W.

Improvements in the Manufacture of Alloys, and in the Purification of Metals and Alloys. J. B. Torres, Paris. Eng. Pat. 13,555, July 25, 1892.

The metals and alloys are purified and the alloys are formed by adding to the bath of melted metals one or more of the following purifying bodies, either in their natural condition, melted or otherwise, or in the condition of alloys or compounds:—

Sodium, potassium, and other alkaline metals.

Aluminium, magnesium, barium, and other alkaline earthy metals.

Antimony, bismuth, tungsten, molybdenum, manganese, titanium.

Phosphorus, boron, and silicon.—J. H. C.

Improvements relating to the Manufacture of Steel and to Furnaces therefor. G. F. Simonds, Fitchburg, Mass., U.S.A. Eng. Pat. 15,444, August 27, 1892.

Low carbon steel or wrought iron is treated by an improved case-hardening or cementation process, so that articles having the characteristic properties of refined high-grade steel are economically produced in a much shorter time and at less expense than is required by the processes hitherto in use. This is effected by the use of a specially designed air-tight heating chamber, in which a uniformly intense degree of heat is maintained. The pieces of iron, &c. to be carbonised are enclosed along with carbonaceous material in refractory boxes or receptacles which are heated for a suitable time in the chamber, from which all free oxygen is excluded. The closed boxes are afterwards withdrawn and cooled sufficiently to permit of their being opened. A temperature below the melting-point of cast iron, say, 1,200° to 1,500° F. (yellow or orange heat), gives the best results. Articles treated by the process described are free from scale and remain unchanged in form, whilst the carbonisation can be carried to a greater depth than is possible by the usual well-known method of case-hardening. —C. R. A. W.

Improvements in Apparatus for Dressing Tin Ores. Joseph Rule, Camborne, Cornwall. Eng. Pat. 11,524, September 12, 1892.

In the operation of tin-dressing in Cornwall, the tinstuff, after being cleaned and enriched to a fairly high degree, is called "tin whits," and requires to be calcined or burnt to get rid of certain impurities and to effect other chemical changes in the ore. The "whits" as prepared is of too liquid a nature to allow of its being taken from the dressing floors to the calcining house without special treatment; it is therefore usually spread out and "treaded" or "packed" by boys until the larger portion of the water mechanically admixed has been got rid of, so that it is of a consistency to be handled with shovels and carried in carts. The object of the inventor is to perform this operation mechanically, for which purpose he employs a specially constructed packing-box or platform set in vibration by blows from a hammer operated by a wiper or cam-wheel; a similar hammer is also employed for knocking the kieves whilst the material therein is settling. The platform may be of any width and length required, and is preferably constructed of planks with flanges at the edges for retaining the material; the hammer strikes against a projecting piece or "bumper," so as to cause a continual tremor or vibration, whereby the tinstuff is made to settle rapidly, the water flowing away. —C. R. A. W.

Soldering Aluminium. Otto Nicolai, Wiesbaden, and Carl Laugenbach, Frankfort-on-the-Maine. Eng. Pat. 16,292, September 12, 1892.

For soldering aluminium any combination of silver with the halogens is employed, *e.g.*, chloride or subchloride of silver, bromide of silver, or iodide of silver. The salt used is strewed in the form of powder on the part to be soldered, or applied in the moist state by means of a brush dipped in spirits of wine; the soldering is completed by applying heat by means of a soldering lamp or blow-pipe.—C. R. A. W.

A Process for Recovering Copper and Nickel from Ores or Mattes containing these Metals. Jules Strap, Paris Eng. Pat. 16,800, September 20, 1892.

Ores containing copper and nickel as sulphides, together with iron or other metals, or the mattes thence obtained, are pulverised so as to pass through a 2-millimetre mesh, and roasted at a temperature sufficiently high to decompose the iron sulphate formed by oxidation, but not high enough to decompose copper or nickel sulphate. The product is lixiviated with water containing from $\frac{1}{2}$ to 1 per cent. of sulphuric acid, and the solution treated with scrap iron, whereby the copper is precipitated and obtained in merchantable form. The iron is separated from the mother-liquor by blowing in cold air and adding carbonate of lime frequently in small doses; in this way a precipitate of "sulphate of iron peroxide" is obtained mixed with calcium sulphate; after five or six hours' treatment, the whole of the iron is precipitated and a very pure solution of nickel sulphate obtained. This is treated with calcium or sodium chloride to transform nickel sulphate into chloride; in the former case the calcium sulphate formed is separated by filtration. Milk of lime is then added, and the precipitated nickel oxide dissolved in sulphuric acid to a solution of 12° B.; 30 per cent. of sulphate of ammonia is then added, and an electric current passed through so as to electrolyse the fluid and deposit metallic nickel; 2 volts and 20 ampères per square metre of cathode surface is requisite. More nickel oxide is added to the bath from time to time to neutralise the sulphuric acid formed, and so keep up the strength as regards nickel. The process of first roasting the matte or ore is carried out by charging the powder in a thin layer of 25 to 30 kilos. per square metre into a roasting oven kept for the first five hours at a temperature not exceeding 300° C., and subsequently at 580° to 600°; the requisite uniformity of temperature is maintained by using producer gas, and regulating by admixing excess of oxygen before it enters the oven. The mass is rabbled every hour to renew the surface exposed; after about 18 hours the iron is converted into Fe_2O_3 and the copper and nickel into sulphates, a small quantity of basic copper sulphate being also formed. Two different ovens may be employed for the roasting at different temperatures, or one only of the Maletra-Perret type as used in sulphuric acid manufacture, the lower slabs being brought together to increase the temperature in the lower part of the oven, whilst the upper ones are separated and provided with air openings arranged to keep down the temperature. A fire in the bottom of the oven about 1·5 metre distant from the slabs gives the requisite heat, excess of air being provided to give a thoroughly oxidising atmosphere; when the action is once started the fire may be extinguished, as the combustion of the sulphur, &c. in the matte evolves sufficient heat to maintain the temperature. The roasted matte is placed in large basins or tanks, which may be of wood, with sand filters at the bottom. Pure water is first poured on, and subsequently water acidulated to 1 or 2 per cent.; the liquors may be used cold, but are preferably heated to facilitate solution, and are conveniently made to flow from tank to tank until a density of 25° to 30° B. is attained, at which strength it crystallises; 450 to 500 grms. of copper and nickel sulphates, or about 60 grms. copper and 55 grms. nickel, are then present per litre. To dissolve basic sulphates a further lixiviation with water containing $\frac{1}{2}$ per cent. of sulphuric acid is employed; for this purpose the water of condensation of the sulphurous acid from towers connected with the roasting ovens may also be employed. The solid residue consists of iron peroxide, which may be utilised as purple ore.—C. R. A. W.

Improvements in the Manufacture of Ingot Iron and Steel. J. Colley, Bilston, and T. Twynam, Chiswick. Eng. Pat. 17,206, September 27, 1892.

This invention relates to improvements in the manufacture of ingot iron and steel by the Bessemer and Siemens processes with a view of increasing the yield of steel from a given weight of pig-iron. The pig-iron to be converted is poured upon a mixture of iron-oxide and carbon contained in the hot ladle, mixer, or other receptacle in which the iron is held before conversion. From 1 cwt. to 2 cwt. of the mixture of iron-oxide and carbon (containing about 15 per cent. of carbon) may be used per ton of molten pig. —J. H. C.

Improvements in or relating to the Purification of Iron or Steel from Sulphur. E. H. Saniter, Wigan. Eng. Pat. 17,692, October 4, 1892.

The processes described in former specifications (8612, 1892; and 8612A, 1892 (this Journal, 1892, 911; *ibid*, 1013 and 1014), may also be applied in other ways, slightly different from the treatment of iron or steel in furnaces, converters, ladles, &c.; thus the metal may be desulphurised in a basic- or neutral-lined cupola by forming in the cupola basic chloride slag by means of addition of calcium chloride; or in a rocking or revolving furnace with basic or neutral lining by addition of the fusible or ready-fused mixture of chloride or fluoride of calcium and lime, the latter in excess.

Similarly, chloride of calcium and lime may be added in blast furnaces, either at the top or lower down; and in puddling furnaces, being either mixed with the fettling before charging into the furnace, or added to the charge before or just after the fusion of the latter. Again, fluid iron or steel may be showered or filtered through hot molten charges of chloride of calcium and lime, and the purified metal drawn off at the bottom; or mixed chloride or fluoride of calcium and lime may be added to the contents of basic-lined crucibles for the purpose of purifying crucible steel during its manufacture. In short, the process can be carried out in almost any furnace where the heat is sufficiently intense, and where acid linings are not used; care being taken that free lime is present and that the heat is sufficient for fusion, a mixture of from 1 to 3 parts of calcium chloride and 3 parts of lime being used, or their chemical equivalents; generally, a halogen salt of an alkaline earth, and an oxide hydrate or carbonate of an alkaline earth; the proportions being such that an excess of uncombined alkaline earth is always present.—C. R. A. W.

A Process for Facilitating the Fusion of Mild Steel and other Refractory Metals. La Compagnie Anonyme des Forges de Chatillon et Commentry, Paris. Eng. Pat. 17,825, October 6, 1892.

When mild steel is to be melted in ordinary crucible furnaces great difficulty is experienced in effecting fusion when the percentage of carbon is as low as 0·30 to 0·35, whilst the fusion becomes practically impossible when only 0·10 to 0·15 per cent. is present. Such fusion, however, is rendered quite easy by adding to the metal to be melted zinc in the proportion of about 0·5 to 1·0 per cent.; the fusion then takes place as readily as with hard steel. The zinc may be added as such, or in the form of an alloy of zinc and cast iron, ferrosilicon, or other metals; the addition may be effected either at the time of charging or when the mass has attained a cherry-red heat; the former is more convenient in the case of crucible metal. The greater part of the zinc added is volatilised during the melting, less than 0·10 per cent. remaining, which quantity does not in any way interfere with the physical qualities of the steel; on the contrary, castings of very mild steel thus treated can be welded, provided that very pure materials were used in the first instance, and that blow holes are prevented by the ordinary means, a small quantity of manganese (from 0·6 to 0·7 per cent., according to circumstances) being also added some minutes before casting. Accordingly castings thus made can be substituted for forgings. Fusion by addition of zinc is especially advantageous in the case of chrome steel of low carbon percentage and similar refractory steels, also ferrochromes and metallic chromium; the process is also applicable when operating with open hearth regenerative furnaces.
—C. R. A. W.

Improvements in Coating Aluminium and Aluminium Alloys. Georg Wegner, Berlin, and Paul Gührs, Rixdorf. Eng. Pat. 511, January 10, 1893.

Coloured coatings or varnishes for aluminium and its alloys containing at least 80 per cent. of aluminium are obtained by either of the two processes described below; by these means the metal is covered with a coating which adheres so strongly that it will not crack or peel off, even though the metal itself is bent or broken.

1. The metal is brushed over with a solution composed of the following ingredients, mixed together in about the proportions named per litre of mixture. Acetous verdigris, 30 grms.; oxide of iron, 30 grms.; sulphur, 30 grms.; salammoniac, 1 grm. The metal is then heated to a high temperature, again brushed over with the solution, and reheated. It is then brushed with a sharp brush and painted over with a solution of 10 grms. sulphur in 100 of turpentine, again fired or heated, and finally dipped into a hot bath of pure linseed oil, and kept there until the oil has entirely evaporated. The coating may be glazed by brushing it over with a solution of beeswax in turpentine, whereby the flexibility and adhesion of the coating are improved, and access of air to the metal hindered.

2. To produce a light or dark shaded coating, the metal is dipped in a bath of vinegar, 1 litre; ammonium chloride, 200 grms.; and chloride of iron, 100 grms.; after heating and cooling again, it is painted over with a pulpy mass formed by mixing together red sulphur, 30 parts; bloodstone, 20 parts; and liquid sulphide of ammonium, 10 parts; and again heated. After this treatment it is painted over with a pulpy mixture of turpentine, 100 grms., and bloodstone, 10 grms. Finally it may be operated upon with the wax-brush, until the surface appears coloured and bright. The shading or tinting is varied by using larger or smaller quantities of bloodstone and sulphide of ammonium; the "red sulphur" referred to is the natural product dug up along with ordinary yellow sulphur.—C. R. A. W.

Improvements in the Method of and Apparatus for Hardening and Tempering in Continuous or other Lengths Steel Wire Bright. E. Oddy, J. Crossley, E. Smith, and A. Smith, Cleckheaton. Eng. Pat. 11,955, June 17, 1893.

In the process of hardening and tempering, oxidation is prevented by passing the wires direct from the heating flame into the tempering liquid, thence to the tempering flame, and finally to the cooling trough by an arrangement of apparatus which excludes atmospheric air throughout the operation.—J. H. C.

Improvements in Apparatus for Testing Presence of and Recovering Float Gold and other Metals. A. F. Seccombe, Gunnislake, Cornwall. Eng. Pat. 12,624, June 27, 1893.

The claim is for an apparatus for the recovery of float metal, such as gold, in which floats are attached to the periphery of a wheel, which revolves in the water around a suitable centre on either a vertical or horizontal axis. The floats and the rim of the wheel are, in the case of float gold, made of copper and amalgamated with mercury.—J. H. C.

Improvements in and connected with the Production of Chromium, Manganese, Molybdenum, Titanium, Tungsten, and Similar Metals from their Alkaline and Alkaline Earth Compounds. A. Sternberg and A. Deutsch, Grünau, Prussia. Eng. Pat. 13,117, July 5, 1893.

When an oxygen compound of chromium, manganese, molybdenum, titanium or tungsten with an alkaline earth, is mixed with carbon and heated to 1,000°—1,200° C., the metal of the metallic salt is reduced, whilst the alkaline earth is set free; thus in the case of calcium chromite and tungstate—

$$2CaO, Cr_2O_3 + 3C = 2CaO + 3CO + 2Cr$$

$$CaWO_4 + 3C = CaO + 3CO + W.$$

With analogous alkaline metal compounds a parallel change ensues, with the difference that the alkaline metallic oxide is further acted on and reduced to the metallic state; thus with sodium tungstate—

$$Na_2WO_4 + 4C = 4CO + 2Na + W.$$

In order to utilise these reactions the compound operated on is mixed with finely-powdered charcoal and packed into a suitable crucible; after heating to about 1,200° C. for six hours, the product is washed with diluted hydrochloric or nitric acid to dissolve away the alkaline earth; the heavy metal of the compound used remains as a finely divided powder. For every 10 parts of compound used about the following proportions of carbon are requisite. Calcium chromite, 1 part; chromate of lime, 2·5; manganate of lime, 2·5; molybdate of lime, 2; titanate of lime, 2; tungstate of lime, 1·4 parts; and similarly in molecular proportion in other cases, *e.g.*, bichromate of soda, 4 parts; molybdate of soda, 2·5; titanate of soda, 3; tungstate of soda, 2 parts. When compounds of the alkali metals are used, the mixtures are preferably heated in distilling furnaces (such as those used in the preparation of sodium) so as to condense the volatile metal for separate use. Chromic and tungsten compounds may be thus employed for case-hardening iron; the alkali-metal compound used is mixed with charcoal powder and strewed over a soft iron article; on heating to about 1,000° C in a muffle, the iron becomes alloyed superficially with the metal of the metallic acid employed, and acquires properties similar to those possessed by the corresponding steel alloy.—C. R. A. W.

Improved Composition or Preparation for Protecting Metals from Rust. W. P. Thompson, Liverpool. From Sohler and Bürger, Würzburg, Germany. Eng. Pat. 13,702, July 14, 1893.

See under XIII., *page* 849.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

Electro-Chemical Researches. Felix Oettel. Chem. Zeit. **17**, 173—174.

Many papers dealing with electro-chemical matters are rendered almost useless to the reader by the want of definite information respecting the electrical measurements involved. Thus no useful knowledge is given by such a statement as that "a metal is thrown down in a solid coherent form by a current of so many ampères," unless the dimensions of the electrode are also stated so as to enable the current density (ampèrage per unit of electrode surface) to be deduced; for the physical character of the deposit depends on the density of the current, not on its absolute amount irrespective of electrode surface. The square decimetre (100 square centimetres) is a convenient unit in such cases; and full information is given by such a statement as that a given metal "can be electrolytically deposited from such and such a solution, and separated from such and such other metals, by a current the density of which is so many ampères per decimetre of cathode surface." When the cathode is a platinum dish, the estimation of the active surface is easy; not so when it is shaped like a cylinder or plate opposed to another, or to a wire. Much more current passes *viâ* the parts of the cathode nearest the anode than by the hinder or further removed portions; great density differences therefore exist between different parts of the cathode surface, and the average density for the entire surface may be very different from the maximum or minimum density. In all experiments where such variations occur, the shape and disposition of the electrode should be carefully stated. The tension or potential difference between the electrodes is a datum which is scientifically interesting; but the knowledge of this cannot replace the absence of information respecting current density, and is of no particular value for most technical purposes. In measuring the strength of the current, the galvanometer or voltameter employed must be included *in the same circuit* as the decomposing cell, not used to measure the current passing when that cell is excluded; a copper voltameter is convenient, as but little trouble is involved in its indications, whilst the resistance and consumption of energy are usually unimportant; or a calibrated tangent galvanometer may be used.—C. R. A. W.

The Importance of Electro-motive Force for the Electrolytic Separation of Metals. H. Freudenberg. Zeits. physikal. Chem. 1893, **12**, 97.

Kiliani (Berg- u. Hüttenmänn. Zeit. 1883) was the first to recognise the importance of electro-motive force in the separation of metals by electrolysis, but he left many questions unanswered, the foremost of these being whether the precipitation of a metal is brought about only at a fixed potential, or whether it takes a gradual course of the kind that it commences at the lowest potentials, reaches its maximum at a certain potential, after which, only a slight increase in the power of precipitation occurs. By the help of the electrolytic dissociation hypothesis and of Le Blanc's experimental evidence the author has thrown light on this process. Le Blanc (Zeits. physikal. Chem. 1891, **8**, 299) showed that every electrolyte has a characteristic decomposition point, which is an additive property of the electrical intensities of attachment of the anions and cathions. For acids and bases this value is about 1·70 volts, from which point the decomposition of water commences, whilst the hydrogen ions give up their charges. The decomposition point of water has another value, however, in neutral solutions. The following are some of the decomposition values:—H_2SO_4 = 1·76 volts; KOH = 1·67 volts; KNO_3 = 2·16 volts; Na_2SO_4 = 2·21 volts; $ZnSO_4$ = 2·35 volts; $AgNO_3$ = 0·70 volts. The differences are very significant and of value for the purpose of separation. The author divides the metals into three groups. 1. Those which are not precipitated from their aqueous solutions by a current at moderate potential, viz., the alkali and earth metals, together with aluminium and chromium. 2. Those which are converted into peroxides at the anode, lead, manganese, and thallium. 3. All metals which appear as a metallic deposit at the cathode. The separation of these three groups is little influenced by the electro-motive force, but the latter is of importance chiefly in the third group. All metals whose salt solutions decompose above 1·7 volts, possess a greater electrical intensity of attachment than the hydrogen of the acids. When, therefore, a sufficient quantity of hydrogen ions is present during the electrolysis (which condition is attained by the addition of strong completely dissociated acids; *i.e.*, acids of strong dissociation affinity value) certain metals are not precipitated by the current, as this is needed for the discharge of the hydrogen ions, which have smaller intensities of attachment. Those metals are, however, precipitated whose salts have smaller intensities of attachment than the hydrogen of the acids; these are gold, platinum, silver, mercury, copper, bismuth, antimony, arsenic, and tin.

The determination of the decomposition point enabled the author to separate the metals above mentioned by the employment of different strengths of current. The galvanic elements cannot be used to obtain a constant E.M.F., the batteries of Daniell, Leclanché, and Meidinger are too weak, that of Bunsen too prone to alteration. Success was here attained by the use of Gülcher's thermo-pile (compare Elbs, Chem. Zeit. 1893, **17**, 97), which, at a tension of 4 volts, exhibited great constancy and small internal resistance, and above all rendered easy the possibility of withdrawing various large potentials. The oxy-hydrogen voltameter was also found to be an instrument unsuitable for the measurements, as it indicates the electrical energy (potential and quantity of electricity), whereas potential only is required (compare Elbs, J. prakt. Chem. 1891, **43**, 39). Moreover, it presupposes the employment of a potential many times in excess of that desired. A galvanometer was therefore used which indicated interruptions in the current, and with which the deflections of the needle could be followed throughout the whole course of the analysis. From the nitrates of silver and copper in the presence of free nitric acid all the silver is precipitated by a current of 1·3 volts [taken 0·379 grm. and 0·1892 grm. Ag; formed 0·38 grm. and 0·1887 grm. Ag]. From the nitrates of silver and bismuth in the presence of free nitric acid and a current of 1·3 volts [taken 0·3790 grm., and 0·2916 grm. Ag; found 0·3793 grm., and 0·2914 grm. Ag]. The separations of silver and arsenic (1·7—1·8 volts); silver and antimony (1·2—1·3 volts); and silver and cadmium (1·6 vols.) were also effected. In a similar manner, the author investigated the separation of silver from platinum and zinc, and the separation of mercury from copper, bismuth, arsenic, antimony, and cadmium; he also enters into great detail on the separation of copper from other metals. In most solutions the decomposition point of copper salts is 1·8 volts, the value being lower (1·1 volts), as Le Blanc found, in the presence of oxalic acid. The author recommends a solution acidified with sulphuric acid. Copper was separated from cadmium and arsenic; from the latter, both in the presence of sulphuric acid (1·85 volts) and in that of nitric acid (1·9 volts).

The author discusses Drossbach's method (this Journal, 1892, 815) and finds that separation in alkaline solution is only accomplished in the absence of arsenic ions. Arsenic must not be present therefore in the form of trioxide, because of the basic properties of the latter and thereby the tendency to form arsenic ions under the existing conditions. In the case of those metals whose salts have decomposition values above that of water, such as cadmium, nickel, cobalt, iron, and zinc, the difference of the strength of the current does not lead to such practical results as in the above-cited cases. The separation in the above-described way may perhaps be effected by a convenient double salt (cyanide and sulphur salt, for example).
—A. R. L.

Purification of Beetroot Juice by means of Electricity. Von Lippmann. Deutsch. Zuckerind. 1892, **17**, 1824.

See under XVI., *page* 852.

PATENTS.

Method of Smelting or Heating Iron or other Metals by means of Electricity, and Apparatus therefor. C. G. P. de Laval, Stockholm, Sweden. Eng. Pat. 15,793, March 8, 1892.

According to this method the electrolyte is introduced into the furnace in a molten condition and there heated still further by causing a current of electricity to pass through it; and when a sufficiently high temperature has been attained, the metal to be smelted is added. If this is of greater density than the electrolyte it is added at the top; if not, it is introduced from below.

The current passes above or below a bridge of refractory material placed between the two pole pieces.—G. H. R.

Improvements in Secondary Electrical Storage Batteries or Accumulators. J. C. Chapman, London. From N. H. Edgerton, West Whiteland, Pennsylvania, U.S.A. Eng. Pat. 2321, July 11, 1892.

According to this invention one side of each plate is pasted with red lead and the other with litharge, so that when formed they are of opposite sign. This construction renders all intermediate couplings or connections between the plates unnecessary.—G. H. R.

Improvements in and connected with Carbonaceous Compounds. E. G. Acheson, Monongahela City, Penn., U.S.A. Eng. Pat. 17,911, October 7, 1892.

This invention relates to the production of artificial crystalline carbonaceous material, named by the inventor "carborundum," to be employed as a substitute for diamonds, bort, and other abrasive materials.

It is produced by subjecting to heat, preferably that produced by an electric current, a mixture of some carbonaceous material, preferably carbon in as pure a state as possible, silica or silicate of alumina or lime, and a flux such as common salt. Suitable proportions are: pure carbon 50 per cent., silica or silicate of alumina 25 per cent., salt 25 per cent. by weight.

It is stated that the "carborundum" appears to be a new chemical compound which when pure may be represented by the formula SiC.

An electrical furnace suitable for producing this body is described.—R. B. P.

Process for the Electrolytic Decomposition of Compounds of Metals and Sulphur. Abel and Imray, London. From Siemens and Halske, Berlin, Germany. Eng. Pat. 18,966, October 22, 1892.

According to this process for the electrolytic separation of antimony and arsenic from their sulphur compounds, the latter are dissolved in sulphydrates with generation of sulphuretted hydrogen. The solution is then electrolysed in the cathode compartments of the bath only, whereby the sulphydrates are regenerated and are employed for further extractions. A secondary process is carried out at the anode, according to which, by the utilisation of the sulphuretted hydrogen given off in the extraction process, any of the foreign metals contained in the ores which form alkaline sulphides are recovered.—G. H. R.

Improvements in Apparatus for the Electrolysis of Salt. Haseltine and Lake, London. From T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 9296, May 9, 1893.

The electrolytic cell consists of a tank with perforated false bottom or grating, to which a receiver is connected. This receiver communicates by valves with a discharge pipe and with an overflow pipe, which latter is carried right up to the level of the electrolyte in the tank. The overflow pipe is flexibly connected with a weighing receptacle, which also is provided with an overflow.—G. H. R.

Improvements in or connected with the Working and Welding of Metals by Electricity. A. Longsdon, London. From F. Krupp, Essen, Germany. Eng. Pat. 9965, May 18, 1893.

This invention relates to improvements on Eng. Pat. No. 12,984, and consists in the combination of two sources of current supply in the working and welding of metals by electricity, one source serving to energise the magnetic field of the constant current dynamo which is employed for heating and welding.—G. H. R.

A New or Improved Method of and Apparatus for Electrically Heating or Welding Metal. W. P. Thompson, Manchester. From C. L. Coffin, Detroit, U.S.A. Eng. Pat. 11,579, June 13, 1893.

This invention relates to a machine for electrically heating or welding pipes, tubes, rings, tires, or continuous metal articles, and consists in the combination with a support of an arm carried thereon, a mandrel parallel with the said arm, a conductor adapted to clamp the material to be welded against the said mandrel and connected with one terminal of a source of electrical energy. The arm carries an insulated traversing conductor connected with the other terminal, and a traversing carriage which carries a pressure roller.—G. H. R.

A Galvanic Element. A. M. and W. Clark, London. From A. Heil, Fränkisch-Crumbach, Germany. Eng. Pat. 13,858, July 17, 1893.

This cell is of the Leclanché type, the carbon electrode being replaced by one of silver attached to a lead core.
—G. H. R.

An Improved Electric Insulating Compound and Process of Preparing the same. A. Gentzsch, A. Goldschmidt, and E. R. von Scanavi, Vienna, Austria. Eng. Pat. 11,369, August 19, 1893.

See under XIII., *page* 848.

Improvements in Electrolytic Apparatus. H. M. E. Andreoli, Brixton. Eng. Pat. 15,197, August 23, 1893.

This invention relates to improvements in an electrolytic apparatus for the decomposition of chlorides, sulphates, &c., described in Eng. Pat. 17,426, 1891. As improved, the apparatus consists of an outer metallic tank directly connected with the negative pole of an electric generator and an inner tank (containing an anode or anodes) made of metallic gauze or of panels of metallic gauze in the form of narrow baskets filled with conducting material in fragments more or less minute. This inner tank which is submerged in the electrolyte contained in the outer tank, is connected with it by a wire, and is completely closed with the exception of inlet and outlet tubes.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Notes on Rice-Oil and Maize-Oil. A. Smetham. Analyst, 18, 1893, 191—193.

Rice-Oil.—The author has examined a sample of rice-oil obtained from Rangoon rice meal by hydraulic pressure. The oil was dirty-greenish in colour, semi-solid at ordinary temperatures, and contained crystals giving it the appearance of the "figging" of soft-soap. The following results were obtained :—

Iodine absorption	96·4 per cent.
KHO required for saponification	19·32 „
Saponification equivalent	290
Free fatty acids (KHO × 5)	64·0 per cent.

Another specimen obtained by ethereal extraction from a mixture of various rice meals yielded almost identical results, with the exception of the free fatty acids which were higher (77·20 per cent.). The melting point of this sample was 29° C. The oil similarly obtained from (*a*) the husk, (*b*) the cleaned rice, separated from a sample of recently imported Rangoon rice, contained a smaller amount of free acids, namely (*a*) 34·0 per cent.; (*b*) 31·6 per cent. The meal supposed to have been derived from the same rice, yielded an oil containing 43·4 per cent. of free fatty acids.

English rice meal as a rule contains 8—9 per cent. of oil, whilst Rangoon meal averages 15 per cent. (rice meal is the by-product obtained when rice is dressed between emery rollers, and does not therefore include the interior portion of the grain).

Maize-Oil.—This is a clear yellowish oil, sweet to the taste and smell, and sufficiently cheap to render it available as an adulterant of the dearer oils. Its iodine absorption and saponification equivalent are 116·3 per cent. and 282 respectively.—H. T. P.

The Detection of Heated Cotton Seed Oil in Lard. W. G. Crook. Analyst, 18, 1893, 221.

See under XXIII., *page* 869.

PATENTS.

An Improved Cleansing Material. E. H. Lawton and J. Carder, London. Eng. Pat. 18,271, October 12, 1892.

Soap is incorporated with "the substance known in commerce as 'loofah,' which is a portion of the plant *luffa*," the mixture acting as a mechanical as well as a chemical detergent. The loofah may be incorporated with the soap in definite portions, or it may be simply shredded and incorporated.—B. B.

An Improved Sheep Dip. A. Robertson, Oban. Eng. Pat. 2990, February 10, 1893.

See under XVIII. *C., page* 858.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Gutta-percha. O. Oesterle. Archiv. Pharm. 1892, 230, 641.

Commercial gutta-percha was boiled with successive quantities of water until the aqueous extract was no longer coloured. This treatment extracts a tannin, sugar, and salts. The dried residue was repeatedly boiled with fresh portions of alcohol, when *alban* separated from the solution on cooling, and when the filtrate from this was evaporated *fluavil* was obtained. The residual matter was dissolved in chloroform and alcohol added to the solution, when *gutta* separated after a while in flakes, together with an unstable viscous substance, *guttan*, containing oxygen; the latter is very unstable, and yields gutta when repeatedly dissolved in chloroform and precipitated by alcohol.

Gutta, $(C_{10}H_{16})n$, is a white amorphous hydrocarbon, which melts at 53° C. and reacts with bromine, evolving hydrogen bromide; it possesses all the characteristic properties of gutta-percha, ductility, elasticity, and power of becoming plastic when heated.

Alban, $C_{40}H_{64}O_2$, crystallises from alcohol in small yellowish scales, melts at 195° C., and possesses none of the useful properties of gutta-percha; when heated in a sealed tube with alcoholic potash at 150° C. it yields *albene*, a hydrocarbon which the author is investigating.

Fluavil, $(C_{10}H_{16}O)n$, is an amorphous yellow substance, and melts at 82°—85° C.; when present in large amount it reduces the value of the sample of gutta-percha.

Guttan dissolves in boiling ether, oil of turpentine, and light petroleum, separating from these solvents, on cooling, in a pulverulent form.

As a whole, the constituents of gutta-percha are very resistant towards chemical reagents, hence the value of this substance.—A. R. L.

PATENTS.

An Improved Varnish or Composition applicable as a Protective Coating for Wood, Iron, and the Like. C. Beck, Vienna, Austria. Eng. Pat. 13,925, July 18, 1893.

Eight parts of amber colophony and three parts of linseed oil varnish are melted together, and after cooling the mixture, 1 part of thick turpentine and 14 parts of refined benzine (sp. gr. 0·700) are added. The resulting varnish may be used in combination with colours, and is especially useful as a preservative of wood and a preventative of the rusting of iron. It dries very rapidly, and becomes extremely hard, and a small quantity suffices to cover a large surface, whilst the coating can be washed without injuring its lustre.—D. B.

An Improved Electric Insulating Compound and Process of Preparing same. A. Gentzsch, A. Goldschmidt, and E. R. von Scanavi, Vienna, Austria. Eng. Pat. 11,369, August 19, 1893.

Shellac is heated in a suitable vessel or distilling apparatus. It first becomes soft, then melts into a thick pulp, and begins to swell up. The temperature is now raised to about 400° F., by which means the product increases tenfold in volume and changes its colour to a dark blackish-brown. Decomposition takes place, and during this operation the mass returns to its original volume and a substance remains in the still, which continues soft and pliable after cooling, and possesses the property of being able to be vulcanised in the usual manner. The vulcanised product can be mixed with oils and fats in certain proportions without losing its insulating properties.—D. B.

Process for the Manufacture of Lead Oxide and of White Lead from Crude Lead Sulphate. P. Bronner, Stuttgart, Germany. Eng. Pat. 16,184, September 9, 1892.

Crude sulphate of lead occurring in cotton-print works, and mostly of a yellowish or brownish colour, invariably contains, besides aluminium acetate, a small quantity of basic aluminium salts, which, owing to their comparative insolubility, cannot be completely eliminated by washing. It also contains insoluble organic colouring matter originating from the tar in the pyroligneous acid.

The process consists in boiling the crude material with dilute sulphuric acid, then washing it and treating it with a solution of sodium carbonate. The resulting lead carbonate is calcined slightly in a muffle furnace, the lead oxide digested with a solution of lead acetate, and the basic acetate thus formed precipitated by passing a current of carbonic anhydride into the solution. The solution of lead acetate is drawn off from the precipitated white lead, and is then again digested with the same quantity of lead oxide. The mud of the lead chambers in sulphuric acid works may be treated in a similar manner.—D. B.

Improvements in Solutions for Waterproofing and Airproofing Woven and other Fabrics, in Applying the Same, and in Apparatus therefor. F. Eckstein, London. Eng. Pat. 18,932, October 22, 1892.

The agents used are soluble gun-cotton, turpentine or equivalent, alone, or having dissolved therein one or more solid resins and ethyl alcohol, with or without the addition of sulphur or castor oil. The above agents are mixed together so that a solution is obtained, which solidifies on allowing the alcohol to evaporate. The fabrics are moistened with dilute alcohol or water and brought into contact with the requisite quantity of solution. They are then dried. For high temperatures, linseed oil, boiled to a gelatinous consistence, and dissolved in turpentine, is added to the solution. The apparatus consists of the following parts:—(1.) Devices for moistening or spraying the fabric with dilute alcohol or water. (2.) A bath with rollers for coating the fabric with solution. (3.) Scrapers for removing the excess of solution from the coated fabric. (4.) A drying chamber through which the coated fabric is passed whilst the alcohol is evaporated and drawn off to condensers.
—D. B.

Improved Composition or Preparation for Protecting Metals from Rust. W. P. Thompson, Liverpool. From Sohler and Bürger, Würzburg, Germany. Eng. Pat. 13,702, July 14, 1893.

Many years of experiment have shown that a mixture of 5·5 parts of chemically pure bleached beeswax and 1 part of wool-grease when dissolved in oil of turpentine and spread in a thin layer on metal, renders the latter entirely impervious to the influences of air and moisture.—D. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Chesnut Tannin. Pharm. J. 1893, 261.

In the consular report on the trade of Cherbourg and district for 1892, it is stated that the export of an extract from the wood of chesnut trees, used for tanning leather, is developing, having reached 150 tons to 200 tons per month whilst on the opening of a new factory at Dinan it was expected that these figures would be doubled. The tannin of the chesnut tree was found by Trimble to resemble gallotannic acid in all its reactions, so that the substances are probably identical.

PATENT.

Improvements in or Relating to the Extraction of Tanning and Dyeing Materials. M. Heftler and G. Bénard, Paris, France. Eng. Pat. 20,677, November 15, 1892.

See under IV., *page* 823.

XV.—MANURES, Etc.

Manurial Value of the Vinasse from Molasses. M. Maercker. Zeit. Spiritusind. 16, No. 19, May 10, 1893.

See under XVI., *page* 852.

The Genesis of Natural Phosphates, particularly those which derived their Phosphorus from Organised Matter. A. Gautier. Comptes rend. 116, 1271—1276.

The oldest phoshates are met with in igneous rocks, such as basalt, trachyte, &c., and even in granite and gneiss. The second category of phosphates comprises those of hydromineral origin; it includes apatites of the crystalline rocks which often accompany quartz, as well as the more recent phosphates deposited by hot mineral waters in the jurassic, cretaceous, and tertiary formations. These, like the preceding phosphates, are not readily attacked by plants; they are free from organic matter and nitrogen.

Of the third group of phosphates, the true phosphorites occur as rocky concretions, either greyish, yellowish, or without colour; they are mealy, friable, and porous, and generally mixed with calcium sulphate or carbonate. The phosphorites generally contain animal remains and some organic matter, being all of animal or vegetable origin. The phosphates of the Somme, Quercy, Berry, the Ardennes, and those met with in the Grotto of Minerva all belong to this class. In the galleries of this grotto the remains of the large quarternary quadrupeds and prehistoric man have accumulated for centuries, and under the influence of micro-organisms yield nitrates, sulphates, and phosphates. The phosphates are partly derived from phosphates of potassium, calcium, and magnesium origiually present in the animal matter and partly from the decomposition of lecithin, nucleïn, and other organic compounds containing phosphorus. The phosphoric acid thus liberated combines with the ammonia produced in the decomposition of the albuminoids, forming ammonium phosphates, especially diammonium phosphate. The presence of ammonium phosphate was noticed by Chevreul in Peruvian guano. By the action of water percolating through the soil the underlying chalk becomes saturated with ammonium phosphate; double decomposition takes place with formation of hydrogen calcium phosphate, and ammonium carbonate. The latter is eventually converted by nitrification, in presence of chalk, into calcium nitrate. In support of this theory the author describes an experiment in which he heated ammoniacal ammonium phosphate with chalk at 85°; ammonia and carbonic anhydride were given off, and after 24 hours the pulverulent matter, washed with water, was found to contain 82·8 per cent. of hydrogen calcium phosphate, 11·3 per cent. of tribasic calcium phosphate, and 5·7 per cent. of chalk. It is thought that the brushite found in the Grotto of Minerva, and which exists in most rocky guanos, was produced in this manner.
—N. H. J. M.

Some Rare or New Natural Phosphates: Brushite, Minervite. A. Gautier. Comptes rend. 116, 1171—1177.

The minerals referred to occur in the Grotto of Minerva. *Brushite* occurs as a white, pulverulent matter, or in large friable blocks which generally contain some incompletely transformed rock in the middle. It contains a little alumina, carbonate, and silica, with traces of magnesia, sulphuric acid, iron, and nitrates. Leaving these out of account the analytical results point to the formula $2(CaHPO_4).3H_2O$ which is that given by Moore and Julien for *Metabrushite*.

Minervite is a newly-discovered phosphate which occurs as a vein 0·15 m. thick. It is remarkable for its whiteness and has the consistence of dough. After prolonged exposure to the air it is seen to consist of crystalline grains, rhomboidal prisms, and hexagonal plates resembling hydrargylite in appearance; well formed crystals are rare. The air-dried substance has the following composition :—

—	I.	II.
H_2O lost at 180°	21·40	22·74
H_2O lost at 180°—red heat	7·89	5·92
Quartz sand	0·36	7·38
Clay	11·14	
$Al_2P_2O_8$	52·35	57·30
Al_2O_3 soluble in acid	4·71	3·10
$Fe_2P_2O_8$	0·24	0·41
$Mg_3P_2O_8$	Trace	1·17
CaF_2	2·00	2·29

It contains also traces of chlorine and sulphuric acid. The clay can be separated mechanically, but not entirely. The mineral is essentially an aluminium phosphate, $Al_2P_2O_8 + 7H_2O$, and has been formed by the action of decomposing organic animal matter on the clay. It resembles osteolite in containing fluorine, and in composition it resembles *callaïnite* and especially *gibbsite*.

—N. H. J. M.

On a New Type of Phosphorite. A. Gautier. Comptes. Rend. **116**, 1022—1028.

In an earlier communication the author has stated the geological conditions under which phosphates are found in the large *Grotte de Minerve* (see preceding abstract). At a depth of 3—4 metres the soil becomes harder and changes into a yellowish rock forming a bed of 5—9 metres in thickness. Typical specimens were examined and were found to leave, after treatment with dilute acids, an insoluble residue consisting partly of clay. Treatment with weak alkaline solutions showed that phosphate of alumina was present in the rock. The latter (P_2O_5, Al_2O_3) amounted to 28·3 per cent. The clay $(Al_2O_3)_2$, $5SiO_2$, amounted to 21·8 per cent. The proportion of tribasic calcium phosphate present was 24·2 per cent. The analyses showed that the rock is formed by the association of calcium phosphate with phosphate of alumina, the latter preponderating: indeed, there is an excess of alumina present. These two phosphates are combined with calcium fluoride in the proportion of 8·2 of CaF_2 per 100 of phosphates, or 15·6 of CaF_2 per 100 of P_2O_5. Lastly, the rock contains a considerable quantity of clay. Almost all the concreted phosphates in this peculiar locality have a similar composition. Half, or more than half, of the phosphoric acid is combined with alumina, and the rest with lime.

The published analyses of natural phosphates show that they usually contain enough lime to saturate completely, or nearly so, phosphoric acid and the fluorine; here, on the contrary, the whole of the lime would not suffice to form tribasic or even dibasic phosphate. The phosphates of lime and alumina, which together form this rock, are mixed and not combined. This is shown by the fact that the proportions of the two phosphates are different in different specimens. The new type of phosphorite differs markedly from the usual types in which the lime is always sufficient to saturate the phosphoric acid. All the phosphates hitherto known consist of a mixture of clay, siliceous sand, chalk, and tribasic calcium phosphate, together with 8·5 per cent. of its weight of calcium fluoride. In all these phosphates the phosphoric acid, soluble in ammoniacal citrate of ammonia, does not exceed 0·6 or 0·7 per cent. of the rock.

In the type examined by the author phosphate of alumina is generally present in preponderating quantity: it is soluble in the cold in weak alkaline solutions, and, for the most part, in ammoniacal citrate of ammonia.

—D. E. J.

Determination of the Water contained in Soil bearing Various Crops, after a long Period of Drought. Reiset. Comptes rend. **116**, 1177—1179.

In August 1887, after several weeks of drought (there was no rain at all from the 4th of June to 23rd July) samples of soil were taken where plants of different kinds were growing, and the loss of water at 110° determined. Tables are given showing the percentage loss of the various soils. The chief point of interest is that, whilst the herbage of grass land was burnt up when the soil contained 6·8—7·8 per cent. of water, wheat arrived at perfect maturity in soil which, at the time of cutting the plants, contained only 1·22 per cent. of water.—N. H. J. M.

The Quantities of Water contained in Arable Earth after Prolonged Drought. MM. Demoussy and Dumont. Comptes rend. **116**, 1078—1080.

During a prolonged drought most of the larger plants sown in the autumn or early spring are still green and show no signs of perishing, although the quantity of water evaporated from their leaves, exposed at all times to a burning sun and a dry wind, must be considerable. The authors have determined the quantity of water contained in various soils at different depths with the view of finding out whether the earth retains sufficient moisture for the wants of vegetation. The experiments were carried out at Paris (in the Museum gardens) and at Grignon. The following table gives the results:—

Water contained in 100 Grms. of Earth at Various Depths.

——	Surface.	25 Cm.	50 Cm.	75 Cm	1 M.
	Grms.	Grms.	Grms.	Grms.	Grms.
Soil of Museum garden	4·5	27·1	24·0	24·2	22·8
Loose soil	2·0	13·5	14·5	14·0	14·5
Soil from field (Grignon)	6·6	16·3	15·7	15·9	16·7
Broken-up soil (Grignon)	5·0	16·3	16·4	13·8	10·6

If for every soil the mean of the proportions of water contained are taken, it is found that for 12,000 tons of soil there are—

	Tons of Water.
Of garden soil	2,460
Of loose soil	1,400
Of the field soil	1,700
Of broken soil	1,490

These quantities are considerable, but are not altogether at the disposal of the roots; the plants fade away before the earth is entirely dry; and as the chlorophyll cells act more feebly as the leaves become drier, the harvest naturally suffers if rain is long wanting.—D. E. J.

Effect of Decomposing Organic Matter on Natural Phosphates. N. T. Lupton. Amer. Chem. J. **14**, 353—359.

To test the fertilising value of raw natural phosphates and to ascertain whether decomposing organic matter is capable of rendering the phosphate in them soluble; experiments were made in the field and laboratory with acid phosphate containing 14·36 per cent. P_2O_5, of which 9·1 = water soluble, 2·94 citrate soluble, 2·32 acid soluble; with Florida phosphate powder containing, moisture, 4·18; insoluble, 32·39; total phosphoric acid (acid soluble), 16·54; iron and aluminium oxides, 8·89; and with cotton-seed and cotton-seed meal containing respectively 1·03 and 3·19 per cent. of available phosphoric acid. In the laboratory experiments, a sample of South Carolina "floats" (phosphate rock ground to impalpable powder) containing 28·73 per cent. total phosphoric acid with 2·26 citrate soluble was also tested. On a poor sandy soil, with the manures sown broadcast, 400 to 800 lb. of the Florida phosphate per acre, gave better results than similar quantities of the soluble phosphate, but when the same quantities of the phosphates were mixed with equal weights of cotton-seed meal the results obtained were about equal with both phosphates. On a strong red soil, with manures drilled, the cotton-seed and cotton-seed meal alone yielded better results than either of the phosphates alone, and the soluble phosphate proved better than the insoluble in the majority of cases. The results, however, are far from concordant; the author, nevertheless, concludes that "the pulverised raw phosphate evidently produced as good, if not better, results than the acid phosphate, whether used alone or mixed with cotton-seed and cotton-seed meal."

In the laboratory mixtures of each of the phosphates with cotton-seed and water were left in contact, with daily stirring, for three months, July to October, and although fermentation ensued no conversion of phosphate from the insoluble to the soluble form could be detected by analyses made at frequent intervals.—D. A. L.

The Nutritive Matter required for the Cultivation of Beetroots. Hellriegel. Zeit. Ver. Rübenzuck-ind. 1893, **43**, 578.

In order to produce a normal beetroot of 800 grms. weight in soil free from nutritive material—sandy peat,—other conditions being favourable, the following manurial matter must be administered in an easily assimilable form:—

Nitrogen, 2·9 grms.; *phosphoric acid*, 1·2 grms.; and *potash*, 1·7 grms. Lack of nitrogen decreases the total yield, but the relation between the roots and leaves remains constant, and the percentage of dry substance and sugar increases. Lack of potash decreases the total yield in a less degree; it seems in the main to affect the constituents of the roots, and generally it may be said to diminish the percentage of dry substance and sugar. No plasma can be formed without nitrogen, and no starch and sugar without potash. The rôle of phosphoric acid, the importance of which is sufficiently known, is obscure.
—A. R. L.

The Analysis of Fish Guano, Pondrette. Bone Ash, and Similar Substances. M. Weibull. Chem. Zeit. **16**, 1892, 1689.

See under XXIII., *page* 869.

XVI.—SUGAR, STARCH, GUM, Etc.

The Manufacture of Sugar in Egypt. Chem. Ind. **16**, 1893, 210.

According to Grüneberg the manufacture of sugar in Egypt is confined solely to the extraction of sugar from the cane. The plant employed is the same as that used in Europe for the extraction of sugar from beetroot, the concentration of the juice after treatment with lime and carbonic anhydride being effected by means of Jellinek's "triple evaporation system," and finally *in vacuô*. The evaporation is not carried to the granulating stage, but is stopped when a thick syrup has been obtained, this being conveyed in stone jars holding about 20 litres to distilleries, and there being worked up into rum. About half of the fuel consumed is English coal; the remainder consists of sun-dried fibrous material obtained from the pressed canes. The burnt residue from the latter is used for fertilising the cane fields, in addition to which pigeon-dung is employed, the upper stories of most of the workmen's cottages being provided with pigeon-breeding beds.—D. B.

Are Considerable Quantities of Sugar destroyed during the Evaporation of the Juice? Herzfeld. Zeit. Ver. Rübenzuck.-ind. 1893, **43**, 641.

The amount of decomposition is dependant on the duration of the process, the temperature and concentration of the liquor, and to a slight degree also on its alkalinity. In a 10 per cent. solution, for example, by one hour's heating at 80° C., 0·04 per cent. of sugar was decomposed; at 90° C. for the same time, 0·07 per cent.; at 100° C., 0·1 per cent.; at 110° C., 0·16 per cent.; at 120° C., 0·28 per cent.; at 125° C., 0·5 per cent.; at 130° C., 2·06 per cent.; at 135° C., 3·58 per cent.; and at 140° C., 5·1 per cent.—A. R. L.

Soxhlet's New Process of Refining Sugar. E. O. von Lippmann. Chem. Zeit. 1893, **17**, 1195.

The author in his remarks on Soxhlet's process does not regard the problem of dispensing with animal charcoal in the refining of raw sugars as solved, but he looks upon the method as one capable of decolorising and chemically purifying the liquor previously to its being passed over animal charcoal, which latter treatment imparts lustre to it.
—A. R. L.

Estimation of Moisture in Raw Sugars. Seyffart. Zeits. Ver. Rübenzuck.-ind. 1893, **43**, 633.

The author arrives at the conclusion, after comparing 604 duplicate analyses, that the water estimation is by far the most exact in comparison with that of any of the other constituents of raw sugars. He therefore sees no obstacle in the way of adopting the new "*Rendement*" on the basis of the total non-sugar percentage.

Lippmann remarked that in the case of 1,377 duplicate analyses the average experimental values differed from the mean values as follows:—Polarisation, 0·04; ash, 0·01; organic non-sugar, 0·04; and moisture, 0·01. The agreement in the values for the estimation of water is only what might be expected, and will certainly be realised as soon as technical chemists arrive at a uniform method of carrying out the determination.—A. R. L.

New Process for Purifying Raw Sugar Liquor. Saillard. Sucr. indigène, 1893, **42**, 82.

The author recommends acid magnesium sulphite, that is a solution of magnesium sulphite in sulphurous acid, as a very active, purifying, and antiseptic agent for the manufacture of raw sugar, and predicts great advantages in every respect by its employment.—A. R. L.

The Influence of Pectous Substances on the Analysis of the Sugar-beet. Weisberg. Chem. Zeit. Rep. 1893, 155. From Bull. Ass. Chim. 1893, **10**, 841.

See under XXIII., *page* 871.

The Chemical Conditions which influence the Action of Diastase. J. Effront. Monit. Scient. 1893, 266—268.

During the manufacture of glucose from maize, a by-product rich in nitrogenous matters is obtained. An aqueous extract of this material distinctly accelerates the action of diastase on starch-paste, and possesses this property even when prepared at a boiling temperature, showing that the phenomenon cannot be due to the presence of a soluble ferment. Moreover, the extract by itself has no saccharifying influence whatever. The by-product in question had the following composition:—Proteids, 37·63; starch, 38·39; water, 8·46; and non-nitrogenous residue, 15·03 per cent.; total, 99·51.

The author traces its accelerating action on diastase to the presence in it of asparagin, and of compounds of aluminium and phosphoric acid, which, as he has previously shown (this Journal, 1893, 368), favour the saccharifying action of diastase. Details of a number of experiments are given, on the same lines as those previously (*loc. cit.*) described. In some cases the results obtained vary, according as the reagent is added to the starch paste or to the diastase solution (malt extract). Ammonia and potash alum, phosphoric acid, and acid calcium phosphate under the latter conditions appear to check, or even destroy, the diastase. The author has also investigated the action of salt and of sodium carbonate on the saccharification of starch, and states that commercial sodium chloride exerts a favourable influence, whilst the pure salt has no effect whatever. The well-known fact that sodium carbonate exerts a great depressing influence on diastase is confirmed. In one experiment an addition of 0·05 per cent. of sodium carbonate reduced the percentage of maltose formed to 3·10, as compared with 55·3 per cent. obtained without such addition. Sodium and magnesium salts, and certain sulphates, yielded negative results.—H. T. P.

Experiments on the Diffusion of Beetroot Juice. Herzfeld. Zeits. Ver. Rübenzuck.-ind. 1893, **43**, 173.

The author has during the year continued his investigation. But his results do not lead to any general conclusions, since the beetroots experimented with were all of the best quality. It is to be mentioned that the crude juice before defecation was found to contain 0·2—0·3 per cent. of albumin, a tenth of which can at most be precipitated. The so-called albumin filtration has no advantages for purifying the juice, especially as experiments show that after one treatment with lime the albumin is not further acted upon. Crude juice heated for 30 minutes at 90° C. is generally found to contain invert sugar. Apparently the pectin is hereby converted into parapectic acid, which inverts the sugar. On subsequent defecation with lime a brown coloration is produced by reason of the decomposition of the invert sugar.—A. R. L.

Alberti and Hempel's Method of Estimating Ash in Sugar by Incineration with Quartz Sand. Stift. Oesterr. Zeit. Zuckerind (this Journal, 1892, 273).

See under XXIII., *page* 869.

Delicate Reaction for p-Phenetol Carbamide (" *Dulcin* "). N. Wender. Pharm. Post, **26**, 269.

See under XXIII., *page* 869.

The Nutritive Matter required for the Cultivation of Beetroots. Hellriegel. Zeit. Ver. Rübenzuck.-ind. 1893, **43**, 578.

See under XV., *page* 851.

Purification of Beetroot Juice by Means of Electricity. Von Lippmann. Deutsch. Zuckerind. 1892, **17**, 1824.

An account of the author's observations when inspecting a certain sugar factory. The warm diffusion juice is subjected to a current of 30—40 ampères at E.M.F. of 4—5 volts from a Siemen's dynamo machine between electrodes of sheet zinc. A thick muddy precipitate, which gradually sinks to the bottom of the vessel, separates at the anode. The electric current effects the coagulation of the albumin, which carries down many other substances; the zinc oxide which is formed combines also with numerous organic substances, and as a matter of fact the mud which separates at the electrode contains zinc oxide to the extent of one-third of its weight, but the juice is quite free from zinc. As, however, the diffusion juice does not contain much albumin, and the zinc plates are said to last for eight days and longer, it is impossible that the chemical effect can be great. It is therefore difficult to say, in the absence of analytical data, whether the excellence in purity of the sugar turned out at the factory in question is due to the application of electricity, or whether a judicious coagulation of albumin before defecation would not lead to equally good results. —A. R. L.

Amount of Sugar in Beetroots of Recent Harvests. B. Schulze. Bied. Centr. 1893, 346.

Since the year 1887 tabulated statistics have been drawn up at the experimental station for agricultural chemistry in Silesia on the percentages of sugar in the beetroot samples there tested. It is found that the amounts of sugar in the beetroots of harvests 1887 and 1891 are not only the highest, but the samples of the two years exhibit a certain agreement. Now the weather of these two years was quite different, 1887 being on the whole dry, and 1891 wet and cold. Warm, dry, late summer and autumn days were, however, common to both years, and this would seem to confirm the view that the last weeks of the vegetation period are the most important for sugar formation. The year 1889, in which the weather was very varied, occupies the second place. Other observations, during the years 1888 to 1891, inclusive, show that there is a marked increase in the sugar percentage of beetroot after October 15th to November 1st.—A. R. L.

Manurial Value of the Vinasse from Molasses. M. Maercker. Zeit. Spiritusind. **16**, No. 19, May 10, 1893.

Taking the mean values of the analyses published by Wolff and by Stammer, 1,000 kilos. of molasses vinasse contain :—Nitrogen, 3·7 kilos., having a manurial value which, reckoned at 120 pf. per kilo., amounts to 4·44 mk.; and potash, 12·8 kilos., which, reckoned at 20 pf. per kilo., is worth 2·56 mk. The total value of 1,000 kilos. of vinasse, taking into account only nitrogen and potash, is therefore 7 mk. To produce 1,000 kilos. of vinasse, however, 300—350 kilos. of molasses are requisite, so that the monetary value of 100 kilos. of molasses in the form of vinasse is equal in round numbers to 2 mk. Other inorganic substances—lime and phosphoric acid—are only present in small amount. It is very difficult to assign a value to the organic constituents, but that they have also a certain value is beyond question, for the carbohydrate compounds of the vinasse doubtless form a good material for the nitrifying organisms and oxidising bacilli of the soil. The vinasse ought to find a use in the case of those vegetables which require much nitrogen and potash, such as beetroots, turnips, and potatoes. (1 mark may be taken as equal to 1*s.*)—A. R. L.

Sugar-Cane Disease. Kew Bull. **79**, 149; Pharm. J. 1893, 262.

During the last few years a disease has made its appearance amongst the sugar-canes in the West Indies, which was supposed to be caused by a fungus. Specimens were sent to Kew for examination, and it is now conclusively proved that the disease is caused by one special fungus, an undescribed species of *Trichosphæria*. This has three distinct forms of fruit, which are very different in general appearance. In the conidial condition, a delicate, dark-coloured, velvety mass appears on the surface of wounded parts of the canes; the melanconium form is indicated by minute black filaments bursting through the cuticle of old canes; whilst, in the ascigerous form, minute, black, hairy perithecia appear on dead and decayed portions of cane. Conidia obtained from a pure culture, placed on the unbroken surface of very young leaves of lateral shoots of a healthy sugar-cane plant, produced deep red blotches in five days. In fourteen days the conidial form of the fungus was perfectly developed, the mycelium having passed into the shoot and adjoining leaves, and soon afterwards the young infected shoots decayed and dropped off, the mycelium having then reached the tissues of the parent stem. The fungus causing this disease is found to develop readily on the young leaves of the bamboo. The conidia will not germinate nor the mycelium grow in a 1 per cent. copper sulphate solution.

PATENTS.

Improvements in the Artificial Cooling of Syrup for the Manufacture of Refined Sugar, and Apparatus therefor. P. Lebaudy, Paris, France. Eng. Pat. 11,913, June 17, 1893.

The patentee claims the invention of the process, and several devices, forms of apparatus, and arrangements for carrying it out, for artificially cooling syrup (massecuite) in the manufacture of refined sugar in moulds, by the circulation round the moulds of fluids (such as air or water) cooler than the massecuite and varying by degrees.—A. R. L.

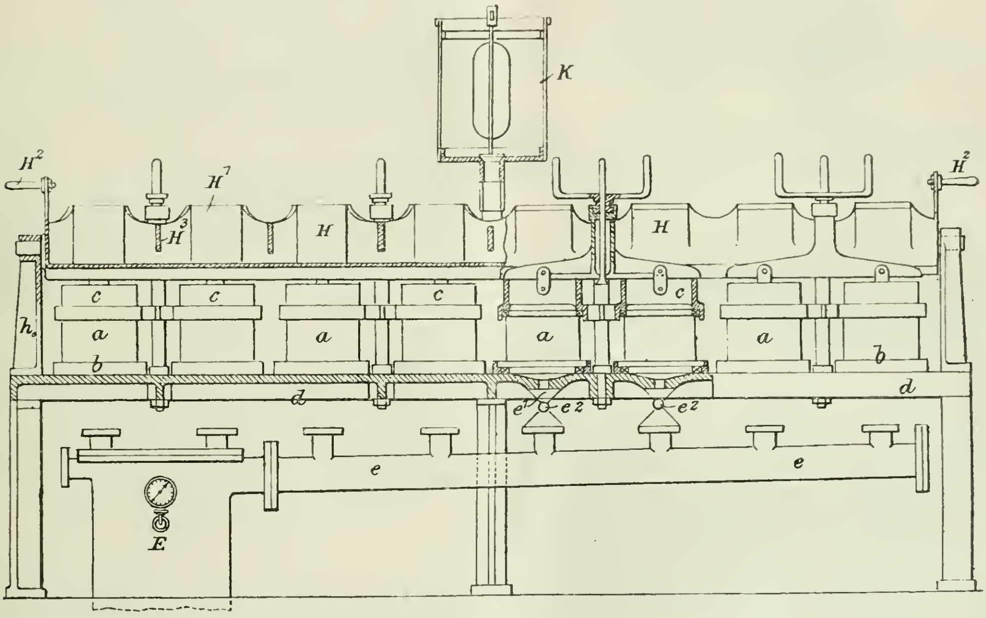
Improved Battery for Sucking off and Liquoring Massecuite with a Measurable and Adjustable Amount of Cleare for each Mould. O. Mengelbier, Penco, Chili. Eng. Pat. 12,359, June 23, 1893.

An improved form of the battery described in Eng. Pat. 5762 of 1892. In the present modification the cups or suction boxes are substituted by rings *b*, whose packings can be placed immediately on the table or plate *d*, receiving a pipe e^1, with cock e^2 for each mould. The cocks are connected with the pipes *e* on each side of the battery leading to the closed receptacle E, from which the air is exhausted. The plate or table *d* preferably inclines towards each pipe e^1 in the form of a funnel.

The conveying and uniform distributing of the cleare from the liquor-measuring vessel K, after opening the bottom valve, is effected by an open conduit H, which can be tilted to one or the other side on trunnions mounted in the frame h^0, by means of a handle H^2.

If the cleare necessary for liquoring all the elements of the battery is run from the liquor-measuring vessel K on one side into the conduit H, the latter will be tilted to the corresponding side (see dotted lines, Fig. 2) and consequently the contents of the conduit discharged by spouts H^1 into the hoods of the elements of the battery, the partitions H^3 uniformly dividing or separating the corresponding quantity of cleare for each hood. By tilting the conduit in the same manner to the opposite side, the cleare will be correspondingly distributed or fed to each hood. When the distribution of the cleare has been effected to every element of the battery, the liquoring operation is completed in such a way that the cleare is sucked through the impure mass in the moulds by the suction pipe *e* connecting the elements of the one side.

Fig. 1.



When it is required to cut out the single elements of the battery or to use compressed air for assisting the operation of liquoring, the separate hoods *c* are connected with the device for distributing the cleare (see Figs. 3 and 4). In that case the distribution of the cleare is effected by a tube H_0, which is rotatable within the tube *h* and provided with semi-partitions H_3, and holes H_1. The tube *h* has corre-

Fig. 3.

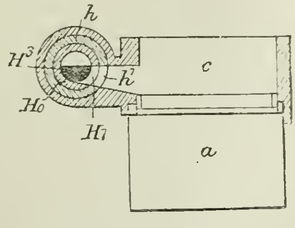
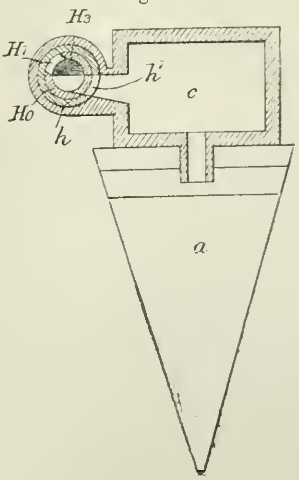
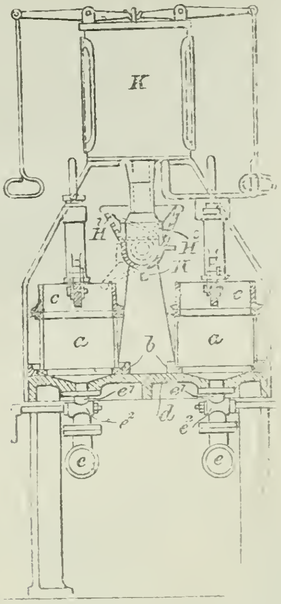


Fig. 4.



sponding holes h^1. When H_1 and h_1 coincide, the cleare contained between the partition walls for each element of the battery is delivered through them to the hoods *c*. The coverings or lids of each hood are correspondingly perforated, so that by turning up the hood it is possible to cut off the corresponding mould from the apparatus.

Fig. 2.



The tight closing of the hoods against the moulds, and the tightening of the same against the rings *b* or plate *d* of the table, is effected as before by means of clamps or bows, but in such a manner that one bow or clamp serves for several moulds.—A. R. L.

Improvements in Defecating or Purifying Saccharine Liquids, and in Apparatus therefor. J. N. S. Williams, Glasgow, N. Britain. Eng. Pat. 14,394, July 26, 1893.

The claims set forth in this specification comprise (1) a process for defecating saccharine liquids, such as sugar-cane juice, in which the latter is first subjected to considerable pressure and to a high temperature, after which it is passed in a shower or spray into a vessel in which the pressure is either that of the atmosphere or below it, and subsequently filtered; and (2) apparatus for carrying out the process.
—A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

Note on Sulphurous Acid, Compound Ethers, and Glycerol contained in Wines. W. Seifert. Zeits. Nahrungsm.-Unters. u. Hygiene, 1893, **7**, 125; and Chem. Zeit. Rep. 1893, 156.

The author confirms Schmitt's observation (Chem. Zeit. 1892, 1433) that sulphurous acid exists in wines, chiefly combined with aldehyde, and only to a small extent in the free state. Aldehyde sulphurous acid is decomposed on boiling, and by alkalis, but not by dilute acids; nor do weak oxidising agents, such as iodine, affect it. The total SO_2 may therefore be determined by distillation, being collected in iodine and converted into barium sulphate; or the distillate may be received in potash, acidified with sulphuric acid, and titrated with decinormal iodine. The free SO_2 is found by acidifying the wine with sulphuric acid and titrating at once with iodine. In forming an opinion regarding a wine, the author is of opinion that the percentage of total SO_2 should be taken into account, since it still remains to be proved that the SO_2 combined with aldehyde is harmless from a medicinal point of view. SO_2 was also found in samples (11 out of 24), which had not been sulphured. The yeast deposit in such samples was always contaminated with bacteria. Whether the bacteria are responsible for the reduction of sulphates in wines was, however, not proved.

The author is unable to trace any connection between the percentage of volatile ethers and the flavour, bouquet, &c. of wines. In fact, the amounts of volatile ethers found, even in inferior wines, were uniformly higher than those which Schmitt found in the finest "cabinet wines."

As regards the alcohol to glycerol ratio, the author confirms the usually accepted value (100 : 7 to 14), even in the case of wines old in bottle; and considers the numbers found by Schmitt (alcohol to glycerol = 100 : 14·1 to 30·7) to be quite abnormal.—H. T. P.

Report on the Spirit Industry and on Alcoholic Preparations. G. Arends. Chem. Ind. **16**, 78—83.

See under XX., *page* 859.

The Soluble Carbohydrates of Malt and Barley. G. Düll. Chem. Zeit. **17**, 67—68 and 100.

From the results of his examination of the matters extracted from malt by means of 80 per cent. alcohol (boiling for 5 hours) and distilled water (in the cold for 15 hours), the author concludes that the carbohydrates of malt, which are soluble in water, consist almost entirely of cane sugar and invert sugar, with only small quantities of gummy matter (galactoxylan, &c.), dextrin being wholly absent. By similarly treating dried and kiln-dried malt from the same barley, cane-sugar alone is obtained as soluble carbohydrate.—C. R. A. W.

The Use of Yeast in the Quantitative Estimation of Fermentable Substances. A. Bau. Chem. Zeit. 1893, 392.

See under XXIII., *page* 871.

The Estimation of Alcohol and Extract in Full-bodied Wines. T. Wetzke. Chem. Zeit. 1893, 836.

See under XXIII., *page* 870.

Contributions to the Chemistry of Malting. C. J. Lintner. Zeits. ges. Brauw. 1893, **16**, 14; and Chem. Zeit. Rep. 1893, **17**, 36.

The author makes some remarks regarding the chemistry of the kiln-drying of malt in connection with the publication of a paper by G. Düll "On the soluble carbohydrates of malt and barley." The action of diastatic ferments on the starch in the plant cell is different from the action of the same ferments on starch paste, as in the latter case dextrins coloured by iodine are always first formed. In the kiln-drying no action of the diastatic ferments on the starch constituents of the grain ought to be allowed to take place. The water in the malted grain is not evenly distributed, the germ portion containing most, and hence the greatest amount of action with formation of aroma, takes place in the germ and in its immediate vicinity during the kiln-drying. The increase of reducing sugars during the kiln-drying is entirely due to the inversion of cane sugar. Düll finds that isomaltose cannot be detected at any time during the kiln-drying. According to the author it appears probable that isomaltose is produced by the action of diastatic ferments on the starch formed transitorily in certain tissues of the germ, but that it cannot be detected as a constituent of malt, since the temperature at which it is formed is the same as that at which it is destroyed. In any case the formation of an aromatic malt is the same thing as the formation of a well-grown strongly-developed green malt. Such a malt will contain the greatest amount of cane sugar and transitory starch, together with very active enzymes.—T. A. L.

Report on the Spirit Industry and on Alcoholic Preparations. G. Arends. Chem. Ind. **16**, 78.

See under XX., page 859.

PATENTS.

Improvements in the Preparation of Wort from Indian Corn. C. Rach, Prussian subject. Chicago, U.S.A. Eng. Pat. 8144, April 22, 1893.

The claim set forth in this specification is a process for the preparation of wort from Indian corn. The corn is run through a "cracking or breaking machine" and thereby converted into hominy and flour. The hominy is then mixed with about one-fifth its weight of crushed malt and the mixture boiled with about one barrel of water for every hundred pounds of hominy. This mash is then mixed in the mash tun with a malt mash; to this mixture the liquid portion of a third mash is added, which is prepared as follows:—One hundred pounds of the Indian corn flour, half a barrel of water, and the same quantity of malt extract are slowly raised to a temperature of 167° F., and kept at this temperature until the starch is transformed, when the temperature is raised to 200° F., and the solid portion of the product allowed to settle. The whole is then made into wort.—A. R. L.

Process of Making Brandy-Mash and Composition for Same. M. Wool, New York, U.S.A. Eng. Pat. 10,290, May 24, 1893.

A process is claimed for making "brandy mash" thus:—Raisins and malt are mashed with water at a temperature of 52° R.; after remaining for 24 hours the mash is cooled to 13° or 14° R., and grapes (say $2\frac{3}{4}$ lb. to 100 lb. of mash) are macerated with it, a solution of carbonate of ammonia containing $\frac{1}{4}$ lb. of that substance being finally mixed with it. Thus prepared, the mixture constitutes "the yeast or active fermenting agent." A saccharine fluid is then made by macerating 88 lb. of dates with 100 lb. of the last mash and 45 gallons of water at a temperature of 50°—56° R. The mixture is then run into a suitable receptacle to ferment.
—A. R. L.

Improvements in the Process of Malting. J. A. Tilden, Hyde Park, Massachusetts, U.S.A. Eng. Pat. 12,555, June 27, 1893.

This invention relates to a process whereby grain (ordinarily barley) is converted into malt without "hand manipulation" or transference from one place to another during the entire operation.

The grain is introduced into a perforated drum 5—7 feet in diameter, within which is concentrically placed a smaller drum, also perforated, and about one-third the diameter of the larger one, so that an annular space is formed. Means are provided for rotating the drum about its axis in a horizontal position. The grain is introduced into the annular space of the drum and a shower of water at a temperature of 50°—60° F. is allowed to fall on to the drum for a period of two or three days. This initial operation is the steeping process. The claims are as follows:—Steeping the grain as above described; couching it by holding it in bulk in a quiescent state to develop spontaneous heat; germinating by intermittingly agitating the grain whilst it is being subjected to the influence of moist air at a temperature of 55°—70° F.; withering it by passing a current of non-saturated air through it; bleaching it by passing through it a current of air mixed with a limited amount of bleaching agent (sulphurous acid or chlorine); and curing it by passing dry hot air through it under increasing temperature and dryness from and above the temperature and humidity used in withering up to a practically dry air—preferably at a temperature of from 180°—220° F., and while under increased intermittent agitation. The entire operation is therefore continuous and is effected in one apparatus.—A. R. L.

A Novel Treatment of Beers to adapt them for Transport and for Preservation Purposes. E. Korn, Berlin, Germany. Eng. Pat. 14,118, August 4, 1893.

The object of this invention is a new improved treatment of beers by the employment of a liquor containing per hectolitre of water, sodium sulphate (70—80 grms.), sodium chloride (30—150 grms.), and sodium bicarbonate (40—150 grms.). The relative proportions of the salts depend upon the taste which it is required to impart to the beers. The addition of the above salts to the beer is said to act "very energetically in generating yeast, but the fermentation of the beer wort prepared according to this process is effected more slowly than usual, and in consequence thereof more uniformly, while the powerful yeast produced renders it more thorough than by the processes hitherto used and causes a considerable increase in the soundness of the products, which products are not deteriorated by agitation during transport, not affected by a sea voyage."—A. R. L.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Leaves of Vines as Cattle Food. A. Müntz. Comptes rend. **116**, 1314—1315.

Vine leaves have long been used for feeding, but only to a very limited extent. As regards nutritive matter they are very rich, being nearly identical in composition with lucerne of good quality. The amount of fresh leaves per hectare varies from 2,500 to 9,500 kilos. If the quantities are expressed in equivalents of hay (according to the amount of nitrogenous matter they contain) a hectare of vines would give amounts of leaves representing 2,100—3,600 kilos. for the south, 2,900 kilos. for the south-west of France, and 1,500—2,500 kilos. in Champagne. These numbers show the importance of utilising this source of food, especially as no injury is done to the vines, the leaves being removed late in the year; and, moreover, leaf production is much less affected by drought than grass. At present the vine leaves are to a large extent lost owing to their being blown away, so that they do not even manure the soil. If used for sheep feeding, the manure could be returned to the vines.

In France the amount of land used for the cultivation of vines is about 2,000,000 hectares.—N. H. J. M.

PATENTS.

Improvements in or relating to the Treatment of Milk, Cream, and Various Food Materials, and in Apparatus therefor. A. J. M. Bolanachi, W. Dulwich, Surrey. Eng. Pat. 14,651, August 13, 1892.

The claims set forth in this specification are as follows:—The combination with a vacuum pan of an internal stirring or scraping apparatus; or of an internal scraping stirring or stationary apparatus through which heating or cooling media may be passed, in combination with a vacuum or open pan. A continuous process of making "sugar cream," which consists in boiling, cooling, and beating the "sugar" or "sugar and glucose" in the same vessel. The process of preparing food and other materials by boiling it in a pan without the assistance of stirrers, removing the steam, and introducing a cooling medium such as water through the jacket and through the stirring apparatus. The combination with a vacuum pan of a rotatory agitator and its gearing, and, with an open pan, of stirring scraping apparatus as a fixture or otherwise.—A. R. L.

Improved Apparatus for the Manufacture of Aërated Water or other Liquid. C. Turner and S. Burge, London. Eng. Pat. 16,402, September 13, 1892.

The patentees claim the invention of a machine for aërating water or other liquid. It consists of a closed reservoir containing the liquid to be aërated. The reservoir is provided at its lower portion with a nozzle, out of which the liquid flows in a spray through a cylinder placed beneath the reservoir. A gas delivery pipe from a cylindrical vessel containing compressed carbonic acid gas, is connected with the bottom portion of the cylinder, so that the descending spray of liquid takes up the carbonic acid gas, which is forced in under uniform pressure.—A. R. L.

Improvements in the Manufacture of Bread, Biscuits, Biscuit Powder, and Bread Baked Goods. J. Whittaker, Halifax, Yorkshire. Eng. Pat. 16,607, September 17, 1892.

The patentee claims the use of "hypophosphite of calcium" and of "calcium hydrate," either alone or in combination, in the manufacture of breadstuffs. The object is to produce food materials of greater nutriment than those at present manufactured. The following example of the process is cited:—The necessary quantity of flour to make —say eight stones of bread, is incorporated with seven gallons of milk, one ounce of "calcium hydrate" mixed with one gallon of water, four ounces of "hypophosphite of calcium," and the usual amount of sugar, lard, and yeast according to judgment. The whole is then kneaded and baked into bread. The patentee fixes no limit as to the exact proportions of the ingredients, but he states that for biscuits and fancy breads the proportions of "calcium hydrate" and "hypophosphite of calcium" would be slightly more than above given.—A. R. L.

Improvements in Apparatus for Purifying Water. L. Archbutt, Derby, and R. M. Deeley, Derby. Eng. Pat. 19,829, November 3, 1892.

The improved apparatus consists of a tank with suitable inlet and outlet, and partition, also mud-conveying appliances, the whole being so arranged that the water flows continually through the various compartments of the tank. The water in the first compartment is agitated with mud and reagents, and deposits a precipitate in another compartment. Part of the deposit returns to the first compartment and is agitated with the fresh incoming water. (This Journal, 1890, 406.)—L. de K.

New or Improved Process for Removing the Oil from Roasted Coffee Berries for the Purpose of Producing a Wholesome Aromatic Extract of Coffee. G. H. E. Quellmatz, Dresden, Germany. Eng. Pat. 11,370, June 9, 1893.

The roasted and ground coffee is heated with water in a closed air-tight boiler to a pressure of about three-quarters of an atmosphere. At this pressure the volatile constituents of the coffee berries are vaporised, and the soluble portion of the roasted coffee is extracted. When the above-mentioned pressure has been attained the firing of the boiler is stopped, and the contents of the latter are drawn off into a cooling apparatus so as to produce a sudden reduction of temperature from about 100° C. to 10°—15° C. This sudden cooling occasions condensation of the oily portion of the coffee extract and its precipitation on the walls of the cooling apparatus.—A. R. L.

A New Process of Preserving Alimentary Substances. E. De Pass, London. From P. G. Biron, Argenteuil, France. Eng. Pat. 12,030, June 19, 1893.

The patentee claims a process for rendering alimentary substances imputrescible, which consists in immersing them in "nascent hydrochloric acid" produced by any suitable process, but preferably by the action of sulphuric acid on sodium chloride. According to the descriptive portion of the specification hydrochloric acid gas is generated by the action of sulphuric acid on a solution of sodium chloride in a saucer-shaped vessel, which is contained in a wooden box lined with india-rubber, and therefore capable of resisting the action of the acid vapours. The substance under treatment is suspended from the lid of the wooden vessel; the lid is closed at the moment the reaction between the sulphuric acid and sodium chloride commences. —A. R. L.

Improvements in the Manufacture or Production of Articles of Food for Human Consumption. G. W. Richards and J. W. Hodgson, Sheffield, Yorkshire. Eng. Pat. 13,021, July 4, 1893.

The patentees claim the rendering of certain articles of human food more easy of digestion, among which may be mentioned sausages, meat pies, potted meats, meat extracts, meat juices, &c., by mixing them with "papian," the fruit of the tree "*Carica papaya*."—A. R. L.

(*B.*)—SANITARY CHEMISTRY.

Sewage and its Purification. Gebek. Jour. für Gasbeleucht, **36**, 410—414.

Owing to the great variations in amount and composition of sewage and in local conditions, a uniform method of treatment is not possible. Sewage generally contains mixtures of impurities, mechanical mixtures, organic and inorganic substances in combination, as well as living organisms. The impurities may be divided into (1) suspended matter; (2) mineral matter; and (3) nitrogenous organic matter. Suspended substances, which are chiefly objectionable owing to their liability to cause stoppage with sand or mud, are generally worthless and may be disposed of by means of subsiding tanks or ponds. If, however, hair, wool, and vegetable matters are present an arrangement of sieves becomes necessary.

As regards water containing dissolved mineral substances, dilution to such an extent as to render it harmless is the simplest treatment if practicable; or the impurities may be precipitated by means of cheap chemicals. Lower metallic oxides, if present, must be oxidised. Water contaminated by salt springs should be evaporated down, as potassium and sodium salts are not readily retained by soils; the water, moreover, tends to extract the soil and render it infertile.

Sewage contaminated with organic matter includes the sewage of towns, waste from slaughter-houses, tanneries, &c., and the drainage from all the agricultural industries. Non-nitrogenous waste products, such as woody fibre, are nearly harmless until oxidised, when the organic acids formed are injurious. In water so contaminated it is desirable to induce the formation of carbonic anhydride, and this may be done by letting it become stagnant after the precipitation of the organic acids by lime and the subsequent addition of ferments. Another method is to precipitate the (non-nitrogenous) organic matter by means of lime, alumina, &c.

Nitrogenous organic matter, suspended or dissolved (and generally both forms occur), is most objectionable, as it readily decomposes, yielding a variety of products, many of which are poisonous; and also on account of the micro-organisms which accompany it. It is essential that the decomposition should take place in presence of plenty of oxygen, the products being then more or less harmless. It is a mistake to suppose that water which has contained suspended nitrogenous matter is pure when it has become clear, as it still probably contains putrefying germs. On the other hand, the purity of water cannot be measured by the number of bacteria it contains, since many are quite harmless.

The most usual method of purification is irrigation, fæcal matter being first separated by means of sieves. This method is valuable when the water contains nothing injurious to plants. Another process is filtration through soil; this involves the frequent removal of the deposit from the surface of the soil. All of the suspended and most of the dissolved organic matter is retained by the soil, as well as nearly all the bacteria.

In purifying water by chemical methods the two points to be borne in mind are the production of a stable precipitate and the employment of such chemicals as will not injure the river into which the water eventually passes. Of such methods the Röckner-Rothe process is about the most perfect, but leaves much to be desired.

The power of rivers of taking up large amounts of organic matter is not due to direct oxidation, but to the nitrifying organisms present.

In the course of the discussion on the paper it was remarked that the Röckner-Rothe process, though not perfect, would purify water to such an extent that it might be kept for months in open flasks, and the number of bacteria per cc. is reduced from millions to a few hundred.

—N. H. J. M.

Improvement and Sterilisation of River Water by Chemical Means, with Special Regard to the Hamburg-Elbe Water. B. Kröhnke. Jour. für Gasbeleucht. 36, 513—521.

There can be no doubt that the rapid spread of cholera last year in Hamburg, as well as the yearly occurrence of typhus, are connected with the quality of the Elbe-water. Among the proposed remedies, and methods for the purification of the water are (1) boring wells or bringing water from elsewhere; (2) boiling the water; (3) mechanical purification by subsidence and then filtration; and (4) chemical disinfectants. The first method would be the simplest and best, but a sufficient supply could hardly be got. Boiling would be safe, but far too expensive. Sand filtration will remove a good deal of impurity, but will allow many bacteria to pass through—cholera bacteria as well as others. It is also impossible to construct very large filters so that the rate of filtration will be uniform all along; the water, therefore, passes through the different portions at different rates and will be unequally purified. Water so purified will still contain much organic matter, as may readily be shown by treating a few litres with lime and allowing to settle; a considerable amount of yellowish-brown sediment is formed.

Among the various chemical disinfectants only inorganic compounds are considered, since the various organic substances are either impossible or very difficult to remove. Of inorganic compounds it seemed likely that compounds of elements which have a great affinity for sulphur would be suitable. Experiments with cuprous chloride gave satisfactory results. It is very readily prepared, is very easily removed from solutions, and becomes much less poisonous when oxidised. It is, moreover, not acted on by calcium carbonate. The following process was found suitable for the purification of water:—Cuprous chloride ($\frac{1}{200000}$) and ferrous sulphate (free from more oxidised iron, $\frac{1}{50000}$) are mixed with the water, which, after six hours, is treated with lime ($\frac{1}{100000}$) stirred for one hour and left for $1\frac{1}{2}$ hour to settle. It is then filtered through sand. The water, which originally contained 40,000—50,000 germs per cc., is now completely sterilised, clear, almost absolutely colourless, and is free from iron and copper.

The sand filter can be used for a very long time without cleaning, as is necessary in the case of filters employed directly for the Elbe-water.

The cost of purifying the water by the above method is estimated at a shilling per 1,000 cm.

The agitation of the water should be just sufficient to mix the cuprous chloride, &c.; if too violent there will be a too great absorption of atmospheric oxygen.

The sediment from the purified water may be burnt and the copper recovered.—N. H. J. M.

PATENTS.

Improvements in the Disposal of Sewage and Apparatus connected therewith. J. Norris, Egham. Eng. Pat. 20,726*, November 28, 1891.

The object of the invention (this Journal, 1892, 451) is the disposal of sewage without the ordinary cesspool and the prevention of accumulation of sewer gas *in the soil-pipe.* The bottom of the fresh air inlet chamber is no longer immediately connected with the enamel overflow pipe, but leads first to a central gutter. The soil drain from the *house* enters the chamber as before. The strainer is placed underneath the *outlet* of the soil drain. The current of fresh air which passes through the iron grating of the inlet chamber is induced *by a ventilating shaft.* A few more alterations of less importance will be noticed in the amended specification.—L. de K.

Improvements in Apparatus for Generating and Applying Fumes, Smoke, or Vapours for Disinfecting, Deodorising, or Fumigating Purposes, or for the Testing of Pipes or Passages by what is known as the Smoke Test, or for analogous Purposes. J. Watts, Bristol. Eng. Pat. 18,317, October 13, 1892.

The invention consists of an air-forcing device, such as a pump or fan, in connection with an air chamber and a combustion chamber. The lighted substance is placed in the combustion chamber and sufficient air is driven through holes in the floor thereof to burn the material.

The pressure gradually rises in the air chamber and opens valves so that air may pass by the sides of the combustion chamber and mix with the smoke or fumes, which are then forced to an outlet furnished with a valve, which closes when the apparatus is not in use. The whole is rendered air-tight by an outer cover provided with a water-seal joint.

—L. de K.

Improvements in and in connection with the Manufacture of Iron Sulphate, and of Materials for use in the Filtration and Precipitation of Sewage and Polluted Waters. F. P. Candy, Balham. Eng. Pat. 18,598, October 18, 1892.

Sulphide of iron such, *e.g.*, as iron pyrites, is roasted in a current of air and steam, and the gases evolved are passed through or over a layer of hydrated ferric oxide, mixed, if desired, with alumina (bauxite). The result of this treatment is, on the one hand, a residue composed of porous iron oxide and iron sulphate, and on the other hand an absorption of the sulphurous acid with formation of ferric, or aluminium sulphates. The iron sulphate preferred is ferric sulphate. The oxidation to sulphate may be promoted by the use of a little manganese dioxide. After lixiviating out the sulphate from the *residue*, the insoluble matter is heated to redness out of contact with air, with or without addition of carbonaceous matter, such as coal, tar, sawdust, green oils, &c. Care must, however, be taken not to reduce the oxide to the metallic state. After reducing it to a suitable size the material is ready for use. When solid ferric sulphate is wanted, the solution, instead of being evaporated down, may be advantageously used instead of plain water in the manufacture of a salt of iron, or alumina, from iron or aluminium oxides.—L. de K.

Improvements in or relating to the Treatment of Sewage. W. D. Scott-Moncrieff, London. Eng. Pat. 19,247, October 26, 1892.

The invention relates to certain improvements in the purification of the effluent obtained from the inventor's "Cultivation filter beds," which depend for their working upon the action of microbes. The effluent is passed downward through vertical chambers of a great height, sometimes as much as 100 feet, filled with a porous material, preferably coke. Or, the effluent is forced through pipes which are never allowed to run full, but are loosely filled with filtering material.—L. de K.

Improvements in the Treatment of Sewage and Polluted Waters, and in connection with the Manufacture of Materials for use in the Treatment of Sewage and Polluted Waters. F. P. Candy, Balham. Eng. Pat. 19,587, November 1, 1892.

The patentee takes 100 parts by weight of the dry "iron oxide" produced from the iron borings used in aniline works for the reduction of nitrobenzene. This oxide is treated with a mixture of 150 parts of commercial sulphuric acid and 10 parts of water, both liquids being preferably used hot. The result is the production of a nearly dry iron salt, which must, however, undergo a further drying in a kiln so as to remain in a dry condition. The inventor sometimes adds to the iron oxide a suitable proportion of bauxite, or any other soluble aluminous substance, with an extra quantity of sulphuric acid sufficient to dissolve it. It is best to dry the sulphate in moulds so constructed that the dry contents can be easily removed. For instance, moulds of four sides only, or of four sides and a bottom only. One or more of the sides of the bottom may be hinged or removable, for greater convenience.

When using the iron oxide for filtration purposes it should be well washed and then used in combination with clay. Or, it is mixed with carbonaceous matter, such as coal-dust, sawdust, tar, &c., and then burnt or carbonised. The residue is then granulated or otherwise reduced to a suitable size. The salts of iron and alumina referred to are added to the sewage or polluted water in the ordinary way for the introduction of precipitants. The effect is a powerful precipitating and deodorising action on such sewage or polluted water.—L. de K.

(*C.*)—DISINFECTANTS.

Disinfectants for Dwelling Rooms. C. Chamberland and E. Fernbach. Ann. l'Institut Pasteur, 1893, **7**, 433,

"*Eau de Javelle*," bleaching powder solution of a concentration 1 : 120, and commercial hydrogen peroxide are found to be stronger disinfecting agents towards pathogenic microbes than a 1 per cent. solution of mercuric chloride. These antiseptics, however, at the ordinary temperature either do not act at all on moist germs, or only do so after several hours. When, however, the disinfecting solutions are heated to a temperature of 40°—50° C. (or higher), moist germs are destroyed in a few minutes. The disinfection of rooms which sick persons have occupied must therefore be effected by the above-mentioned solutions raised to a high temperature. Dry germs are capable of resisting for several hours the action of the above-mentioned solutions at 40°—50° C. When the germs are moistened with water they are again rendered more susceptible of attack. The walls of the sick room should therefore be moistened with warm water before the antiseptics are applied.

It is also noteworthy that 0·8 per cent. bleaching powder solution is far more active than the ordinary concentrated solution (1—120) whether moist or dry germs are being dealt with, or whether the solution is applied hot or cold. Thymol, "lysol," and oil of turpentine are, in comparison to the above-named agents, bad antiseptics. A solution of bleaching powder prepared in the following manner is equal in activity to a 1 per cent. solution of mercuric chloride. Ordinary bleaching powder (100 grms.) is triturated with water (1,200 grms.), allowed to remain for an hour, filtered, and diluted with 10 litres of water.

—A. R. L.

PATENTS.

An Improved Sheep Dip. A. Robertson, Oban. Eng. Pat. 2990, February 10, 1893.

The inventor has succeeded in preparing a suitable sheep dip containing both tar acids and arsenic.

Three parts of rosin and one part of grease are melted and mixed with $6\frac{1}{2}$ parts of tar oil, which should contain 25 per cent. of tar acids, and also with two parts of 95 per cent. carbolic acid. To this mixture is added two parts of white arsenic dissolved in $1\frac{1}{2}$ parts of soda-lye, or an equivalent weight of yellow sulphide of arsenic may be used. The product is soluble in cold water, and has the properties of a simple carbolic dip and an arsenical dip, the tar acids coagulating the parasites and the arsenic having a continuous poisonous effect on their progeny.

When used for preventing fly striking in summer, the inventor recommends mixing 15 lb. of the above compound with 5 lb. of a mixture composed of 3 lb. of flowers of sulphur, 1 lb. of tobacco powder, and 1 lb. of Hellebore, and of course also with a sufficiency of water.—L. de K.

XIX.—PAPER, PASTEBOARD, Etc.

PATENTS.

An Improved Process of and Apparatus for Treating Peat for the Manufacture of Paper Pulp. A. Brin, Twickenham. Eng. Pat. 15,720, September 1, 1892.

The invention has mainly for its object to effect a thorough bleaching of the peat so as to render it suitable for making the finest white paper. First it is disintegrated by means of masticating rollers, impurities being at the same time washed away by a copious stream of water. It is then charged into a closed vessel containing one or more squeezing rollers between which the peat is caused to pass repeatedly by the circulating action of helical agitators at the same time that it is subjected to the action of a hot solution of caustic soda, say at $2\frac{1}{2}$ per cent., and under a steam pressure of, say, 5 atmospheres. The disintegrated cellulose, after washing, is forced into the bleaching vessel also provided with squeezing rollers and agitators, where it is subjected to the action of hypochloric acid, the latter being produced by injecting, by means of a steam jet, what the inventor calls active oxygen or oxychloride of hydrogen, which is a mixture of oxygen and dry chlorine resulting from the passage of oxygen over binoxide of manganese in the presence of liquid hydrochloric acid. Provision is made for the recovery of the chlorine which is used over again for bleaching another charge, the strength of the bleaching agent being restored or maintained by the injection of active oxygen as before described.—E. G. P. T.

Improved Process and Apparatus for Manufacturing Plastic Articles from Paper Pulp. E. and W. Gelinek, Komatau, Bohemia. Eng. Pat. 5178, March 9, 1893.

The materials, consisting of waste paper scraps, 40 per cent.; size, glue, or paste, 20 per cent.; clay, 20 per cent.; and flour, 20 per cent., are first roughly mixed, and then kneaded into a plastic mass (papier-mâché) in a special apparatus from which it is fed in a thin plate or sheet. The plastic plates thus produced are placed in moulds, preferably of gypsum or metal, and pressed into the same by means of elastic dies. When the die is removed a sheet of soaked, long-fibred paper is placed upon the papier-mâché, the die being once more applied to fasten the paper lining to the moulded mass. The object of the lining is to prevent pieces of the moulded article from scaling or falling off. The flexible die is made as follows:—The unpolished gypsum mould is filled with clay-water which is kept stirred for some time. The dry gypsum sucks up the water and a deposit of clay takes place on the surface of the mould. The excess of clay water is run off, a short time allowed for drying, and the operation repeated until a coating is obtained equal in thickness to that of the object to be moulded, the space confined within this coating indicating exactly the size which the die working in the mould should present. The clay surface is polished, coated with oil, and the die is formed therein by filling the empty space with joiner's glue.

To remove the layer of clay from the gypsum mould it is only necessary to allow it to dry sufficiently for the clay to contract. It then cracks and scales off of its own accord.

—E. G. P. T.

Paper Board. J. C. Marks, Birmingham. From R. B. McEwan, J. L. McEwan, and R. W. McEwan, New Jersey, U.S.A. Eng. Pat. 7221, April 8, 1893.

The inventors claim, as a new article of manufacture, a paper board formed from printed newspapers or the like, ground to a pulp and having the permanent particles of the printers ink minutely subdivided and uniformly distributed throughout the body of the board. The paper, cleansed from foreign matter, is soaked in hot water until it is thoroughly softened. Without permitting it to cool, it is transferred to the beating engine, whence it passes to the stuff-chest, from which it is pumped to the making cylinder-vat, and it is always kept as hot as possible. By this means the ink, once softened, is never allowed to set, so that a smooth and even tint is obtained throughout, while the strength of the fibres has not been impaired by attempts to bleach out the ink.—E. G. P. T.

Improvements in or Connected with the Manufacture of Pulp for Paper Making. J. P. Cornett, Claxheugh, Durham. Eng. Pat. 14,191, July 22, 1893.

This invention relates to a machine for breaking up esparto, straw, and other paper-making fibres without materially reducing the roots, weeds, and similar obnoxious materials, so that the latter can easily be extracted by knottering before bleaching, whereby a saving of bleach is also effected. The improved machine consists in a fixed "conical cylinder" with an inner rotary "conical cylinder," both being fitted with teeth, so that when the fibrous material from the pulp boilers is introduced in conjunction with a large volume of water at the feeding hopper, the paper making fibres shall be materially reduced within the machine without reducing the roots, weeds, &c., prior to the automatic exit of the mass into a trough placed below.
—E. G. P. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Simple Method of Preparing Oxygen. Tonneau. Union Pharm.; through Répert Pharm., 1893, **45**, 304.

The following process is recommended for the preparation of oxygen for inhaling purposes:—Into a Woulf's bottle of 2—3 litres capacity, provided with three openings, 100—200 grms. of manganese dioxide are introduced, together with barium peroxide and sufficient water to cover the mixture; a thin layer of oil is now poured upon the surface of the water to prevent the formation of froth during the reaction. A funnel provided with a tap, and filled with concentrated acetic acid passes through the middle opening of the bottle. Of the two other openings, one is connected by a glass tube to a wash-bottle, to which is attached a caoutchouc tube, terminating with a mouth-piece for the patient; whilst a glass tube with a caoutchouc bladder passes through the remaining opening. By pressing the latter, air is introduced and the reaction moderated. Oxygen is evolved when a few cc. of acetic acid are dropped upon the mixture above described.—A. R. L.

Report on the Spirit Industry and on Alcoholic Preparations. G. Arends. Chem. Ind. **16**, 78—83.

Although a good deal both of scientific and technical work on this subject has been done during 1892, the author states that little has been published and that there are no important novelties to be mentioned. The paper describes improvements in the preparation of the grain and in the fermentation process, gives methods for purifying and analysing spirit, and refers to work which has been done on alcoholic preparations, such as ether, ethyl chloride, chloroform, and iodoform, &c., concluding with some extracts from the new Italian Pharmacopœia, in cases in which the preparations are different from those described in the Ph. Ger. In last year's report Effront's method (this Journal, 1892, 931) was described for preventing the formation of lactic and butyric acids in the spirit mash by treatment with fluoric acid or fluorides. (See also this Journal, 1893, 777). The Société Générale de Maltose of Brussels have patented a method for treating the fields with soluble fluorides in order that the grain may be rendered more suitable for the preparation of spirit. J. Weber, Ger. Pat. 55,413, in order to remove fatty substances from potatoes, malt, and grain, extracts the raw materials with ether or petroleum ether preparatory to their employment for fermentation. An important branch of the spirit industry is the cultivation of an effective yeast, and a yeast nursery was erected in Berlin at the beginning of 1891 for this purpose. It is, however, necessary, in order to produce a healthy yeast, to provide a suitable food, and a patent of Nyrander and Francke (Eng. Pat. 22,399 of 1891; this Journal, 1892, 1023) describes a process by which a large number of hitherto useless nitrogenous substances can be employed in the yeast or spirit industry. These substances are the refuse from slaughter-houses, albumin, blood, leather and fish refuse, guano, and pressed cakes of different seeds, such as linseed, rape, poppy, hemp, mustard, and cotton seed. These bodies all contain protein, which can be peptonised by heating under pressure with dilute acids, or by long standing with dilute lactic acid, and in this way rendered suitable for the yeast. The fluids so obtained, after careful purification, form an excellent food for the yeast, and a calculated quantity is added to the mash or molasses, which causes the formation of a strongly fermenting yeast, and consequently an increased yield of spirit. After the fermentation has been started, several methods have been proposed for preventing the formation of substances other than ethyl alcohol. A. B. Görner adds 1—2 grms. of carbon bisulphide to every cubic metre of liquor in order to prevent the formation of an excess of acid, whilst the Société Générale de Maltose recommends the addition of fluoric acid. For preventing the formation of fusel oil, J. Hradil, Ger. Pat. 53,672, adds 1 grm. of finely divided stearic acid to every hectolitre of mash. On the other hand, L. Perdrix is of opinion that the formation of amyl alcohol is due to the presence of starch, and he has found in his work on the formation of fusel oil in alcoholic fermentations that it is due to a simultaneous fermentation caused by an organism which he has termed *bacillus amylocymicus* (this Journal, 1892, 699). According to L. Lindet, most of the fusel oils are formed when the true alcoholic fermentation is nearly at an end, *i.e.*, when the amount of sugar present is insufficient for the yeast. The following table gives the amounts of fusel oil formed in each litre of ethyl alcohol at different times:—

	Cc.
After 14 hours' fermentation	3·64
„ 20 „	4·45
„ 38 „	6·44
„ 62 „	9·20

Lindet is also of opinion that the higher alcohols are products of a different micro-organism, which does not begin to act readily until the yeast can no longer produce alcohol. In order, therefore, to prevent the growth of *bacillus amylocymicus* it is only necessary to employ a proportionately large amount of an active yeast. As regards the addition of antiseptics to the mash E. Biernacki finds that small quantities, even of the strongest antiseptics, such as corrosive sublimate, thymol, &c., increase, whereas larger quantities diminish or entirely prevent the formation of spirit, and that this action is more marked in the case of organic than of inorganic compounds. A method, which has been patented, in order to utilise the escaping carbonic acid gas and to retain the alcohol which escapes with it (about 1 per cent.) during fermentation is briefly alluded to. A fuller account is given of the method for obtaining pure spirit from roots according to a patent of Rivière and Bailhache. The expressed juice is boiled with slaked lime to remove albuminous matters, filtered, acidified with sulphuric acid, and sterilised by heating to 125°. After cooling, pure wine yeast is added and the liquor is allowed to ferment, which commences in about 24—48 hours and is complete in about ten days. The liquor is then allowed to settle for some days, and when quite clear is distilled twice, giving an alcohol of 50—55 per cent. Tr. For purifying spirit, Weitenkampf's process (Ger. Pat. 57,393) appears to give good results. The crude spirit is strongly cooled and saturated with carbonic acid which precipitates all soluble matters and the fusel oil sinks as a heavy oil to the bottom of the vessel. The spirit so obtained is said to be equal to that produced by the best rectifying methods. Some notes are given as to the analysis of spirit. In order to estimate higher alcohols, C. Bardy extracts the spirit with carbon bisulphide, in which ethyl alcohol is insoluble. The butyl and amyl alcohol which dissolve are after separation estimated volumetrically as acetic ethers. Acetone, according to L. Vignon, is estimated by adding iodine and soda solution in order to produce iodoform. The presence of denatured spirit in wine even to 0·25 per cent. can be detected by the following method due to K. Portele (this Journal, 1893, 379). Nine-tenths of the suspected liquid are distilled off, and the distillate, after the addition of dilute sulphuric acid, is again distilled. This distillate is tested for methyl alcohol by means of potassium permanganate, and the residue, concentrated to a small volume is supersaturated whilst still warm, with caustic soda. If pyridine bases are present they at once become evident by their smell. A method patented by E. Gossart (this Journal, 1892, 712) of testing for foreign liquids has probably no technical value. It depends upon the fact that two chemically or physically similar liquids mix more easily than two which are unlike. Thus a spirit which already contains propyl alcohol will mix more easily with pure propyl alcohol than pure spirit will. The liquid to be tested for is used as the reagent, and in the case just mentioned the method employed is as follows. The liquid to be tested is placed in a cylindrical glass tube, which is so inclined that the surface of the liquid is concave, and a drop of pure propyl alcohol is allowed to run down the side of the tube. If much propyl alcohol be present the drop mixes at once, whereas if the liquid consist of pure spirit the drop rolls to the middle of the surface and then mixes. The patents of Spiller, Bendel, Hahn, and Löwe refer to the sterilisation of alcoholic liquids by passing them through an electrical or magnetic field. J. A. Hasbrouck and the Mechanical Spirit Maturing Syndicate have each patented a process for ageing or maturing spirits. Both methods consist in spraying the liquid in a vessel of a particular shape so as to aërate it as much as possible. According to Schierholz, one part of sulphur dissolves in 265 parts of boiling and 3,300 parts of cold alcohol. The distillation apparatus of W. Haeck is so arranged that the liquid after filtration is gradually heated to certain temperatures, so that the liquid boiling at each of these temperatures is driven off at that point. It is said to be possible to separate by means of this apparatus, ether, aldehyde, alcohol and fusel oil in a single rectification. Bolton's apparatus consists of a column containing three spiral condensers, through which cold water runs. The less volatile products condense on the outside of these tubes, whilst the lower boiling liquids escape through the upper part of the apparatus and are condensed separately. Reference is also made to Barthel's Bunsen burner for spirit.

The subsequent portion of the paper is a *résumé* of work on various preparations of alcohol, and deals with the substances under different headings.

Collodion.—Supernitrated collodion wool is steeped in ammonia for 24 hours, and after thorough washing and drying dissolves easily in alcohol and ether. In order to render it more elastic after having been applied to the skin, it is covered whilst still wet with a thin layer of cotton wool.

Aldehyde.—It has hitherto been supposed that paraldehyde was a condensation product of three acetaldehyde groups and that metaldehyde contained more than three. J. Troeger has found that pure metaldehyde after 10 years has been gradually converted into liquid paraldehyde, and that both compounds have the same molecular weight, so that they are both modifications of the triple molecule and both may be converted into ordinary acetaldehyde. Claisen, in his investigation on the condensation products of aldehydes and ketones in presence of alkaline reagents, has discovered the formation of hydracetylacetone—

$$CH_3.CH(OH).CH_2.CO.CH_3$$

which is to be employed for the preparation of ethylidene acetone. In addition to the sodium nitroprusside reaction (this Journal, 1892, 846) for the detection of aldehydes and ketones in alcohol, a method has been discovered by Von Bitté which depends upon the fact that aldehydes and ketones give a characteristic red colour with certain aromatic nitro-compounds, especially with *m*-dinitro-benzene after neutralisation with alkali, which changes or disappears on adding an organic acid.

Chloroform.—According to Anschütz pure chloroform can be obtained by the following method. By acting with phosphorus oxychloride on salicylic acid, two crystalline compounds are obtained. One of these, called *Salicylide*, $C_6H_4CO.O$, is soluble in chloroform and crystallises with it as $(C_6H_4CO.O)2CHCl_3$ This compound is perfectly stable in closed vessels, but decomposes on standing or gentle heating into salicylide and pure chloroform. (See also this Journal, 1893, 782). By acting with antimony trifluoride and bromine on chloroform, Swarts has obtained *fluorochloroform*, $CHFl_2Cl$, a colourless liquid boiling at 14·5° C. Friedel and Crafts have produced phenylanthracene by acting with chloroform on benzene in presence of aluminium chloride. As regards the solubility of iodine in chloroform, Duncan finds that one part of iodine is soluble in 56·6 parts of chloroform at ordinary temperatures. Weitenkampf's method alluded to above can be employed for precipitating substances from alcohol, ether, or chloroform without evaporating the solvent. The fluid is contained in a cylindrical, closed vessel provided with a conical bottom and cooled with liquid carbonic acid by means of a worm. The carbonic acid is allowed to escape into the apparatus, which is provided with a safety valve to blow off at 3 atmospheres. After some time the dissolved substances separate out and can be removed by suitable arrangements.

Chloralimide.—By heating chloral-ammonia in a flask on the water-bath, chloroform and dilute ammonia distil off, leaving formamide and chloralimide, and the latter is extracted by alcohol. The substance can also be obtained directly by heating chloral and chloral-ammonia until chloroform is no longer given off. The yield is about 16—22 per cent. of the theoretical.—T. A. L.

Hydrogen Peroxide. T. Gigli. Bollett. chim. farmac. 1893, **12**, 675; Chem. Rep. 1893, **17**, 186—187.

Many chemists have stated that pure hydrogen peroxide has a neutral reaction (this Journal, 1893, 78). The author has submitted a 3 per cent. solution of commercial hydrogen peroxide to distillation, and constantly observed that the reaction of the distillate was acid, although no acid impurity could be recognised in the distillate. He therefore contends that pure hydrogen peroxide has an acid reaction and must be regarded as a weak acid.

It was originally stated by Thenard that while both MnO_2 and PbO_2 decompose hydrogen peroxide, the former alone does so without itself undergoing permanent change, the latter being reduced to PbO. The author has directly measured the oxygen given off by a 3 per cent. solution of hydrogen peroxide in contact with MnO_2 and PbO_2 and finds the quantity to be identical and to correspond with only the active oxygen of the hydrogen peroxide, none being derived from the metallic peroxides. It is true that PbO_2 becomes converted into a white powder similar in appearance to $Pb(OH)_2$ by contact with commercial hydrogen peroxide, but this must be ascribed to the presence of acid impurities in the latter. This view is confirmed by the fact that PbO_2 is not changed in appearance by hydrogen peroxide purified from acids by distillation.

—B. B.

Terpenes and Ethereal Oils. O. Wallach. Annalen, 272 [1], 99—125.

The constituents of Thuja oil.—Thuja oil has been studied by Schweizer (Annalen, 52, 398), and more recently by Jahns (Arch. de Pharm. 221, 748). According to the latter thuja oil consists chiefly of a body isomeric with camphor, in admixture with a dextro-gyratory terpene. The camphor-like substance, which he named "thujol," apparently existed in two modifications, levo- and dextro-rotatory respectively, possessing almost identical boiling points (195°—199° C.).

Crude thuja oil yields three main fractions on distillation:—I. 160°—190° C.; II. 190°—200° C.; III. 200°—215° C. The first contains pinene and certain other bodies, seemingly ethers of acetic acid. From the second and largest fraction the author has isolated the two varieties of Jahns' "thujol," and finds them to be, not only physical, but also chemical isomers. One of these bodies is a levo-gyratory modification of fenchol (this Journal, 1890, 1147); the other an entirely new, unsaturated compound, which it is proposed to name *thujol.*—H. T. P.

Alkaloids in Cod-liver Oil and their Origin and Therapeutic Action. J. Bouillot. Comptes rend. 116, 439—441.

The author comes to the conclusion that the presence of these alkaloids is not due to any process of fermentation, but that they pre-exist in the tissue itself. Microscopical crystals were observed in a thin section of the liver, after exposure to hydrochloric and hydrofluoric acid gases, and dessication under bell-jar, which possessed the characteristics of the hydrochlorides of dihydrotoluidine, morrhuine, &c. Platinic chloride by its action and formation of chloroplatimates showed the presence of morrhuine.

Pangaduine is the name given to the collective alkaloids, which are soluble in alcohol of 80°, in water, glycerol, &c., and which gives 3·5 per cent. of ash. It is useful in cases of imperfect nutrition, rheumatism, diabetes, tuberculosis, &c. —W. P. D.

Champacol. E. Merck. Chem. Zeit. Rep. 1893, 17, 31.

When champaca wood is distilled with steam, a fragrant substance is obtained, from which a compound, $C_{17}H_{30}O$ can be isolated. This body, to which the name *Champacol* has been given, crystallises in long, white, matted needles, melts at 88° C., and is easily soluble in alcohol or ether, but sparingly soluble in water. It can be sublimed without decomposition, and when pure is odourless and stable. When impure, however, it liquefies, and the pleasant odour of champaca wood is reproduced.—T. A. L.

On Pseudohyoscyamine. E. Merck. Chem. Zeit. Rep. 1893, 17, 31.

In addition to the bases hyoscyamine and hyoscine already found in *Duboisia myoporoides*, the author has now discovered a new base, which he terms *Pseudohyoscyamine*, and which is different from any of the solanum bases known. It is separated from hyoscyamine and hyoscine by repeated crystallisation, and forms yellow needles when precipitated by a large quantity of ether from its solution in chloroform. It has the composition, $C_{17}H_{23}NO_3$, melts at 134° C., is levorotatory and dissolves in water and ether with difficulty, but is very easily soluble in alcohol and chloroform. No simple salts of the alkaloid have been obtained, but the following double salts are described. The gold salt, $C_{17}H_{23}NO_3.HCl.AuCl_3$ forms shining yellow plates melting at 176° C., and tolerably soluble in hot water. The platinum salt $(C_{17}H_{23}NO_3HCl)_2PtCl_4$, crystallises in feathery needles, which are tolerably soluble in hot but very slightly soluble in cold water. The salt chars at 116° C. and is decomposed at 150°. Pseudohyoscyamine, when split up, gives tropic acid and a base isomeric with tropine. The platinum salt of this base $(C_8H_{15}NOHCl)_2PtCl_4 + H_2O$ crystallises in reddish-yellow aggregates, which begin to decompose at 210°, and on further heating to 250° become gradually blacker without showing any definite melting point.—T. A. L.

Hydrastinum Bitartaricum Crystallisatum. E. Merck. Chem. Zeit. Rep. 1893, 17, 30.

Hitherto the only hydrastinine salts which had been obtained in a crystalline form were the picrate and the double salt with stannous chloride. The author has now succeeded in obtaining a bitartrate having the constitution—

$$C_{21}H_{21}NO_6.C_4H_6O_6 + 4H_2O$$

which dissolves easily in hot, but sparingly in cold water, and crystallises in white needles. When dried at 105° C. till its weight was constant the salt lost 12 per cent., and finally fused to a yellowish mass.—T. A. L.

On the Relations between Atropine, Apo-atropine, and Belladonnine. E. Merck. Chem. Zeit. Rep. 1893, 17, 30.

According to the author (this Journal, 1892, 632), the alkaloid which Hesse isolated from a belladonna root, and called atropamine, is identical with apo-atropine. Some additional evidence in support of this view is now brought forward, and it is found that both atropamine and apo-atropine behave similarly to hydrochloric acid, giving belladonnine, $C_{17}H_{21}NO_2$, whereas Hesse asserted that only atropamine underwent this conversion. Hence the relation between the three alkaloids is now explained, for atropine splits off water giving apo-atropine, and this substance, by the action of acids (*e.g.*, dilute hydrochloric acid) gives belladonnine.—T. A. L.

The Volumetric Estimation of Acetone. F. Robineau and G. Rollin. Monit. Scient. 1893, 272—274.

See under XXIII., *page* 870.

Delicate Reaction for p-Phenetolcarbamide ("Dulcine"). N. Wender. Pharm. Post, 26, 269.

See under XXIII., *page* 869.

Volumetric Estimation of Coniine and Nicotine in the same Solution. G. Heut. Arch. Pharm. 1893, 231, 376; Chem. Zeit. Rep. 1893, 165.

See under XXIII., *page* 871.

The Furfurol Reactions of the Alkaloids. N. Weinder. Chem. Zeit. 17, 950.

See under XXIII., *page* 869.

The Present Prospects of Ipecacuanha. J. Soc. Arts. 41, 1893, 975.

The advances that have taken place in the price of ipecacuanha of late in the English drug markets—due, it is said to the fact of the plant becoming more scarce every year in its Brazilian home—is a matter that brings to mind the attempts made some 28 years ago to introduce the plant into India for extended cultivation. Though in India the ipecacuanha has not made for itself a happy home, the attention given to it by the Indian Government, and the valuable assistance rendered by Kew, have been felt in other parts of the East, with the result that ipecacuanha root now finds its way into the English market from Johore. The history of the single plant sent from Kew, in 1866, is interesting, as showing what may result from small beginnings. From the original plant, which died in 1868, 14 other plants were propagated, and the offspring of these in about three years, amounted to about 400 by further propagation; and, from these and other plants sent to India, the stock increased, in a very few years, to over 6,000. Up to this period, the plants had been propagated by leaf cuttings, but, as plants increased, they were more rapidly propagated by starting small portions of the rhizome, so that in a short time as many as 63,000 plants had been raised. Experience has shown that the plant can be easily propagated, but for extended and profitable culture, India does not seem suited to it; some roots, however, that were grown, dried, and prepared in India in 1876, were used in one of the Calcutta hospitals, and were proved to be equal in medicinal value to the best ipecacuanha grown in Brazil.

Ten years later we find this valuable plant reported as growing in the Straits Settlements "with all the luxuriance of its native country, when a proper situation is hit upon." Though at the date referred to, namely, 1886 or 1887, ipecacuanha was brought into the London market from extensive plantations in Johore, it would seem not to have succeeded since then so well as was anticipated, judging from the fact of the advance in price and the cause to which it is attributed, namely, decreased supply.

The district upon the frontier of Bolivia is only very imperfectly explored, the soil is marshy, and it is covered with tropical forest. Tribes of savages roam about, and the work of gathering ipecacuanha is neither safe nor pleasant enough to induce the lazy half-castes, the only kind of labour available, to undertake it unless at a very high rate of wages. Ignorant and lazy, these people never take the trouble to leave enough of the plant to give it a chance of growing again, and so season after season they have to go further afield, taking provision with them, and frequently remaining in the marsh for weeks. Thr collecting goes on pretty well all the year round, and the root dug up is brought to the chief settlement, when it is packed and shipped down the river—a tremendous distance—to Buenos Ayres or Montevideo, about 2,000 miles. Steamers now ply on these rivers, and take about three weeks to accomplish the journey from the upper reaches to the Atlantic port. The freight is very high, but it is hoped that in a few years' time the railways which are being pushed inland, will tap this district, and then the drug may be got again from Rio, where it came from many years ago before the coast regions were exhausted.

The Ipecacuanhas of English Commerce. E. M. Holmes (British Pharm. Conference, Nottingham, 1893). Pharm. J. 1893, 209—11.

For some months past attention has been directed to the inferiority in character of recent importations of ipecacuanha due to the large admixture of the woody stem with the root. Conflicting statements have been published regarding the relative proportion of alkaloid present in the stem and in the root. According to a series of careful analyses recently made by Messrs. Paul and Cownley (*Pharm. Journ.*, [3], xxiv., 61), the stem appears to contain about one-third less of alkaloid than the root. They have, moreover, shown that Carthagena ipecacuanha also contains a crystalline alkaloid which is not identical with that obtained from Brazilian ipecacuanha. It seems highly probable that the medicinal value of the root does not depend upon emetine entirely, since results are obtained by the powder that cannot be obtained from emetine.

The ipecacuanhas of English commerce may be divided into two sections—

1. Those that are derived from the genus *Cephäelis.*
2. Those that are derived from other genera belonging to the same or to different natural orders.

1. Official Ipecacuanha (*Cephäelis Ipecacuanha,* Rich.).—Of this kind there are several commercial varieties or qualities.

A. Brazilian or Rio Ipecacuanha.—A good sample should yield about 80 per cent. of bark.

B. Indian Ipecacuanha.—This is derived from the plant cultivated in Johor (Straits Settlements). It is imported from Singapore. It appears to contain 1·7 of (the so-called) emetine as against an average of 1·66 per cent. in the Brazilian kind, and may therefore be supposed to be of good quality.

C. Mouldy Ipecacuanha.

D. Woody Ipecacuanha.

E. Doctored Ipecacuanha.—This quality consists of inferior, woody, or mouldy ipecacuanha that has been washed and dried.

2. Carthagena or Savanilla Ipecacuanha (*Cephaëlis acuminata,* Karsten).—This kind of ipecacuanha has recently been imported in increasing quantities.

Spurious Ipecacuanhas.

Owing to the name "Poaya" being used in a generic sense in South American countries for roots possessing emetic properties, various drugs bearing this name are sent to this country by merchants at intervals of a few years. Sometimes these meet with purchasers, but their ultimate destination is involved in obscurity. None of them approach ipecacuanha in therapeutic value.

The plants from which these Poayas are derived belong chiefly to the natural orders *Rubiaceæ* and *Violaceæ*, and one to the *Polygalaceæ*. Those which have been identified in English commerce are three in number, viz.: (1.) *Psychotria emetica;* (2.) *Richardsonia scabra;* and (3.) *Ionidium Ipecacuanha.*

A. Black or Greater Striated Ipecacuanha (*Psychotria emetica,* Mutis).—A decoction of the root gives evidence of the presence of a reducing sugar[*], but not of starch. According to F. Ransom it contains traces (·016 p.c.) of emetine, or of an alkaloid giving the same reactions. The woody column is dense, and not visibly porous.

B. Lesser Striated Ipecacuanha (*Richardsonia species*).—Planchon refers it provisionally to the genus *Richardsonia.*[†] Examined by F. Ransom it was found to contain 0·027 of emetine.[*]

C. Undulated Ipecacuanha (*Richardsonia scabra*).—It has been stated to contain emetine, but the statement needs confirmation.

D. (1.) White Ipecacuanha, Ionidium Ipecacuanha.—It does not contain starch (Moeller, "Lehrbuch für Pharmacognosie," p. 313.

D. (2.) A root, supposed to be that of *Ionidium Ipecacuanha,* entered the London Market in 1884, and was examined by Mr. W. Kirkby. (Pharm. Journ., [3] xvi., 126).

E. False Indian Ipecacuanha.—Some years ago a quantity of a small root said to be imported from Southern India was offered in the London market as ipecacuanha.[‡]

It should be remarked, in conclusion, that although it is comparatively easy to identify any of the spurious ipecacuanhas by their microscopical structure and external characters as seen under a good lens, it is by no means so easy to detect the presence of the spurious roots in powder, since in several of them starch and acicular raphides are present, and the starches can only be determined by careful and repeated examinations and measurements.

Deëmetinised Ipecacuanha. F. C. J. Bird. British Pharm. Conference, Nottingham, 1893. Pharm. J. 1893, 211.

In the course of discussion on this paper, Dr. B. H. Paul said he had lately had occasion to examine some samples of ipecacuanha for the purpose of ascertaining the amount of so-called emetine in them. At the outset he was impressed with the defective nature of most of the methods recommended for the determination of emetine, and endeavoured in the first place to devise one by which better results could be obtained. He had not proceeded very far before it became evident that the alkaloid in ipecacuanha, to which the name emetine had been given, is by no means an independent, homogeneous chemical substance, but consists of two or more distinct alkaloids. Emetine is described as being a perfectly amorphous substance, incapable of crystallisation, and as generally obtained, either by means of chloroform or ether, from Brazilian ipecacuanha, it is always in that form; a solution with either of those solvents drying up to a perfectly transparent varnish. But when the alkaloid was sufficiently purified it could be separated into two portions, one of which was distinctly crystalline. He exhibited a small sample of these crystals. So long as it was mixed with the amorphous base, there was no sign of crystallisation at all, but was the resinous transparent mass usually met with. It was not until the separation was effected to a considerable extent, which was a tedious matter, accomplished by continual fractional precipitation, that this base distinctly crystallised. But the hydrochloride of the amorphous base was a distinctly crystallisable salt, which was very soluble in water, though it would crystallise from a watery solution much in the same way as hydrochloride of morphine. With regard to the amount of alkaloid in ipecacuanha, the fact that there were two distinct substances present rendered it difficult to determine the value of ipecacuanha on the basis of the alkaloid present, until something was known of the therapeutic action of the two different alkaloids. He hoped before long to have worked out some descriptions of the characteristics of these two or three bases which he had already separated, and to get them therapeutically examined, so as to learn which was the efficacious medicinal agent and what were the characters belonging to it. Altogether the knowledge of the therapeutics of ipecacuanha was very deficient, and this was well illustrated by what had been written lately about deëmetinised ipecacuanha. The reports from Indian physicians were in direct conflict with one another; some saying that the deëmetinised ipecacuanha was no better than sawdust, and others that it was very efficacious. Mr. Martindale had been kind enough to obtain for him a sample of the so-called deëmetinised ipecacuanha, supplied by the German house referred to by Dr. Kanthack, and on submitting it to analysis he found it contained nearly 0·5 per cent. of the alkaloid corresponding to the ordinary alkaloid from ipecacuanha. The difference between the root and the stem attaching to what was called woody ipecacuanha appeared to him to be a result of the different relative proportion between the woody core and the bark. In the stem of ipecacuanha there was an extremely thin bark, the whole mass almost consisting of woody core, whereas in the true root there was a comparatively slender woody core and a very thick bark. He had good reason to believe that the seat of the alkaloid was entirely in the bark, and consequently it was easy to understand that woody ipecacuanha containing a large proportion of stem would contain much less alkaloid than the true root.

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[*] Pharm. Journ., [3], xviii., 788.

[†] Journ. de Pharm., xvi. (1872), p. 400; xvii., p. 19.

[‡] Pharm. Journ., [3], xviii., 628. "Pharmacographia Indica," vol. iii. p. 548.

Acetone as a Tannin Solvent. Trimble and Peacock, Amer. Pharm. Assoc. Pharm. J. 1893, 261.

Trimble and Peacock, in a paper read at a recent meeting of the American Pharmaceutical Association, devoted special uttention to the use and value of acetone as a solvent of oak tannins. By its aid they extracted from powdered nutgalls 62·24 per cent. of solids, whereas commercial ether removed 59·77 per cent. only. It is a better solvent of tannin than either alcohol or ether, and extracts it with less admixture of sugar and other carbohydrates. Its low boiling point, also, renders its recovery easy and rapid, without risk of decomposing the tannin. The process recommended as satisfactory is as follows :—The powdered oak bark is moistened with acetone, packed in a closed percolator, allowed to macerate with acetone for forty-eight hours, and then percolated until exhausted. A dark red or brown semi-solid extract is left on distilling off the solvent. On treatment of this with water and filtering, dilution of the filtrate with more water, results in the precipitation of anhydrides, and, after successive agitations of the filtrate with acetic ether, the tannin thus separated is further treated with ethylic ether, and finally obtained in a nearly pure form in which it is readily and completely soluble in water.

Vanillin from Cloves. MM. Jorissen and Hairs. Bull de l'Assoc. Belge des Chim. Pharm. J. 1893, 261.

The authors noting the similarity in composition between vanillin and eugenol, have examined cloves and the essential oil obtained from them to ascertain whether vanillin was one of their constituents. An ethereal tincture of cloves was prepared and treated with solution of sodium acid sulphite. This solution, being separated, was then treated with a mineral acid and the sulphurous acid thus liberated removed, after which the mixture was agitated with ether. This, on being separated and evaporated, left a residue which gave off a strong odour of vanilla. A similar crystalline residue was obtained on subjecting oil of cloves to the same treatment. The crystals were soluble in water, especially when warm, also in alcohol and ether. They were coloured by ferric chloride, began to melt at 79°, and sublimed readily. The yield was very small, so that an extended examination was not possible, but the investigators consider that the physical and chemical characters of the product, so far as they have been ascertained, indicate its identity with vanillin.

Cocillana. Pharm. J. 1893, 262.

This is the name given to a drug obtained from a species of *Guarea* (Meliaceæ) reputed to possess expectorant properties (*Am. Journ. Pharm.*, lxii., 178). A collective study of it has been made by Drs. Rusby, Coblentz, and Wilcox, on similar lines to those suggested in the *Pharmaceutical Journal* of July 2, 1892, and their reports appeared in the *Brooklyn Medical Journal* for July last. Only the thicker bark from the trunks and larger branches of the trees is collected. It yields 0·13 per cent. of a white crystalline body having a peculiar aromatic taste, soluble in ether, chloroform acetic ether, and glacial acetic acid, but insoluble in alkalis and, when heated with water, melting to oily globules which congeal on cooling. The melting point of the compound, which is apparently a solid hydrocarbon and requires further investigation, is 80°, and above that point it sublimes. Traces of alkaloid were indicated by Mayer's reagent, and a resin (2·36 per cent.) and fixed oil (2·50 per cent.) were also found, whilst a glucoside is also probably present. The preparations of the bark employed in the clinical investightion were a concentrated tincture, a fluid extract, and a syrup. It is claimed that, in diseases of the respiratory organs, the drug is superior to apomorphiue, preferable to ipecacuanha, and safer than pilocarpine.

PATENTS.

Improvements in and Apparatus for the Production of Oxygen and Nitrogen from Atmospheric Air. L. Chapman, London. Eng. Pat. 19,078, October 24, 1892.

This improvement in the potassium manganate and hydrate process of separating oxygen from air consists of an apparatus for carrying on the oxidation and reduction of the material continuously instead of intermittently as hitherto. Two vertically-elongated vessels are placed side by side in a furnace, and each is connected with the other by a pipe leaving the one vessel at the bottom, passing into the other, and then upwards centrally inside it, opening at a point below the level to which the vessel is charged with material. Air is passed through narrow slits into the bottom of one vessel and steam into the bottom of the other, the two vessels being maintained at an equal pressure by the escaping gases passing through equal columns of water. When the temperature is high enough to render the materials used sufficiently liquid, circulation takes place from one vessel to the other, peroxidised material passing down the central tube of its own vessel into the deoxidising vessel, and then similarly passing, after deoxidation, into the oxidising vessel again. This circulation is accelerated by injecting air or steam into the pipes connecting the two vessels.—J. G. W.

Manufacture of Neutral Aluminium Salicylate and of a Soluble Compound of the Same. J. Wetter, London. From J. D. Riedel, Berlin, Germany. Eng. Pat. 11,380, June 9, 1893.

When aqueous solutions of aluminium salts are added to solutions of alkali salicylates, in such proportions that for each molecule of alumina added there are six molecules of salicylic acid present, a slightly reddish, crystalline precipitate is obtained of neutral aluminium salicylate,

$$Al_2(C_6H_4.OH.COO)_6.$$

When this compound is treated with ammonia, either in the form of gas or solution, an ammoniated double salt, $Al_2(C_6H_4.ONH_4.COO)_6$, "*aluminium salicylicum ammoniatum,*" is formed. It is a yellowish white powder easily soluble in water. The inventor claims that these salts, and particularly the soluble ammonia one, combine the therapeutic effects of aluminium and salicylic acid.

—J. G. W.

An Improved Process of Fixing Atmospheric Nitrogen, and of producing Bicarbonate and Formiate of Ammonium, Formic Acid and other Formiates. P. Rogatien, Nantes, France. Eng. Pat. 12,604, June 27, 1893.

If a mixture of moist nitrogen and hydrogen be passed over slightly heated porous, absorbent bodies, such as pumice-stone, charcoal, &c. ammonia is produced. If carbonic anhydride be added to this mixture of gases, ammonium bicarbonate and formate are formed, or ammonium formate only if carbon monoxide be added instead. In the preparation of these two salts the temperature of the absorbent material must be only slightly raised. Water-gas is used to supply the hydrogen and either the carbon mon- or di-oxide, and "*Ebelmen*" gas to supply the nitrogen, and either carbon mon- or di-oxide, according to the method of their manufacture. The ammonium formate yielded is distilled with milk of lime and the calcium formate employed for the production of formic acid.—J. G. W.

Production of a Diamidophenolester and its Acid Derivatives. P. Monnet, Lyons, France, and M. C. Traub, Basel, Switzerland. Eng. Pat. 12,928, July 1, 1893.

When α-dinitrophenetol, in alcoholic solution, is reduced by any suitable reducing agent, preferably by tin and hydrochloric acid, and the tin removed by hydrogen sulphide, diamidophenetol hydrochloride is obtained, from which the base, α-diamidophenetol, $C_6H_5(NH_2)_2.O.C_2H_5$, is prepared by decomposing with alkalis and extracting with ether. It is a colourless liquid readily decomposing in the air or on heating, but forming permanent salts with acids. It yields acid derivatives with organic acids or their chlorides, the diacetyl derivative being a white crystalline body, readily soluble in hot water and melting at 193° C.

—J. G. W.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Action of Sodium Sulphite on Salts of Amidophenol. New Method for obtaining Amidophenols in the Free State. A. Lumière and A. Seyewetz. Comptes rend. **116**, 1202—1205.

Owing to the ease with which free amidophenols become oxidised when liberated from their salts by means of alkali or alkaline carbonates, it is difficult to obtain them in a state of purity. It was found that the compounds may be readily isolated by means of sodium sulphite, provided that the base is but slightly soluble in aqueous sodium sulphite, and that its basicity is weak enough to prevent its union with sulphurous acid. In this manner paramidophenol and 1·2·4-diamidophenol were separated from their hydrochlorides. In the case of the latter compound a saturated solution of sulphite, containing some undissolved crystals, has to be employed. The pure base melts at 78°—80° with decomposition, is rather readily soluble in water, alcohol and acetone, sparingly soluble in ether, benzene, and chloroform, readily soluble in acids and alkalis. All the solutions become brown when exposed to air; the aqueous solutions when treated with potash or soda becomes red, with ammonia it acquires an indigo blue colour.

Triamidophenol could not be isolated in this manner, as it yields a stable sulphite. This forms white spangles which melt at 120°—121° with liberation of sulphurous anhydride. It dissolves in acids at 30°—40° with liberation of sulphurous acid, and in cold solutions of the alkalis. The aqueous solutions behave towards potash, soda, and ammonia, like diamidophenol.

These compounds have recently acquired importance as photographic developers.—N. H. J. M.

Gelatinous Silver Cyanide. Lee. K. Frankel. Journ. Franklin Inst., **136**, 157.

See under Analyt. and Scient. Notes, page 872.

XXII.—EXPLOSIVES, MATCHES, Etc.

Notes on some New Explosives. A. Berg and L. Cari-Mantrand. Monit. Scient. 1893, 271.

A mixture of equal parts of barium hypophosphite and potassium chlorate, previously separately powdered and dried at 100° C., possesses interesting explosive properties. In the open air it burns with great rapidity producing a feeble report; but when at all confined, as for instance in a screw of paper, a sharp detonation results. An electric spark readily fires the mixture; and it is moreover very sensitive to shocks and friction, so that great care must be observed in its preparation. The following experiments exhibit the great rending properties of the compound:—A cork loosely placed on 1—2 decigrms. of the powder, was by the explosion of the latter, torn to pieces. A small portion of the powder contained in a closed glass tube was plunged into an earthen vessel containing water (20 litres) and fired by an electric spark. As a result the vessel was shattered, and the water projected to a considerable height, &c.

A mixture of the explosive with magnesium powder burns very rapidly and with dazzling brilliancy; and as no special contrivance is needed for its combustion it might be employed as a flash-light for photographic purposes. As the powder is so readily fired by an electric spark, it might advantageously replace mercuric fulminate. It is much cheaper than the latter and its two components, which need be mixed only when required, are perfectly harmless when separate.

A mixture of syrupy sodium hypophosphite and powdered sodium chlorate in some respects resembles nitroglycerol. A drop when heated on metal foil liquefies, boils, and finally when quite dry, explodes with great violence, generally perforating or deeply indenting the foil. Trials with other hypophosphites did not yield good results.

—H. T. P.

PATENTS.

Improvements in the Manufacture of Kieselguhr-dynamite. E. Grüne, Unterlüso, Hanover. Eng. Pat. 16,116, Nov. 23, 1887.

This is an invention for obviating the violent and dangerous expulsion of nitro-glycerin which takes place when ordinary kieselguhr-dynamite comes in contact with water. It consists in, either intimately mixing the kieselguhr—before treatment with nitro-glycerin—with vegetable or animal carbon, or in mixing it with organic matter and then carbonising, either in the presence or absence of air. It is claimed that these products have as great an absorptive power as kieselguhr, and that dynamite prepared with them, resists entirely the expelling action of water.—J. G. W.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS, ETC.

Application of Liquid Carbonic Anhydride for the Manufacture of Mecurial Thermometers for Measuring High Temperatures. A. Mahlke. Zeit. f. Instrumentenkunde. 1892, **12**, 402.

The construction of mercurial thermometers of special "Jenna" glass, capable of measuring temperatures as high as 550° C., has been accomplished by introducing nitrogen under a pressure of 17—18 atmospheres into the capillary, and thus the mercury is prevented from boiling. The filling of the instruments under so high a pressure is, however, attended with many difficulties, and the taps and connections are only rendered secure from leakage by very special precautions.

The matter is considerably simplified, however, by filling the capillary with liquid carbonic anhydride. This liquid has a pressure at the ordinary temperature amounting to 50—60 atmospheres, and this pressure must be reduced to 17—20 atmospheres by interposing a receiver. Commercial liquid carbonic anhydride must be freed from moisture before introducing it into the thermometers.—A. R. L.

Demonstration of Processes of Manufacturing Chemistry by means of Hempel's Furnace. R. Lüpke. Zeits. physik. u. Chem. Unterr. 1893, **6**, 176; Chem. Rep. 1893, **17**, 185—186.

(1.) Preparation of wood charcoal in a condition for demonstrating its absorptive powers can be effected by heating 1 cm. cubes of box-wood in a crucible with a clay-luted lid for half an hour in the furnace arranged for a non-oxidising atmosphere.

(2.) Lime-burning can be shown by heating 10 grms. of coarsely-powdered marble for about 15 minutes, at the end of which time its loss of weight approaches the theoretical limit (4·4 grms.).

(3.) The preparation of black ash can be demonstrated by heating a mixture of 13 parts of sodium sulphate, 9 parts of precipitated calcium carbonate, and 2 parts of powdered wood charcoal for 20 minutes, at the end of which time the crude soda can be extracted with water.

(4.) In showing the formation of water glass, caustic soda is preferable to sodium carbonate, as frothing is thereby avoided. 4 grms. of caustic soda are fused in a porcelain crucible and small quantities of sand added from time to time, the operation being complete in about a quarter of an hour. The melt can be extracted with water and the presence of soluble silica proved.

(5.) The author has not succeeded in making a genuine soda-lime glass in Hempel's furnace. A product of pasty consistency, which could be drawn into threads, was obtained by heating a mixture of 4 grms. of sand, 4·5 grms. of red lead, and 1·5 grms. of caustic potash for half an hour. A mixture of 2 grms. of caustic potash, 4 grms. of red lead, 4 grms. of silica, and 2 grms. of borax, with or without ½ grm. of cobalt oxide, was somewhat more fluid. A perfectly fluid mass can be obtained by heating a mixture of 2 grms. of sand and 15 grms. of red lead for half an hour.

(6.) Sodium stannate can be prepared by roasting and finely powdering 6 grms. of tin ore and fusing it with 4 grms. of caustic soda for 15 minutes.

(7.) 2 grms. of finely-powdered chrome iron ore ignited for half an hour with 6 grms. of a mixture of equal parts potassium carbonate and potassium nitrate, yield potassium chromate.

(8.) Sodium aluminate can be prepared by heating 3 grms. of finely-powdered bauxite with 12 grms. of sodium carbonate for half an hour.

(9.) The formation of brass by alloying copper and zinc can be shown by preparing a mixture of 100 grms. of powdered zinc and 40 grms. of powdered charcoal moistened with water, moulded into pieces the size of peas, and dried, and heating 14 grms. of this mixture with 6 grms. of copper filings. The heating is conducted in a closed crucible, and after half an hour a button of brass can be poured out.

Many other technical processes can be demonstrated by means of Hempel's furnace in a manner analogous to that adopted in practice.—B. B.

A Portable Holder for Sulphur Trioxide, serving also for Distillation in the Laboratory. C. Hensgen. Chem. Zeit. 1893, 395.

Sulphur trioxide, although a valuable reagent, is seldom employed in research laboratories, because of the difficulties attending its transport and manipulation. As usually sent out in sealed glass vessels or tins, it is impossible to remove a portion of the contents without serious loss, inconvenience, and risk. The apparatus shown in the accompanying drawing is intended to overcome these difficulties. It is constructed entirely of cast iron (thickness of wall, 12—15 mm.), and during transport the opening in the neck is closed by a washer (of asbestos and lead sheeting) clamped between the cover and the head of the bottle. The sulphur trioxide is removed from the bottle by *distillation*, for which purpose a bent glass tube D is inserted in the aperture (12 mm. diameter) of the bottle, air-tight connection being secured by an asbestos ring, fitting round the glass tube and wedged into the bevelled cavity between the cover and the top of the bottle. The lid (Fig. 1 F^1 and Fig. 2) instead of bolt-holes, has two slits S, which arrangement makes adjustment of the lid easy.—H. T. P.

Fig. 1.

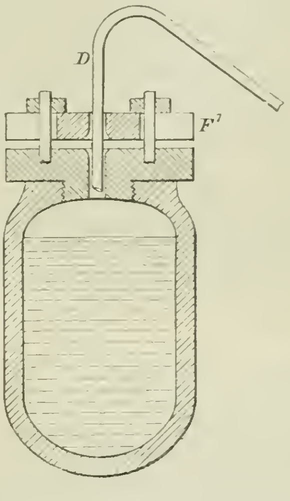
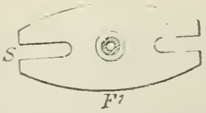


Fig. 2.



Simple Appliances for Testing the Consistency of Semi-solids, with Note on a New Method of Examining Butter. C. E. Sohn. Analyst, **18**, 1893, 218—221.

Various means have been suggested for testing the consistency of semi-fluid substances, such as paints, varnishes, gelatinous bodies, &c. Legler (Chem. Zeit. **8**, 1857) described an appliance for measuring the consistency of the elaidin obtained from olive oil by the degree to which a rod sank into the mass in a given time; and Kissling's apparatus (this Journal, 1891, 555) for testing railway greases and glue is based on the same principle.

The author describes three forms of apparatus for consistency tests which he employs.

1. A modification of Kissling's device. Instead of rods of fixed weight, a rod is employed which may be loaded to any desired extent by slipping perforated weights over the upper end.

2. This form may be used when the fluidity of the substance is too great for form 1. The time is observed in which a plummet, suspended by a thread passing over a pulley, sinks to a given depth in the material. The plummet is counterbalanced by a scale pan and weights at the other end of the thread.

3. This form is also restricted to fairly fluid substances. The time is noted in which a disc or pan *rises* in the material through a given height, when pulled up by a thread variously weighted passing over a pulley.

In view of the great diversity of substances it may be required to test by these appliances it is impossible to give any dimensions and weights that shall be universally applicable. In the case of form No. 1 the author employs brass rods, 5 mm. in diameter, and 300 mm. in length, weighing 25 grms., the added weights being 5—250 grms., according to circumstances. In selecting the weights to be used, the best results are obtained when the material is penetrated comparatively quickly—in 20—100 seconds. Accuracy is not increased by diminishing the weights, so as to increase the time. "The following rules must be carefully observed:—

"1. The rod must descend in an absolutely perpendicular direction.

"2. It must slide in its bearing with the least possible friction.

"3. Conditions of temperature must be constant.

"4. Vessels of one diameter must be used, to contain the substance under examination.

"5. The rod must enter the centre of the vessel, or at a fixed distance from the circumference.

"6. The same depth of material must always be used.

"7. The material must be allowed to rest a certain fixed time before examination."

Finally, the author describes Brullé's method of detecting margarin in butter, which is based on the remarkable difference in consistency exhibited by the elaidins produced from margarin and pure butter respectively. (For details, see this Journal, 1893, 717—718.)—H. T. P.

Handy Electromotors for Chemical Laboratories. Karl Elbs. Chem. Zeit. **17**, 66, 97—98.

On account of the practical inconveniences generally attending the use of primary batteries (*e.g.*, Meidinger's, Bunsen's, bichromate, &c.), and the difficulties often experienced in charging accumulators in chemical laboratories by means of small dynamos, it is recommended to employ small storage cells of the German post office type, charged as required by Gülcher thermo-batteries, which yield an E.M.F. of 3·8 to 4·3 volts according to the gas supply, at a cost of about 3 pf. per 170—180 litres used during an hour's working, little or no attention during charging being requisite.—C. R. A. W.

INORGANIC CHEMISTRY.—QUALITATIVE.

New Method for the Separation of Metals precipitated by Sulphuretted Hydrogen in Acid Solution. W. Antoni and L. Niccoli. Gazz. chim. ital. 1892, **22**, 245.

The author's method is as follows:—The mixture of sulphides precipitated in acid solution, carefully washed with a solution of sulphuretted hydrogen (silver, lead, and mercurous compounds having been previously precipitated by hydrochloric acid), is boiled with dilute hydrochloric acid of sp. gr. 1·11, access of air (which oxidises the copper sulphide) being avoided by the insertion into the flask of a plug of cotton wool. The sulphides of antimony, tin, bismuth, cadmium, and lead are dissolved by this means (first sub-group). The solution is decanted from the insoluble matter, which is then treated a second time with dilute hydrochloric acid as before; the combined solutions are then placed aside.

The insoluble portion is washed first with cold and then with boiling water until the washings are no longer rendered opalescent by silver nitrate. Lead chloride is dissolved by this treatment, and may be detected in the filtrate as chromate. The insoluble portion is now heated to incipient boiling with nitric acid of sp. gr. 1·12 in order to dissolve arsenic and copper sulphides (second sub-group)

The liquid is decanted and the insoluble residue, containing mercury, gold, and platinum (third sub-group), washed and dried.

The solution of the metals of the first sub-group, is evaporated to dryness, and the residue, after addition of a few drops of ammonia, treated with ammonium sulphides to separate the sulphides of antimony and tin from bismuth, cadmium, and lead sulphides. The other separations need no further explanation.—A. R. L.

INORGANIC CHEMISTRY.—QUANTITATIVE.

The Importance of Electro-motive Force for the Electrolytic Separation of Metals. H. Freudenberg. Zeits. physikal. Chem. 1893, **12**, 97.

See under XI., *page* 846.

Note on the Estimation of Chlorine in Water. T. Fairley. Analyst **18**, 1893, 222.

The chlorine in a mineral water from Harrogate was determined in three ways: (1) gravimetrically, as silver chloride; (2) volumetrically, by titration with decinormal silver nitrate, using potassium chromate as an indicator; (3) as under 2, the water being previously concentrated to one-tenth. The chlorine found in grains per gallon was: (i.) 1·34; (ii.) 1·66; (iii.) 1·44. The author ascribes the above discrepancies to the presence in the water of alkaline silicates, which, he finds, interfere with the accuracy of Mohr's process, even when existing in only small amount. No other substance likely to interfere with the process of titration was discovered in the water.—H. T. P.

Reduction of Ferric Salts; Dissolution of Anhydrous Ferric Oxide. L. Storch. Ber. d. österr. Ges. z. Förder. d. Chem. Ind. 1893, **15**, 9.

The author concludes from his experiments that the reduction of ferric salts for the estimation of iron by permanganate, is best effected by metallic copper. When a solution of ferric salt is warmed with copper turnings previously washed with alcoholic ether and then with water, the yellow colour changes to yellowish-green and thence to blue. Before titration the solution is diluted until its colour is hardly perceptible. With the end-reaction the colour changes from greenish-blue to violet.

Ignited ferric oxide is generally rendered soluble by fusion with potassium bisulphate. The author employs sulphuric acid of 40 per cent. strength for this purpose. About 0·4 grm. of the oxide is gently heated for half an hour with 20 cc. of this acid. After solution the reduction is performed in the same flask. It is not necessary to employ so concentrated an acid [sulphuric acid, 8 parts; water, 3 parts] as prescribed by Mitscherlich, to render silicates soluble.—A. R. L.

Estimation of Manganese Oxides by Means of Hydrogen Peroxide. A. Carnot. Comptes. rend 116, 1295—1297.

Hydrogen peroxide decomposes with effervescence in contact with manganese dioxide, a small amount of manganese dioxide being able to decompose an indefinite quantity of hydrogen peroxide. If, however, sufficient acid is present to combine with the manganese, both oxides eliminate half their oxygen, thus:—

$$MnO_2 + H_2O_2 + 2HNO_3 = Mn(NO_3) + 2H_2O + O_2.$$

Very weak sulphuric or nitric acids and acetic acid may be employed. The following method, based on the above reaction, was found to be suitable for the estimation of displaceable oxygen in the higher oxides of manganese. A flask of 150 cc. capacity is fitted with a double-bored cork, the one hole being for the insertion of a small separating funnel, the other for the delivery tube. This is bent four times, and its upper end reaches to the top of a gas measuring tube of 300 cc. capacity. 1 grm. of finely-powdered oxide, 30 cc. of water, and 20 cc. of nitric acid are put into the flask, which is left open until all the carbonic acid (if any) is liberated. The cork is then fitted to the flask, and the measuring tube filled with water, as well as the delivery tube to the point where it leaves the water in the trough. 20 cc. of 10 vol. hydrogen peroxide are then put into the funnel, from which it is gradually let into the flask, which is shaken from time to time. When the evolution of oxygen ceases, the measuring tube is lowered in the water until the water-level inside and outside correspond; the volume of gas is then read off. The following formula — used in calculating the results:—

$$p = \tfrac{1}{2}V^{t} \times 1{\cdot}4298 \times \frac{H-h}{760} \times \frac{1}{1+0{\cdot}00367t}$$

V is the volume read off; v the volume of gas contained in that part of the delivery tube which was filled with water at the commencement of the experiment; t and H are the temperature and atmospheric pressure; h is the tension of the aqueous vapour.

The method is simple and quick, and gives very satisfactory results, the error being less than 0·001 grm. with 1 grm. of mineral.—N. H. J. M.

Phenolphthaleïn and Methyl-orange as Indicators. M. B. Breed. Jour. Franklin Inst. 135, 312—316.

In standardising hydrochloric acid the author observed that 20 cc. of standard hydrochloric acid and methyl-orange required 19·443 cc. of alkali for neutralisation, whilst with phenolphthaleïn 19·765 cc. of alkali solution were consumed in cold or boiling solutions. In reversing the operation and titrating the alkali with acid, the pink colour of the phenolphthaleïn gradually reappeared after prolonged boiling until the quantity of acid used equalled that used with methyl-orange. The discrepancy in the two experiments is ascribed to the presence of carbonic acid, for acid potassium carbonate, which would be formed during titration, is neutral to phenolphthaleïn but alkaline to methyl-orange. It is therefore not considered safe to use phenolphthaleïn unless the solutions are free from carbonic acid—a matter of embarrassment in the case of standard caustic solutions. Methyl-orange, as not being affected by carbonic acid, is as an indicator strongly recommended. In the subsequent discussion E. S. Kleiner pointed out that the red colour of an alkaline solution of phenolphthaleïn may be discharged by shaking with air or by simply breathing upon the solution—as indicated by Warder. Otherwise Breed's results agree with R. T. Thomson's (Chemical News, 47, 123, 135, &c.; see also this Journal, 1889, 252 *et seq.*).
—H. A.

Titration of Alkaline Liquids containing Chlorine. C. Ullmann. Chem. Zeit. 1893, 17, 1208—1209.

In electrolytic processes it is frequently necessary to determine the alkalinity of liquors which contain chlorine or hypochlorites. When it has to be ascertained what percentage of alkali capable of absorbing CO_2, is present in a solution containing sodium chloride, hydrate, hypochlorite, and chlorate, ordinary methods are useless; indicators are destroyed; hydrochloric acid liberates chlorine by acting on hypochlorous acid; sulphuric acid evolves hydrochloric acid by its action on sodium chloride, and nitric acid and oxalic acid are also unavailable.

In such cases the author uses succinic acid in the following manner. A measured quantity of the liquor is treated with excess of standard succinic acid and heated until the smell of hypochlorous acid has ceased, when the resulting liquid is titrated back with caustic soda. Succinic acid is not volatile and is capable of liberating CO_2 and hypochlorous acid, but not hydrochloric acid; it is not oxidised or chlorinated under the condition obtaining in electrolysed liquors.

A full investigation has not yet been made of the capabilities of the method, but the following example is quoted:—Chlorine was led for a short time into a solution containing 22·8 grms. of sodium carbonate per litre. 5 cc. of this solution boiled with 15 cc. of succinic acid solution (of which 1 cc. was equivalent to 0·01 grm. of Na_2CO_3) until the solution had no further smell of hypochlorous acid, and titrated back with caustic soda solution (1 cc. = 0·01 grm. Na_2CO_3), using phenolphthaleïn as an indicator, required 4·9 cc. of the alkali. This corresponds to a strength of the sodium carbonate solution after treatment with chlorine of 20·2 grms. per litre in place of the original value, 22·8 grms. A check analysis was made by estimating the oxidising power of the solution on a ferrous salt, and gave the result 20·7 grms. of residual Na_2CO_3 per litre.
—B. B.

The Commercial Method of Estimating Boric Acid in Boronatrocalcites. G. A. le Roy. Chem. Repert. 17, 163—164.

The method is based on the use of two indicators: Orange III. Poirrier (dimethylamido-azo-benzene ammonium sulphonate) and Orange II. Poirrier (β-naphtholazobenzene sodium sulphonate), the former of which is not influenced by boric acid.

2·5—5 grms. of finely-ground mineral are heated with a few cc. of sulphuric acid diluted with an equal volume of water and with some hydrochloric acid in a flask provided with an inverted condenser. The thoroughly decomposed mass is allowed to cool, filtered from the silica and alumina, which are washed with cold acidified water, the filtrate neutralised with sodium hydrate, boiled, and filtered from the iron and the alumina. The filtrate is now boiled with excess of hydrochloric acid to expel carbonic acid, cooled down, and the liquid made up to a known volume. All boric acid is now present in the free state.

20 cc. of this solution are now titrated with standard alkali and Orange III. (Poirrier) until the shade produced corresponds to the yellowish-red colour caused by the same number of drops of Orange III. in 20 cc. water. The cc.'s of alkali consumed, indicate the free hydrochloric acid present.

Another volume of 20 cc. of solution is titrated with Orange II. until the colour changes into dark red. The difference of the two titrations indicates the boric acid present. The standard alkali must be free from carbonates, silicates, or aluminates, and cannot be replaced by caustic potash or ammonia. The presence of considerable quantities of sulphates, nitrates, ammonium salts, or of an atmosphere of carbonic acid, should be avoided.—H. A.

The Determination of Chromium in Ferro-Chromium. J. Spüller and S. Kalman. Chem. Zeit. 1893, 17, 1207—1208.

The authors have already pointed out (Chem. Zeit. 1893, 17, 880), that chromium can be determined in ferro-chromium by the aid of a mixture of caustic soda and sodium peroxide as a flux. Further experiments with two samples of ferro-chromium—one 40 per cent., the other 60 per cent.—have led to the adoption of the following method:—0·35 grm. of the finely-powdered sample first sifted through linen and then rubbed down in an agate mortar, is mixed with 4 grms. of sodium peroxide and 8 grms. of caustic soda and heated in a silver dish over a slightly smoky flame. The temperature is gradually raised so that at the end of five minutes the edge of the mixture begins to fuse, and after a further period of 10 minutes the whole mass has become liquid. The heating is continued for half an hour over the slightly smoky flame until the bottom of the dish is covered with soot. During the last quarter of an hour the melt is stirred with a silver spatula. The attack of the ferro-chromium is then complete if the heating has been conducted as described and the sample has been powdered sufficiently fine. The basin with its contents is allowed to cool to 40°—50° C., freed from soot, and digested, in a large hemispherical porcelain dish, with hot water. The dish is then removed and rinsed into the basin. The loss in weight of a silver dish weighing about 38 grms. may be as much as 0·04—0·05 grm. for a single fusion. The aqueous extract of the melt contains sodium manganate and ferrate as well as chromate. Only traces of sodium peroxide remain, as the bulk is decomposed during solution. Sodium manganate and ferrate are removed by the addition of successive small quantities of sodium peroxide, which reduces these salts, itself undergoing simultaneous reduction. A quantity of 0·3—0·6 grm. is usually requisite, and any excess that may be added is got rid of either by allowing the solution to stand while being kept warm for some hours or preferably by passing CO_2 into the solution for an hour and heating it for 15 minutes on a water bath or graphite bath (the latter being a convenient substitute for a sand bath). By the latter treatment hydrogen peroxide is liberated from the sodium peroxide, and being unstable in alkaline solution is decomposed on heating. Sodium chromate is not affected by excess of sodium peroxide in alkaline solution.

The aqueous solution of the melt is made up to 500 cc., the contents of the flask allowed to stand and an aliquot portion (*e.g.* 100 cc.) filtered from ferric oxide, &c. and the chromium in it determined by Schwarz's method. For this purpose a permanganate solution of which 1 cc. = 0·00423 grm. of iron, and a solution of ferrous ammonium sulphate containing 7 grms. of the salt in 500 cc., are required. The chromium solution is diluted with 1 litre of cold water which had been previously boiled and acidified with 20 cc. of sulphuric acid (1 : 5 by volume); 100 cc. of ferrous ammonium sulphate are added and the mixture titrated back with permanganate solution. The strength of the ferrous solution is determined by a blank experiment under similar conditions.

An alternative gravimetric method is also described. The solution of the melt obtained as already described, is filtered, and the residue washed with a solution of sodium carbonate to prevent the insoluble matter passing through the filter. The filtrate is treated with 1·5 grm. of ammonium nitrate, evaporated to dryness, extracted with water, and the solution filtered. The filtrate is acidified with hydrochloric acid warmed on a graphite bath, the chromate reduced with 1 grm. of pure potassium nitrite, and the chromium precipitated in the hot solution with ammonia, avoiding an excess. The chromium hydroxide is filtered after standing for some time at 90° C., washed, dried, and ignited. The residue left after the evaporation to dryness with ammonium nitrate and extraction with water, consisting mainly of silica and alumina, contains a little chromium chromate. It is therefore treated with hot dilute hydrochloric acid, the chromium hydrate and alumina, which had gone into solution, precipitated together by dilute ammonia, filtered, ignited, fused with caustic soda and sodium peroxide, and separated as already described.

In spite of all precautions chromium hydroxide obtained in these processes of separation is contaminated with alkali, which forms chromate on ignition. The weighed precipitate is therefore digested with hot water, rubbed down in the dish with a glass rod, and thoroughly washed. The aqueous extract is acidified, reduced, and reprecipitated, the resulting chromium hydroxide being added to the main portion. The following comparative results are quoted:—

—	Chromium Per Cent.	
	Volumetric.	Gravimetric.
I.	43·95—44·0	44·20
II.	57·60—57·68	57·92

The insoluble residue obtained from the original melt was examined for chromium with negative results. The volumetric process takes about 4 hours, the gravimetric 3—3½ days to execute. Sample I. contained 8·5 per cent. of Mn and 5 per cent. of Si. No. II. 0·1 per cent. of Mn and a trace of silicon.

The mixture of caustic soda and sodium peroxide can be used in most cases where an oxidizing alkaline flux is required. Thus pyrites can be opened up by its means, as well as chromite and commercial chromium oxide (chrome green).—B. B.

Use of Sodium Peroxide in Analysis. W. Hempel. Zeits. f. anorgan. Chem. 1892, **3**, 1893.

Sodium peroxide of high purity is now a commercial article, and as an oxidising agent at a red heat is extremely convenient. Chromium and manganese are readily detected by fusing the substance tested with two parts of peroxide in a silver or platinum dish, a yellow or green mass resulting. Minerals containing tungsten treated similarly, give a melt containing sodium tungstate, from which tungstic acid is obtainable by heating with water and acidulating with hydrochloric acid. Titanic iron ore gives a melt, which on treatment with water and filtration leaves undissolved ferric oxide, containing all the titanic acid present: on heating this insoluble matter with strong sulphuric acid, it dissolves, so that on dilution and treatment with sulphurous acid the titanic acid is separated as usual. Sulphides (galena, zinc blende, pyrites, &c.) react explosively on fusion with sodium peroxide, so that the mass must be diluted with soda, conveniently one part of substance, two of soda and four parts peroxide. On dissolving the melt in water, filtering, acidulating, and adding barium chloride, the sulphur is obtained as barium sulphate.—C. R. A. W.

Estimation of Silicon in Cast Iron. H. Rubricius. Chem. Zeit. **17**, 101.

Good results are obtained by the following method:—5 grms. of the finely divided sample are dissolved in 25—30 cc. of hydrochloric acid (sp. gr. 1·15) in a tall beaker, and the solution diluted to 150—200 cc. and filtered. According to the author, no appreciable amount of silicic acid is formed and dissolved by thus operating, avoiding large excess of acid and long continued heating; so that the residue on the filter contains sensibly the whole of the silicon originally present. This residue is washed two or three times with water, as often with dilute hydrochloric acid (one part acid sp. gr. 1·15, two of water), and finally with hot water; the filter is dried and carbonised in a platinum capsule, and the residue fused with saltpetre over a blast lamp. A solution of recrystallised salammoniac (30 grms.) in 75 cc. of water is made in a porcelain dish, and the platinum capsule and contents digested therewith boiling, whereby the flocculent silica is ultimately left undissolved; the liquid is then diluted two or three fold and filtered, the silica left on the filter being washed with chloride of ammonium solution, and finally with hot water; after ignition it is usually pure white.—C. R. A. W.

ORGANIC CHEMISTRY.—QUALITATIVE.

The Detection of Heated Cotton Seed Oil in Lard.
W. G. Crook. Analyst, **18**, 1893, 221.

"Ten grains of the sample to be examined are placed in a cup-shaped porcelain capsule of about half an ounce capacity. A small disc of white filter-paper (previously soaked in hydrochloric acid, washed, and dried) is *just moistened* with a 12 per cent. solution of silver nitrite, and placed in the concave part of a watch-glass, which, with the paper downwards, is then inverted over the capsule containing the sample. The capsule is then slowly heated in an oil-bath until the thermometer marks 240° F. when the source of heat is *immediately withdrawn.* In presence of even less than 1 per cent. of heated cotton-seed oil, a very marked coloration appears on the disc, varying from a light brown to nearly black. If the sample be pure and fresh no coloration is observed."—H. T. P.

Delicate Reaction for p-Phenetolcarbamide ("Dulcine").
N. Wender, Pharm. Post, **26**, 269.

Traces of dulcine (*New sweetening agent. This Journal,* 1893, 288) may be recognised as follows:—The substance is treated with fuming nitric acid, a few drops of which produce a somewhat violent reaction, with formation of an orange-yellow substance. This product, when dried on the water-bath and the residue treated with two drops of liquid carbolic acid and two drops of concentrated sulphuric acid, gives rise to an intense and characteristic blood-red coloration, which is tolerably permanent.—H. A.

The Furfurol Reactions of Alkaloids. N. Wender.
Chem. Zeit. **17**, 950–951.

It has long been known that sulphuric acid and sugar added to various alkaloids and other bodies give colour reactions; this is in many cases traceable to the formation of furfurol by the action of the acid on the sugar, and the reaction of the nascent furfurol on the alkaloid, &c. The author describes various colour reactions serving as qualitative tests for alkaloids obtained by means of furfurol and sulphuric acid; other acids do not produce the effect, which consequently is attributable to the formation of condensation derivatives. Veratrine and sabadilline give the most marked effects. By treating veratrine with sulphuric acid and other carbohydrates the same colorations are formed, but mostly to a notably lesser extent; inulin and lævulose give an effect nearly equal to that of cane sugar, whereas dextrose, starch, and milk-sugar produce much more feeble effects, indicating that with these bodies there is less production of furfurol.—C. R. A. W.

The Colour Reaction of Phenylhydrazine and Lignonin.
E. Nickel. Chem. Zeit. 1893, **17**, 1209.

In view of the aldehydic nature of lignin indicated by the author's investigations on the colour reactions of wood, a trial was made by him of the action of phenylhydrazine, which Fischer has shown to be a precipitant of aldehydic compounds.

The wood was brought in contact with an aqueous solution of phenylhydrazine hydrochloride. Using the ordinary method of boiling with sodium acetate, no definite colour reaction was observed, but with the hydrochloride the wood took a light yellow colour, which was deepened by the addition of dilute hydrochloric acid. On standing, the yellow colour changed into a fairly pure green after the lapse of one hour or more, according to the character of the wood. The phenomenon is noteworthy, as it is perfectly distinct from all known lignin reactions.—B. B.

ORGANIC CHEMISTRY.—QUANTITATIVE.

Alberti and Hempel's Method of Etimating Ash in Sugar by Incineration with Quartz Sand. Stift. Oesterr. Zeit. Zuckerind. (This Journal, 1892, 273.)

The author's experiments with various products of the sugar industry show that this method yields good results. The quartz sand must be previously tested, as when it is of "bad quality" erroneous results are obtained. The method has the advantage over all others that more accurate and concordant results are obtained for the percentage of inorganic matter, and the exact calculation of the amount of organic non-sugar constituents present, is thus rendered possible. Its adoption in technical analysis is not however advisable, as the carrying out of the unavoidable control experiments is troublesome, and the testing of the quartz sand, on the purity of which all depends, is uncertain. Raw sugars containing much nitrate yield inaccurate values, because the nitrates decompose when heated with quartz sand, and in these cases the nitric acid must be estimated. Such raw sugars, many of which are of Hungarian origin, are however very rare.—A. R. L.

The Analysis of Fish Guano, Poudrette, Bone-Ash, and similar Substances. M. Weibull. Chem. Zeit. **16**, 1892, 1689—1690.

The difficulty of a direct estimation of phosphoric acid in substances rich in organic matters is well known. The organic matters have to be first destroyed, a tedious operation, which is effected by treatment with aqua regia or chlorate of potash, &c. The author proposes to apply part of the acid solution resulting from the nitrogen determinations (according to Kjeldahl's method) in these substances for determining the phosphoric acid, and he proceeds as follows:—

2½ grms. of the finely-ground substance are treated with 20 cc. of concentrated sulphuric acid and a few centigrms. of copper oxide. The decomposition being complete the mass is diluted with water to 250 cc., and 50 cc. treated with ammonia until the appearance of a blue colour, and the phosphoric acid is precipitated with ammonium molybdate. Another volume of 50 cc. is used for the nitrogen determination.

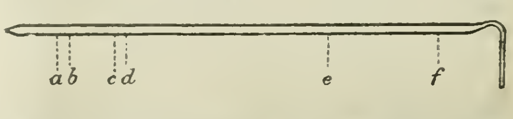
The results obtained by this method agree fairly well with those obtained in the old way, the latter inclining to the low side.—H. A.

A Stable Solution of Hübl's Reagent. P. Welmans. Pharm. Zeit. 1893, **38**, 220; Chem. Rep. 1893, **17**, 111—112.

The author states that a stable solution of Hübl's reagent can be obtained by the use of a mixture of equal volumes of acetic acid and acetic ether, as the solvent. The solution is ready for use immediately after preparation, and its strength shows but slight alteration on keeping.—B. B.

A Method for Simultaneously Estimating Carbon and Nitrogen in Organic Substances. F. Klingemann. Annalen. **275**, [1], 92—102.

The author adopts for the above purpose Frankland's method for determining organic carbon and nitrogen in water residues, *i.e.,* the organic substance is completely burnt in contact with copper oxide, and the resultant gas analysed by the ordinary processes of gas analysis. The combustion tube (5—6 mm. internal diameter) sealed at one end, is charged in the usual way (see accompanying sketch). A layer of coarse cupric oxide (5—6 cm.) is first introduced (to *a*), followed successively by fine copper oxide (1 cm.) (between *a* and *b*), an



intimate mixture of the organic substance with fine oxide (4—6 cm.) (from *b* to *c*), fine oxide (1 cm.) (*c* to *d*), coarse oxide (20—25 cm.) (to *e*), and lastly a spiral of copper wire (9 to 10 cm.) (to *f*). The end of the tube is then drawn out, bent at right angles and connected to a Sprengel pump by a piece of rubber tube, the joint being surrounded by a water-jacket. After exhaustion of the tube, combustion is effected in the usual way. The gases given off are collected over mercury in a cylindrical vessel of 250 cc. capacity, terminating at the top in a capillary tube and stop-cock, and tapering below to an orifice sufficiently small to be closed by the thumb. The total volume of the gas is determined by means of any suitable gas-analysis apparatus, and the relative amounts of carbon dioxide, nitrogen, and nitrogen dioxide (if present) estimated in the whole or a portion of the gas. The method is very rapid, and is claimed to be exceedingly accurate. Moreover, only a small amount (0·1 grm.) of substance is required, and explosive bodies may be burnt without danger. The results of a large number of test analyses are given. From these it appears that nitrogen dioxide is in most cases not present in the products of combustion, or if present exists in too small a quantity to appreciably affect results.—H. T. P.

The Estimation of Alcohol and Extract in Full-Bodied Wines. T. Wetzke. Chem. Zeit. 1893, 836.

The following analyses were made with the object of comparing some of the recognised methods for the determination of alcohol and extract. The alcohol percentages by the "difference method" were obtained by subtracting the difference between the specific gravities of the original and the de-alcoholised wine from 1,000, the remainder being regarded as the true specific gravity of an alcohol of the same concentration as the original wine. The gravimetric extract determinations were made by evaporating a known volume of wine in a platinum dish, and drying for three hours at 100° C. The indirect extract results were deduced from the "extract density" by means of Hager's and Schultze's tables respectively :—

No.	Specific Gravity of the Wine at 15° C.	Percentage of Alcohol by Weight. Distillation Process.	Percentage of Alcohol by Weight. Difference Method.	Extract Gravimetrically Determined.	Extract according to Schultze's Tables.	Extract according to Hager's Tables.	Specific Gravity of Extract Solution at 15° C.
				Per Cent.	Per Cent.	Per Cent.	
1	0·9958	10·38	10·08	3·01	3·05	2·59	1·0118
2	0·9930	12·23	11·38	2·66	2·76	2·36	1·0107
3	0·9978	10·69	10·46	3·66	3·71	3·14	1·0143
4	0·9973	11·23	10·69	3·67	3·67	3·09	1·0141
5	0·9992	11·15	10·38	4·02	4·12	3·42	1·0156
6	0·9956	12·08	11·69	3·49	3·54	3·00	1·0137

It will be seen that the "difference method" gives low results for alcohol. The extracts, according to Schultze's table, agree very well with the directly determined numbers; but the use of Hager's table is not to be recommended, at least not in the case of full-bodied wines. The author condemns the so-called "sand-method" of determining extract, as being utterly worthless.—H. T. P.

Report on the Spirit Industry and on Alcoholic Preparations. G. Arends. Chem. Ind, 16, 78.

See under XX., *page* 859.

The Volumetric Estimation of Acetone. F. Robineau and G. Rollin. Monit. Scient. 1893, 272—274.

It is customary to estimate acetone in liquids by determining the weight of iodoform yielded by them on treatment with iodine and soda, all interfering bodies being previously removed. The principal objection to this method is that distinct losses may occur owing to the volatility of iodoform, even at ordinary temperatures; moreover, the process is a comparatively lengthy one. The authors have devised a volumetric method, by which they determine the volume of a standard solution of sodium hypochlorite required to exactly convert the acetone into iodoform, in presence of an excess of potassium iodide and soda. In practice it is essential to operate always as nearly as possible under the same conditions as those observed in standardising the hypochlorite. Moreover, the potassium iodide and soda should be present in considerable excess, and titration should be effected in a *weak* light and with *constant* agitation. The standard solution is prepared thus:—500 cc. of commercial sodium hypochlorite solution (strength, 45—55 vols. of Cl) are mixed with 500 cc. of water and 10 cc. of caustic soda solution (36° B.). Standardisation is effected as follows:—100 cc. of a solution of pure acetone (about 4 grms. per litre), 10 grms. of potassium iodide, and 20 cc. of caustic soda solution (28° B.) are placed in a flask, and the hypochlorite is run in from a burette, ½ cc. at a time, with continual shaking. Iodoform is precipitated in large flocks, and so soon as this precipitation almost ceases, a drop of the liquid may be withdrawn from time to time and brought into contact with a drop of starch paste containing sodium bicarbonate. In presence of the least excess of hypochlorite, the blue starch iodide reaction makes its appearance. The amount of acetone corresponding to 1 cc. of hypochlorite is thus found. In actual analysis the plan of procedure is precisely the same as above, the same volumes of solution of sample, alkali, &c. being employed.

Ethyl and methyl alcohols, and even considerable quantities of paraldehyde do not appreciably affect the accuracy of the results; but aldehyde if present to any extent must be removed by Bardy's method prior to titration. The standard solution must be preserved in a yellow glass bottle in a cool, dark place; and it is advisable to frequently check its strength, as the solution is liable to change, especially when weak. For estimating small quantities of acetone, a solution of hypochlorite one-fifth the above strength may be employed. Qualitatively, the reaction on which the method is based is very delicate. A solution containing only 0·0012 grm. of acetone per litre when treated with an excess of alkali and potassium iodide, and a small amount of hypochlorite, becomes distinctly turbid almost immediately, providing strong light be excluded. In bright light, the precipitated iodoform rapidly re-dissolves, and the liquid becomes clear.—H. T. P.

Analysis of Crude Commercial Carbolic Acid. Drs. Stockmeier and Thurnauer. Chem. Zeit. 17, 119—120, 131—132.

The authors modify Toth's process (Zeits. Anal. Chem. 1886, 25, 160; this Journal, 1886, 618) as follows:—1·5—2 grms. of so-called 60 per cent. carbolic acid, or 1 grm. of so-called 100 per cent. acid, is weighed out and shaken for 5—10 minutes with three times its volume of 30 per cent. potash ley. The whole is diluted to a litre, and somewhat more than 100 cc. filtered off clear from suspended globules of undissolved hydrocarbons, &c. 50 cc. of filtrate are treated in a stoppered funnel with 100 cc. of bromine liquor (made by dissolving 2·517 grms. sodium bromate and 9 to 10 grms. of sodium bromide to a litre) and 5 cc. of fuming hydrochloric acid. After standing for 10 minutes 15 cc. of 12·5 per cent. potassium iodide solution are added, and the quantity of iodine set free titrated with sodium thiosulphate (12—13 grms. per litre), a little pure chloroform being added to prevent iodine being taken up by the precipitated tribromophenol. The carbolic acid thus found is often much less in quantity than that indicated by the German pharmacopœia test, viz., vigorously shaking 10 vols. of crude carbolic acid with 90 of soda ley (sp. gr. 1·079), and measuring the undissolved hydrocarbons after standing so as to separate; from 23 to 42 per cent. being indicated by the bromine test with samples yielding 55 to 60 per cent. by the pharmacopœia test, and sold as containing 60 per cent.; and about 75 by the bromine test, with samples yielding 100 per cent. by the pharmacopœia test. This diminution partly arises from the fact that large quantities of cresylic acid and higher homologues are present, as indicated by the distilling limits of the tar acids extracted from the samples by shaking with caustic potash, washing out undissolved hydrocarbons with ether, acidulating the alkaline solution and distilling with steam, and saturating the distillate with salt. But even after making allowance for the higher molecular weight of the cresylic acid, &c., present, a considerable discrepancy is still manifest. A useful test of the quantity of higher homologues may also be based on the solubility of the tar acids in 3 per cent. soft-soap solution, which should dissolve 5 per cent. of pure carbolic acid, but take up less of substances containing admixtures of higher homologues according as the proportion of these increases.

—C. R. A. W.

Estimation of Sulphur in Liquid Organic Substances. R. Höland. Chem. Zeit. 17, 99—100 and 130—131.

Although Carius' method (heating in sealed tubes with nitric acid) is excellent in many cases, yet it often fails with difficultly oxidisable or highly carbonised bodies, and in particular with such materials as shale oils and the like. Direct combustion in tubes supplied with oxygen, or containing various oxygen-yielding substances, has been tried with fairly satisfactory results by several chemists. The author uses for this purpose an intimate mixture of finely-divided pure barium carbonate and potassium chlorate. A potash-glass combustion tube 40 cm. long is used, sealed at one end. The liquid to be examined is dropped in from a weighed pipette, &c., and spread about over as large a surface of this mixture as possible, conveniently by diluting with ether, and subsequently allowing the solvent to evaporate. After the combustion is over, the contents of the tube are treated with hydrochloric acid and the undissolved barium sulphate weighed. Evolution of sulphuretted hydrogen indicates imperfect oxidation.

—C. R. A. W.

Volumetric Estimation of Coniine and Nicotine in the same Solution. G. Heut. Arch. Pharm. 231, 376.

These two alkaloids differ in their behaviour to phenolphthaleïn, inasmuch as an alcoholic solution (sp. gr. 0·95—0·96) of nicotine does not produce a red coloration with phenolphthaleïn, whilst the addition of a minute quantity of coniine does. Presence of chloroform increases the sensitiveness of the reaction.

An estimation of the alkaloids may be effected in the following way. The bases are dissolved in a small quantity of water, alcohol added and 5 cc. of the clear solution well shaken with five drops of chloroform and then one drop of a saturated solution of phenolphthaleïn is added. Coniine may now be titrated with one-tenth normal sulphuric acid till the solution becomes colourless, and the titration is completed with litmus, to estimate the nicotine.—H. A.

Simple Appliances for Testing the Consistency of Semi-Solids, with Note on a New Method of Examining Butter. C. E. Stone. Analyst 18, 1893, 218.

See page 866.

The Influence of Pectous Substances on the Analysis of the Sugar-Beet. Weisberg. Chem. Zeit. Rep. 1893, 155. From Bull. Ass. Chim. 1893, 10, 841.

The author agrees with Herzfeld that the alcoholic extraction method is the best, for the analysis of the sugar-beet; but states that Pellet's cold aqueous extraction method, if properly executed, yields identical results; although it is desirable to control the figures by a hot aqueous extraction. Herzfeld's results by the latter process were always too high, and he ascribed it to the formation of strongly dextrorotatory pectous bodies not precipitated by acetate of lead. The author cannot confirm the latter point. He finds, on the contrary, that the acid pectous bodies (obtained by extracting beet-pulp with a dilute acid and subsequently precipitating with alcohol) are precipitated by acetate of lead even from a cold aqueous solution. The lead compound thus obtained is not redissolved by boiling water, and even after four hours' boiling, only traces of a levorotatory substance (metapectic acid) could be detected in solution.—H. T. P.

The Use of Yeast in the Quantitative Estimation of Fermentable Substances. A. Bau. Chem. Zeit. 1893, 392—393.

It is becoming customary to supplement purely chemical methods for the analysis of mixtures of sugars, by a fermentation test, involving the use of yeast. In order that reliable results may thus be obtained, it is essential to adhere to the following conditions:—The solution to be examined must be sterilised prior to fermentation; a pure cultivation of yeast must be employed for inoculation; and lastly, fermentation must be complete before the analysis is further proceeded with. The latter condition is by no means easily recognised, and the author therefore details the appearances which indicate it.

1. The fermented liquid should be perfectly brilliant. Occasionally, however, perfect brightness does not set in, owing to the formation of a resin turbidity.

2. Every external indication of fermentation must be absent.

3. The weight of the fermentation flask must remain practically constant (within 0·02 to 0·03 grm.) during 24 hours.

4. On agitating the contents of the flask, the scum produced should not be dense and creamy (indicating presence of CO_2).

5. The foregoing conditions being complied with, the flask is kept cool for 24 hours (10—15° C.), the contents diluted up to the original weight or volume, and thoroughly shaken, prior to analysis. There should be no development of internal pressure during shaking, as this would indicate incomplete fermentation. In all cases it is well to sterilise a portion of the liquid, inoculate afresh, and "force" for at least three days, at 25° C. If no further signs of fermentation appear in this period, it may be taken for granted that all fermentable matter has been removed.

6. In the case of *Saccharomyces cerevisiae*, fermentation is complete when the yeast exhibits film-formation; or when a white deposit of cells is produced at the line of contact between the glass and the surface of the liquid. These indications, however, only appear after some considerable time and need not usually be waited for.—H. T. P.

The Determination of Fat in Milk by Weiss's Method. Lang. Pharm. Zeit. 1893, 38, 219; Chem. Rep. 1893, 17, 113.

The author recommends the following modification of Weiss's method:—50 cc. of milk are treated with 5 cc. of caustic potash of sp. gr. 1·27 and the mixture shaken with 50 cc. of petroleum ether of sp. gr. 0·663. The separation of the two liquids is effected by the addition of 50 cc. of

96 per cent. alcohol. Extraction is complete after shaking the mixture two or three times and allowing it to separate again. 20 cc. of the fat solution are then drawn off, the petroleum ether evaporated, the residue dried at 110°—120° C., and weighed as fat.—B. B.

Estimation of Margarin in Butter. C. Micko. Zeits. österr. Apoth. Ver. 1893, **31**, 229; Chem. Rep. 1893, **17**, 113.

The use of potassium permanganate in oxidising the sulphurous acid produced in the saponification of butter fat by sulphuric acid according to Kreis's method for the determination of volatile fatty acids is condemned, as involving a certain degree of oxidation of the fatty acids. Potassium bichromate can be substituted, as its action is less drastic, and a moderate excess is without injurious effect.—B. B.

Estimation of Moisture in Raw Sugar. Seyffart. Zeits. Ver. Rübenzuck.-ind. 1893, **43**, 633.

See under XVI., *page* 851.

ANALYTICAL AND SCIENTIFIC NOTES.

A Nitrogenous Organic Acid occurring in Nature. F. Klingemann. Annalen, **275**, 89—91.

The author has obtained from a fungus (*Polyporus igniarius*), occurring on diseased oak and willow trees, an organic acid containing nitrogen. The acid may be extracted from the fungus by ammonia, and precipitated from its solution by hydrochloric acid. It forms an amorphous, dark brown powder, which the author could not purify. A neutral ammoniacal solution of the acid yields dark, amorphous precipitates with the salts of the alkaline earths, and several heavy metals. The formula $C_{36}H_{39}N_3O_{16}$ approximates most closely to the analytical results.

—H. T. P.

Gelatinous Silver Cyanide. Lee K. Frankel. Jour. Franklin Inst. **136**, 157—158.

Silver chloride was fused with potassium cyanide with a view of obtaining metallic silver. The crucible and contents were placed in a beaker, covered with water, boiled for 30 minutes, and put aside until the following day. The liquid was then found to contain a gelatinous mass, soluble in ammonia and reprecipitated by nitric acid. It decomposes without fusion on heating, leaving metallic silver. It gives the Prussian-blue reaction, but no chlorine reaction. The silver contained in the substance is 5 per cent. below the quantity required by silver cyanide, but this may be due to impurities in the materials used. Repeated, but futile, attempts have since been made to reproduce this new, gelatinous modification of silver cyanide.—H. A.

The Dyeing Properties of Ammoniacal Ruthenium Oxychloride. Nicolle and Cantacuzène. Ann. de l'Inst. Pasteur, **7**, 331; Chem. Zeit. Rep. **17**, 1893, 170.

The authors employ Joly's ammoniacal ruthenium oxychloride, $Ru(OH)_2Cl_4(NH_3)_7 . 3H_4O$, for the quick dyeing of all textiles, even when these are in the fresh state. The "going on" of excess of colour is a circumstance not to be feared. Addition of acetic acid renders this colouring matter suitable for an intrinsically thorough dyeing of the fibre. Its great tinctorial power and its insolubility in alcohol render it specially adapted for colouring those microbes which cannot be tinted by the Gram process. It is superior to any other vegetable or animal dye for colouring sections that have been hardened by means of osmic acid. As a matter of theory, it is interesting to notice as a chromogen a mineral compound possessing the properties of the basic aniline dyes, and one is tempted to establish a connection between the great colouring power it possesses and the presence of the NH_2 group in its case as well as in those of the basic aniline dyestuffs.—H. A.

New Books.

On Sewage Treatment and Disposal for Cities, Towns, Villages, Private Dwellings, and Public Institutions. By Thomas Wardle. Manchester: John Heywood, Deansgate. London: 2, Amen Corner, E.C. Price 15*s*.

This work, which is dedicated to the author's old friend and schoolfellow, Chas. Lowe, Esq., consists of a comprehensive treatise on the treatment and disposal of sewage. It fills 408 pages, exclusive of a preface, table of contents, and alphabetical index, and is illustrated by 56 wood engravings. The subject is planned out in sections or chapters, the headings of which will give a fair conception of the mode of treatment adopted. (*i.*) Estimations and Standards of Purity. (*ii.*) Bacteria and Bacterial Sewage Purification. (*iii.*) Principles and Modes of Sewage Treatment and Disposal. (*iv.*) Various Methods of Sewage Treatment. (*v.*) The Amines System. (*vi.*) Electrical Treatment of Sewage. (*vii.*) International Water and Sewage Process. (*viii.*) A Day at the Birmingham Sewage Works. (*ix.*) The Manchester and Rochdale Pail Systems. (*x.*) The Buxton System and others. (*xi.*) Spence's Alumino-ferric and other Processes. (*xii.*) The Salford Trials. (*xiii.*) English Cities and Towns and their Present Methods of Sewage Treatment and Disposal. (*xiv.*) Crude Sewage. (*xv.*) Precipitation, Settlement, and Filtration of Sewage. (*xvi.*) Sewage Effluent Waters; Deductions as to the most effective Method of treating Sewage. (*xvii.*) Sewage Sludge and its Disposal. (*xviii.*) Sludge-pressing and Sludge-Cake. (*xix.*) Irrigation by the Pumping of Sewage and Sewage Effluents, &c. (*xx.*) Composition and Growth of Plants; their Food and Fertilisation. (*xxi.*) Soils and their Nitrification; Manures. (*xxii.*) Etiology of Sewage, &c. (*xxiii.*) Sewage Farming. (*xxiv.*) Removal of Storm-Water, and the Flushing of Sewers, &c. (*xxv.*) Wardle Precipitation System, or Ozonine, &c. Appendices, including a Bibliography of Sewage, &c. The book is of 8vo. size, and is bound in cloth.

Analysis of Milk and Milk Products. By Henry Leffmann, M.D., Ph.D., Professor of Chemistry in the Woman's Medical College of Pennsylvania, &c., and William Beam, M.A., M.D. Philadelphia: P. Blakiston, Son, and Co., 1012, Walnut Street. 1893. Price 1 dol.

Octavo volume, bound in cloth, and containing table of contents and 189 pages of subject matter and an alphabetical index. The text is illustrated with some 9 woodcuts, and is subdivided as follows:—I. Nature and Composition of Milk. II. Analytical Processes. III. Data for Milk Inspection. IV. Milk Products. V. Appendix, containing Table for Correcting Specific Gravities and a Table for Calculating Total Solids.

Handwörterbuch der Pharmacie. Herausgegeben von A. Brestowski. Wien und Leipzig: Wilhelm Braumüller, K.U.K. Hof und Universitäts Buchhändler. 1892. London: H. Grevel and Co., 33, King Street, Covent Garden.

Parts 11 and 12 of this Dictionary of Pharmacy have now appeared. Part 11 commences with "Hohlmasse" and terminates with "Iodwasserstoff," the treatment of which is not completed, but runs on into part 12, which ends with the word "Kyphose." With Part No. 12, Volume I. (A to K) of the entire work closes.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

Customs Decisions.

(From the Board of Trade Journal.)

The following decisions affecting the classification of articles in the French Customs tariff have recently been given by the French Customs authorities:—

Trional and tetronal, chemical products prepared with the aid of alcohol, are dutiable at the rate of 2 frs. 40 cents. per kilo.

The following decisions affecting the classification of articles in the Spanish Customs tariff have recently been given by the Spanish Government:—

Tallow in sticks or simply melted, unprepared, will pay the duties of Category 250 of the tariff, in place of those of 254, that is to say:—

For the maximum tariff 1·30 frs. per 100 kilos., in place of 0·65 frs.

For the minimum tariff 1 fr. per 100 kilos., in place of 0·50 frs.

The following decisions respecting the classification of articles in the Customs tariff have recently been given by the United States Customs authorities:—

Chloral hydrate crystals, a medicinal preparation, of which alcohol is not a component part, but in the preparation of which alcohol is used, are dutiable at 50 cents per pound, under paragraph 74 N.T.

White lead, ochre, umber, and other colours all in oil, and put up in small metal tubes are dutiable at 25 per cent. under paragraph 61 N.T.

Vermilionette is dutiable at 12 cents a pound under paragraph 57 N.T.

An Act to amend the Law with respect to the Sale of Agricultural Fertilisers and Feeding Stuffs.

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

1.—(1.) Every person who sells for use as a fertiliser of the soil any article manufactured in the United Kingdom or imported from abroad shall give to the purchaser an invoice stating the name of the article and whether it is an artificially compounded article or not, and what is at least the percentage of the nitrogen, soluble and insoluble phosphates, and potash, if any, contained in the article, and this invoice shall have effect as a warranty by the seller of the statements contained therein.

(2.) For the purposes of this section an article shall be deemed to be manufactured if it has been subjected to any artificial process.

(3.) This section shall not apply to a sale where the whole amount sold at the same time weighs less than half a hundredweight.

2.—(1.) Every person who sells for use as food for cattle any article which has been artificially prepared shall give to the purchaser an invoice stating the name of the article and whether it has been prepared from one substance or seed, or from more than one substance or seed, and this invoice shall have effect as a warranty by the seller of the statements contained therein.

(2.) Where any article sold for use as food for cattle is sold under a name or description implying that it is prepared from any particular substance, or from any two or more particular substances, or is the product of any particular seed, or of any two or more particular seeds, and without any indication that it is mixed or compounded with any other substance or seed, there shall be implied a warranty by the seller that it is pure, that is to say, is prepared from that substance or those substances only, or is a product of that seed or those seeds only.

(3.) On the sale of any article for use as food for cattle there shall be implied a warranty by the seller that the article is suitable for feeding purposes.

(4.) Any statement by the seller of the percentages of nutritive and other ingredients contained in any article sold for use as food for cattle, made after the commencement of this Act in an invoice of such article or in any circular or advertisement descriptive of such article, shall have effect as a warranty by the seller.

3.—(1.) If any person who sells any article for use as a fertiliser of the soil or as food for cattle commits any of the following offences, namely:—

(*a*.) Fails without reasonable excuse to give, on or before or as soon as possible after the delivery of the article, the invoice required by this Act; or

(*b*.) Causes or permits any invoice or description of the article sold by him to be false in any material particular to the prejudice of the purchaser; or

(*c*.) Sells for use as food for cattle any article which contains any ingredient deleterious to cattle, or to which has been added any ingredient worthless for feeding purposes and not disclosed at the time of the sale,

he shall, without prejudice to any civil liability, be liable, on summary conviction, for a first offence to a fine not exceeding twenty pounds, and for any subsequent offence to a fine not exceeding fifty pounds.

(2.) In any proceeding for an offence under this section it shall be no defence to allege that the buyer, having bought only for analysis, was not prejudiced by the sale.

(3.) A person alleged to have committed an offence under this section in respect of an article sold by him shall be entitled to the same rights and remedies, civil or criminal, against the person from whom he bought the article as are available to the person who bought the article from him, and any damages recovered by him may, if the circumstances justify it, include the amount of any fine and costs paid by him on conviction under this section, and the costs of and incidental to his defence on such conviction.

4.—(1.) The Board of Agriculture shall appoint a chief agricultural analyst (hereafter referred to as the chief analyst), who shall have such remuneration out of moneys provided by Parliament as the Treasury may assign. The chief analyst shall not while holding his office engage in private practice.

(2.) Every county council shall, and the council of any county borough may, appoint or concur with another council or other councils in appointing for the purposes of this Act a district agricultural analyst (hereafter referred to as a district analyst) for its county or borough, or a district comprising the counties or boroughs of the councils so concurring. The remuneration of any such district analyst shall be provided by the council, or in the case of a joint appointment by the respective councils in such proportions as they may agree, and shall be paid, in the case of a county, as general expenses, and, in the case of a county borough, out of the borough fund or borough rate. The appointment shall be subject to the approval of the Board of Agriculture. Provided that no person shall while holding the office of district analyst engage in any trade, manufacture, or business connected with the sale or importation of articles used for fertilising the soil or as food for cattle.

5.—(1.) Every buyer of any article used for fertilising the soil or as food for cattle shall, on payment to a district analyst of a fee sanctioned by the body who appointed the analyst, be entitled, within 10 days after delivery of the article to the buyer or receipt of the invoice by the buyer, whichever is later, to have the article analysed by the analyst, and to receive from him a certificate of the result of his analysis.

(2.) Where a buyer of an article desires to have the article analysed in pursuance of this section, he shall, in accordance with regulations made by the Board of

Agriculture, take three samples of the article, and shall in accordance with the said regulations cause each sample to be marked, sealed, and fastened up, and shall deliver or send by post one sample with the invoice or a copy thereof to the district analyst, and shall give another sample to the seller, and shall retain the third sample for future comparison: Provided that a district analyst, or some person authorised by him in that behalf with the approval of the body who appointed the analyst, shall, on request either by the buyer or by the seller, and on payment of a fee sanctioned by the said body, take the samples on behalf of the buyer.

(3.) The certificate of the district analyst shall be in such form and contain such particulars as the Board of Agriculture direct, and every district analyst shall report to the Board as they direct the result of any analysis made by him in pursuance of this Act.

(4.) If the seller or the buyer objects to the certificate of the district analyst, one of the samples selected, or another sample selected in like manner, may, at the request of the seller, or, as the case may be, the buyer, be submitted with the invoice or a copy thereof to the chief analyst, and the seller, or, as the case may be, the buyer, shall, on payment of a fee sanctioned by the Treasury, be entitled to have the sample analysed by the chief analyst, and to receive from him a certificate of the result of his analysis.

(5.) At the hearing of any civil or criminal proceeding with respect to any article analysed in pursuance of this section, the production of a certificate of the district analyst, or if a sample has been submitted to the chief analyst, then of the chief analyst, shall be sufficient evidence of the facts therein stated, unless the defendant or person charged requires that the analyst be called as a witness.

(6.) The costs of and incidental to the obtaining of any analysis in pursuance of this section shall be borne by the seller or the buyer in accordance with the results of the analysis, and shall be recoverable as a simple contract debt.

6. If any person knowingly and fraudulently—

(*a*) tampers with any parcel of fertiliser or feeding stuff so as to procure that any sample of it taken in pursuance of this Act does not correctly represent the contents of the parcel; or

(*b*) tampers with any sample taken under this Act;

he shall be liable on summary conviction to a fine not exceeding twenty pounds, or to imprisonment for a term not exceeding six months.

7.—(1.) A prosecution for an offence under this Act may be instituted either by the person aggrieved, or by the council of a county or borough, or by any body or association authorised in that behalf by the Board of Agriculture, but in the case of an offence under section three shall not be instituted by the person aggrieved or by any body or association except on a certificate by the Board of Agriculture that there is reasonable ground for the prosecution.

(2.) Any person aggrieved by a summary conviction under this Act may appeal to a court of quarter sessions.

8.—(1.) For the purposes of this Act the expression "cattle" shall mean bulls, cows, oxen, heifers, calves, sheep, goats, swine, and horses; and the expressions "soluble" and "insoluble" shall respectively mean soluble and insoluble in water.

(2.) This Act shall apply to wholesale as well as retail sales.

9. In the application of this Act to Scotland—

(1.) The expression "council of any county borough" shall mean the magistrates and town council of a burgh, and the duties and powers of councils of counties and county burghs shall be performed and be exerciseable in a county by the county councils or district committees thereof, and in a burgh by the magistrates and town council, and the remuneration of district analysts appointed under this Act shall be paid in the case of a county out of the consolidated rate, and in the case of a burgh out of the police or burgh general assessment.

(2.) The expression "burgh" means a burgh which returns or contributes to return a member to Parliament, not being a burgh to which section fourteen of the Local Government (Scotland) Act, 1889, applies.

(3.) Penalties for offences under this Act may be recovered summarily before the sheriff in manner provided by the Summary Jurisdiction Acts, and any person aggrieved by a summary conviction may appeal therefrom in accordance with the provisions of those Acts.

10. For the purposes of the execution of this Act in Ireland, inclusive of the appointment of a chief agricultural analyst, the Lord Lieutenant acting by the advice of the Privy Council shall be substituted for the Board of Agriculture, and the district analysts shall be the analysts appointed for counties and boroughs in Ireland under the Sale of Food and Drugs Act, 1875, and the additional remuneration of such analysts for their duties under this Act shall be provided in manner directed by the said Act of 1875 and any Act amending the same.

11. This Act shall come into operation on the first day of January, one thousand eight hundred and ninety-four.

12. This Act may be cited as the Fertilisers and Feeding Stuffs Act, 1893.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

THE SUGAR INDUSTRY IN THE NETHERLANDS.

In a despatch to the Foreign Office dated the 14th September, Mr. C. L. des Graz, Her Majesty's Chargé d'Affaires at the Hague, transmits a memorandum on certain points connected with the sugar-refining trade, together with answers to certain questions submitted in a letter from the Foreign Office on the 30th August. The memorandum states as follows:—

Beet-root may be said to have entirely supplanted cane as the material used for the manufacture of sugar in this country.

The beet-root sugar manufacturer pays duty according to one of the two following systems, either of which he is at liberty to adopt.

1. Under the *Prise en charge* system, the duty the manufacturer has to pay is calculated on the basis of an estimated yield of 1·45 or 1·4 kilos. of refined sugar per hectolitre of juice and per degree of its density according as the process of defecation takes place before or after the last day of December. A supplementary duty of 5½ per cent. is levied if the juice is subjected to the "osmose" process, and one of 9 per cent. if Dr. Steffen's method of separation is followed.

The presumed yield under this system has not been altered since 1867, whereas the cultivation of the beet-root and the process of manufacturing sugar from it have both improved since then, the consequence being that the actual amount of sugar obtained from the beet-root exceeds the amount which it is estimated to yield.

This excess or *overpond* on which the manufacturer has no duty to pay constitutes a great advantage for him, the yield of "overpond" having during the last few years averaged 22 per cent.

The "overpond" may therefore be considered a general bounty on the production of sugar.

2. The second system the manufacturer can adopt is the "*exercise.*"

In Holland one manufactory only is worked under this method. Duty in this case is levied on the direct output declared for home consumption. No previous duty is levied and no drawback granted on exportation.

The duty on raw sugar is calculated according to its saccharine richness, certain deductions* being made; a margin is thus afforded to the refiner, turned by him to greater or less profit according to the more or less perfect methods of refining he employs.

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* Deduction of glucose with coefficient 2, and ash with coefficient 4, and a further deduction for waste of 1½ per cent.

It may be added that there is at present a bill before the Second Chamber of the States General which has for its object, by means of stringent supervisory regulations, to arrive at a correct estimate of the profits accruing to beet-root sugar manufacturers and refiners under the systems described above.

In answer to the question as to how the duty on raw sugar is levied and as to how the drawback is granted to refiners on sugar exported, Mr. des Graz states :—

The duty on raw sugar (for home consumption) and the equivalent drawback granted to refiners (on exportation) is calculated according to its saccharine richness as ascertained by the polariscope, with deduction of the glucose with the coefficient 2, and the ash with the coefficient 4. A further deduction for waste during the refinery process is made of 1½ per cent. in the case of beet-root sugar, and of 2½ per cent. in the case of cane sugar.

With regard to the amount of duty on raw sugar paid by the refiners, and the amount of drawback granted to refiners on export, Mr. des Graz says :—

The amount of duty on raw sugar paid by the refiners is 27 fl. (2*l.* 5*s.*)† per 100 kilos. of refined sugar, and the amount of the drawback paid to refiners on exports is the same, viz. : — 27 fl. per 100 kilos. of refined sugar exported. The home consumption of sugar in Holland is estimated at 40—42 million kilos., and the amount of duty paid for sugar consumed in Holland is 8,500,000 fl. (708,333*l.*).*—*Board of Trade Journal.*

The Manufacture of Wood-Pulp in the United States.

The Belgian Consul-General at Philadelphia, in a recent report, supplies the following particulars of the wood-pulp industry in the United States :—

An industry, connected with the working of the forests, that of the manufacture of wood-pulp, has within late years largely developed in the United States. From 1881 to 1891 the increase in production was about 500 per cent. It is estimated that at the present time this industry consumes 1,000,000 cords of wood annually, and meanwhile the production is still far from what it might be were it not for the fear of overstocking the market.

The applications of wood-pulp have become very numerous; of it are made household utensils, casts, mouldings for the inside and outside ornamentation of houses; in Austria it has also been used as a sheathing for war-ships. But at first wood-pulp was used solely as the raw material for the manufacture of paper, and this is still the case in the United States. Now, already in this direction alone, production no longer keeps pace with the needs of consumption; as a proof, it may be sufficient to mention that newspapers and books absorb annually in the United States 1,000,000,000 lb. of paper, and the wood-pulp would certainly supply two-thirds of this quantity.

This industry is represented by 22 States, of which 13 are on the Atlantic coast, two on the Pacific coast, and seven in the interior. It is in New York that the largest number of factories are to be found; there were 75 in 1890, or one-third of the total figure, but they are probably more numerous at the present time, for the new tariff has increased the duties on wood-pulp. It formerly paid 10 per cent., it is now taxed at 2·50 dols. per ton (dry weight) for pulp produced mechanically, at 6 dols. per ton (dry weight) for that produced chemically, but not bleached, and at 7 dols. per ton (dry weight) when it is bleached.

Notwithstanding these increases, the imports only diminished by 2,197 tons during the fiscal year 1891—92, or 41,118 tons against 43,315, representing respectively a value of 1,820,143 and 1,902,689 dols.—*Ibid.*

The Utilisation of Scrap Steel in the United States.

Mr. C. Clipperton, Acting British Consul at Philadelphia, in a report to the Foreign Office, dated the 29th September, encloses an extract from the *Pittsburgh Dispatch* of September 19th, with regard to tests being made of a process by which it is claimed that scrap steel can be heated and rolled into any shape.

It is stated that two men of the Jefferson Ironworks have invented a process by which scrap steel can be heated and rolled into any shape. Colonel A. S. Harden and Thomas Woods are the patentees of the composition used in this new process, which will practically revolutionise the steel business as far as the scrap portion is concerned. Thousands of dollars have been going to waste in scrap steel, which could not be placed in the converter and re-melted for re-rolling, as it would be burned.—*Ibid.*

GENERAL TRADE NOTES.

The Chemical Industry of Berlin.

The following report of the German chemical trade has been prepared by the Berlin Chamber of Commerce and published in the *Bericht über Handel und Industrie von Berlin.* The report for the previous year will be found on page 206 of No. 306 of this Journal. The year 1892 must be considered as, on the whole, favourable for the chemical industries. The political relations were of such a nature as to ensure a regular and uninterrupted development of trade, whilst in the special branch of disinfectants the prolonged epidemic of the year created great activity. Profits did not, however, quite keep pace with the increased turnover; the finance of the chemical industries is, in fact, daily becoming a more difficult problem in consequence of the ever-increasing home and foreign competition. The legal enactments as to the protection and insurance of workmen have also aided in hampering the trade.

It must be recognised that hitherto no difficulties have been raised as to the Sunday labour which is necessary in so many branches of chemical work. It will be well from henceforth to remain content with the laws already established for the benefit of the workmen, since it must be remembered that these entail considerable expense on the part of the employer, which must all be taken account of in connection with the question of competition.

Although the new commercial treaties with Austria, Italy, Switzerland, and Belgium have caused serious difficulties in certain branches, such as the lake colours, yet, on the whole, their influence has not been directly perceptible.

It is to be desired that arrangements may be made with other countries by means of which the difficulties arising from high import duties may be removed.

The McKinley Bill had a greater influence in 1892 than in the foregoing year. Its continuance induced the Americans to commence the manufacture of many articles for themselves which they had previously imported, and consequently the export of German goods to the United States fell off in a corresponding degree.

Ammonium carbonate, for example, is taxed to the extent of 1¾ cents per pound English, which amounts to over 25 per cent. of the selling value of the article.

The effect of this heavy tax was to prevent the export of the article, and thus to depress the home price, which gradually fell during the entire year, reaching a minimum of 60 m. per 100 kilos.

Crystallised salammoniac also fell in price, owing to the largely increased production by the gasworks, and was to be had at the rate of 45 m. per 100 kilos.

Salammoniac spirit also suffered a considerable fall in value, so that the technically pure article at a sp. gr. of 0·910 was delivered from the gasworks at 25 m. per 100 kilos.

Ammonium sulphate remained stationary throughout the year, except that during the autumn when the article was temporarily sold out, the price rose for a short period. The average price was 22 m. per 100 kilos.

Potash found a regular and satisfactory sale. The works never had to make stock; notwithstanding this the prices remained very low as in 1891, although the most important raw materials, the Stassfurt potash salts, had undergone a by no means unimportant rise.

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* At 12 fls. to the 1*l.*

Borax and boric acid also maintained their position at unaltered prices.

Oxalic acid and its salts experienced a vigorous sale, but the influence of foreign competition was felt continuously, prices having fallen to 60 m. per 100 kilos.

Potassium chlorate was much in demand, on account of the cholera, and rose gradually in value by more than 50 per cent., the average price being about 140 m.

Yellow prussiate of potash had a ready sale at unaltered rates.

Silicate of soda again fell in price, so that the returns from this article scarcely yield any profit. The sales, as in former years, remained limited, partly because of the great over-production, partly because the protective tariffs hinder the export of the article. The former vigorous and steady export to the United States of America ceased entirely on account of the operation of the McKinley Bill.

Soda crystals, in spite of the union of German alkali makers, have been subjected to frequent variations in value, so that transactions have produced little profit.

Nitric acid was in good demand but at low prices, whilst

Chili saltpetre rose during the year by 1½ to 2 m. per 100 kilos.

Sulphuric acid took a still more curious place in the market. In the East, whilst the production of 60° acid exceeded the demand, there was a steady scarcity of concentrated acid. Notwithstanding this, prices were lower than ever, so that acid of 66° could be bought below 6 m. per 100 kilo., including package.

The tar industry suffered from the general stagnation of trade, even more than in the preceding year. The sale of most of the articles of manufacture was satisfactory, but only obtained by lowering prices.

Benzol continued to fall in value, as in the closing months of 1891; the price gradually fell from 60 m. at the commencement of the year to 45 m., and then during the last few weeks rose again to 50 m. per 100 kilos.

Toluol and xylol remained low in price, and were in but little demand. There was, however, a slightly increased inquiry for the last-named article towards the close of the year.

Anthracene fell in the first nine months by 25 per cent., but gradually recovered, so that at the close of the year it was not much lower than at the beginning.

This recovery in the prices of the more important tar products is probably due to the union of the English tar distillers, in order to prevent a further ruinous fall in prices. It is to be hoped that their efforts may be successful, since no one, not even the purchasers, can wish for a continuance of such excessively low and variable prices.

Naphthalene, in spite of a brisk demand, fell 15 per cent. in value during the year.

Phenol and cresol, especially the latter, were in great demand on account of the cholera, and experienced an improvement in price. When the epidemic passed away there was a temporary return to former prices, but it was found that the stock of cresol had been exhausted, whilst the demand for it as a disinfectant continued. As a result of this and the union already mentioned, both articles rose again in price towards the end of the year, phenol to a slight extent, cresol to a greater degree.

Pitch found a satisfactory sale, but, like most of the other products of this industry, at falling prices.

The year 1893 has opened with a very noticeable dulness of trade, which it is to be hoped is only a result of the extreme cold of the winter. The unfavourable weather of the winter months made itself felt in another way, since the railway service was rendered extremely slow, and at the very time when it was most in demand could only accomplish a small amount of work. It is greatly to be desired that this evil should be in some way obviated.

Artificial colouring matters, aniline and similar products were exported in greater quantity by nearly 2,000,000 kilos. than in the foregoing year, but the course of the market for these articles was nevertheless quiet. Most of the crude products and colouring matters experienced but slight variations in price. The unfavourable conditions of the textile industries at the commencement of the year naturally exerted a depressing influence on the colour market, whilst later on the renewed activity in this important branch of industry gave rise to a certain amount of improvement.

We must again draw attention to the unfair system of the Swiss, who do not grant patents for the protection of chemical inventions and discoveries, and who can therefore make use of German discoveries without any cost, and thus compete with the originators of the new articles or processes. The great sacrifice made by the German firms, by the maintenance of costly research laboratories, is directly to the advantage of the Swiss manufacturers, who are enabled, without any hindrance, to make practical use of all German improvements. This is not the place for further discussion of this question, but the German Government should make every endeavour to protect their home industries as far as possible from such unjustifiable competition.

The trade in intermediate products of the colour industry, such as *naphthol*, was not satisfactory. The demand for these articles maintained the level of the previous year, but in spite of the lowering of prices fresh competition was commenced both at home and abroad, so that the existing over-production was greatly aggravated, and further cutting of the selling prices followed, while the crude products did not fall in the same degree, and even in some cases rose.

The general condition of the trade in non-poisonous *chemical and mineral colours* scarcely underwent any modification during the year. The stagnation which set in at the close of 1891 was maintained throughout the whole period, so that the sale could scarcely be kept up. Competition was exceptionally keen, so that prices fell still lower, and there was, moreover, no improvement in credit transactions. As a result of the new commercial arrangements, the trade with Austria did not experience any improvement, whilst that with Switzerland was unfavourably influenced. Although the tariff on tar colouring matters exported to Austria has been considerably lowered, yet the lake colours, which contain the colour in a combined form, are untouched by this concession. The reduction was, moreover, insufficient to bring about any marked improvement in those articles which were affected by it. The tariff on *baryta white* for example was reduced from three to two gulden. This reduced tariff is, however, still 25 per cent. of the value of the article, so that even under the new conditions the export of any considerable quantity is impossible. The relations with Switzerland are incomparably more unfavourable, since on most of the articles in question the tariff has been increased from to 7 to 20 francs. Such an increase in the duty of course greatly adds to the difficulties of the trade. No amelioration has been granted in the treaty to the lake colour manufacture, which has many difficulties of its own to struggle with. It is greatly to be hoped that in future treaties (with Russia, &c.) this branch of industry may be taken into favourable consideration. The export to the United States of America has maintained its old level, since the colouring matters in question are only slightly or not at all affected by the regulations of the McKinley Bill. The trade with England has also remained at the old level, whilst that with Holland and Belgium has fallen slightly because the competition of the Rhenish and other works is more keenly felt. It must be pointed out that the colour manufacture has suffered from the numerous syndicates and unions to which so many of the suppliers of raw materials belong. It is no doubt permissible to come to the aid of a depressed industry, labouring under over-production, by means of syndicates, but it is just as certainly unjustifiable when the only object of a syndicate is to artificially and without due cause raise the price of materials. This is the attitude taken by the syndicates for *alum, alumina, Prussian-blue, and chromium salts*. The evil influence of the first two of these is especially clear when we remember that the price in England is 40 per cent. below that in Germany, and that, therefore, the increased cost of materials cannot fail to be harmful to the German export industry. This evil can only be combated by lowering the import tariff, under the protection of which such artificial inflation of price is alone posssible.

The price of pure *methyl alcohol*, 135 m., has not appreciably changed from that of the previous year. The improvement in wood spirit, which was noticed towards the close of 1891, was maintained throughout the year, although the English demand fell off in the latter half of the period on account of the fall in price in the home market. The demand for methylating materials (2 parts of wood spirit and ½ part of pyridine bases) was considerably greater than in the preceding year, so that the stocks of *wood spirit* have not increased.

Acetic acid.—The quotations for acetate of lime for America kept at the level of last year (1891), but afterwards rose from 18 m. to 20 and 21 m., without any corresponding change taking place in the position of acetic acid.

The most vigorous movement of prices in an upward direction took place with regard to disinfecting agents, on account of the outbreak and spread of the cholera epidemic. The violent character of the epidemic in Hamburg soon produced a scarcity of disinfectants; the demand for disinfectants, however, ceased as suddenly as it commenced, so that unpleasant conditions for the intermediate dealers could not fail to exist.

Bromine. — In October, the Stassfurt manufacturers succeeded in making an arrangement with the American firms by which mutual competition was obviated. The result of this agreement was that the old higher price for bromine was re-established, the effect of which was to somewhat damp the ardour of purchasers of bromine preparations.

Carbolic acid.—From the causes already referred to an energetic upward movement of prices took place at about the middle of the year, the article advancing from 4½*d.* per lb. to 7¼*d.* As soon as the cholera scare was over, however, a considerable decline set in.

Glycerine maintained the level of 1891. This article has now taken an almost unprecedently low position. The purified varieties are in fair demand.

Iodine experienced no alteration in value, so that the precarious trade in iodine preparations could be carried on in safety. It is not yet known whether all the former supporters of the iodine syndicate have joined the new syndicate.

Permanganate of potassium, which was much sought for during the cholera time, and enjoyed a corresponding rise in value, fell after the expiration of the epidemic almost below cost price, on account of the increased production and accumulation of stocks by the intermediate dealers. Towards the close of the year prices gained ground a little, owing to the fear that the epidemic would return in 1893.

Potassium cyanide was in somewhat increased demand, owing to the extended use of this article for the extraction of gold and silver in the mining districts abroad.—*Chemical Trade Journal.*

The Price of Zinc.

Engineering and Mining Journal, September 16, 1893.

In plotting the curves of the prices for the principal metals in the United States during 1893 there will be some very extraordinary lines, certain of them having fallen to a lower point than ever before recorded. Thus, copper has dropped below the level to which it sank after the collapse of the French syndicate; lead has been lower than it fell after the Corwith failure in 1888, and almost to the panic price of 3 c. in May 1879; pig iron is about down to bed-rock, at 14·50 dols. for No. IX. Foundry here; while tin and quicksilver are both very low, though these have not declined so much proportionately as some of the other metals. We have already commented upon this phase of the financial crisis of the summer of 1893 in previous issues, but a fortnight ago there was an event in the metal market of such unusual character that it deserves further mention. We refer to the continued decline in the value of zinc, which carried the price for that metal below that for lead.

It is not extraordinary that zinc should be quoted lower than lead, but it is uncommon. In looking over the statistics of the average monthly prices of the two metals in *The Mineral Industry* for 1892 we find that since 1874 the value of zinc first declined below that of lead in September 1881, in which month the former averaged 5·125 cents per pound, and the latter 5·16. This happened again in September 1885 and several times during 1886, which year was remarkable, the average for lead for the whole 12 months (4·63 cents) exceeding that of zinc by 0·23 of a cent. In August 1887 and September 1888 lead was again sold at a higher rate than zinc, and in September 1887 the average for the two metals was the same. August 1893 was extraordinary, however, in having zinc quoted for less than lead, when both were below 4 cents.

Two weeks ago the price of lead in New York was 3·675 to 3·75, having risen in a fortnight from 3·30 on account of restriction in production, as we foretold in our issue of August 19th. The condition in the zinc market had become about as bad as it could be, however, and the price continued to fall, until finally, at the end of the month, 3·275 to 3·30 (East St. Louis) was reached, this being equivalent to 3·525 to 3·55 in New York, and lower than the price in London. Ordinary brands of spelter were quoted in London on August 17th at 17*l.* 5*s.* per gross ton (3·74 c. per pound); the next week there was a drop to 16*l.* 15*s.* (3·63 c.), through fear of importations from America, but during the week following the price recovered to 17*l.* 2*s.* 6*d.* (3·71 c.). When spelter, which it costs more to produce in the United States than in Europe, actually sells at a lower rate here than abroad, the weakness of our market is forcibly shown.

As to the chances for improvement we hesitate about expressing our opinion. Things are bad among the brass workers, and among the galvanisers, from whom came the great increase in the demand for spelter last year, business seems to have had a very serious set-back. At the same production has been large. According to a statement published in our market report August 19th, the output in the first six months of 1893 was stated to be 45,794 short tons, against about the same amount in the corresponding period of 1892. If these figures be correct the output of spelter during the first half of the present year was much greater than during the last half of 1892, and this notwithstanding the strike, commencing June 1st, among the coal miners of Kansas, cutting off the fuel supply of the Kansas-Missouri works.

Since the middle of June the production of spelter has been restricted sharply, but the stocks have been large and pressing for sale. The productive capacity of the Mississippi Valley States has been increased so largely during the past two or three years that, without doubt, the demand can be met easily as soon as it springs up again. We do not look for so great a rise proportionately in the price of spelter, therefore, as in that of lead—when the country begins to recover from the recent panic—and we fear that the zinc smelters will have hard times for many months, during which only the best designed works will yield much profit.

The Fertiliser Manufacture in Georgia.

Engineering and Mining Journal, September 16, 1893.

Directly connected with mining, an industry has been built up in the South during the past few years which has become of much importance to both the mineral and agricultural resources of the country. This is the manufacture of fertilisers. In Atlanta this industry has grown to almost as large proportions as in Charleston, notwithstanding the fact that the phosphates used are principally shipped from South Carolina to Georgia, as this mineral is not known to occur in paying quantities in the last-named State. The capacity of the six acid plants of Atlanta is between 40,000 and 50,000 tons yearly. Two of these plants, the Atlanta Fertiliser Company and the Kenesaw Guano Company, use entirely, for the production of the sulphuric acid necessary in manufacturing the fertilisers, brimstone which is imported direct from Sicily. The Scott Manufacturing Company uses one-half imported brimstone and one-half imported pyrites, the latter coming from Spain. The other three companies, the Southern, the Furman, and the O. A. Smith, use entirely pyrites imported from Spain. There are known to exist in Georgia several bodies of pyrites, and experiments have been made with the view of utilising the domestic instead of the imported article, but they have to the present time proved unsuccessful, although the companies would prefer the domestic on account of economy. The chief trouble has been the limited quantity carrying the requisite percentage of sulphur. Another difficulty has been the high percentage of silica, also the small extent of the ore bodies. These difficulties may all be overcome if the owners of pyrites mines will show enterprise enough to fully develop the ore bodies by thorough prospecting, which the value of the mineral would justify in this section, where labour is so cheap and the market so near the mines. North Carolina is the next nearest supply point, and experiments are now being made with pyrites from that State, but they have not yet proved sufficiently successful to warrant any statement regarding the adoption of this supply. South Carolina and Florida furnish all the phosphate used, while the potash and kainit are imported directly from Germany.

Nearly all the known deposits of pyrites in Alabama are copper pyrites, which do not carry a sufficient percentage of sulphur, but the deposits of Georgia are mostly iron pyrites, and if found in solid bodies of sufficient extent carrying the necessary per cent. (from 47 to 49) in sulphur, would prove very pophlar with the fertiliser men, especially of Atlanta. The price per ton of pyrites of the requisite grade is about 5 dols. delivered, and the nearest supply to Atlanta is Villa Rica, about 40 miles west on the Georgia Pacific Railroad. A large quantity has been at times shipped into Atlanta from the different mines in the vicinity of this place, but because of the reasons already given the industry of mining and shipping is not at all extensive, although some work of a development nature is being carried on at these mines in the hope of showing up the mineral in paying quantities of the requisite grade. From reliable information it is very doubtful whether the domestic pyrites will ever displace the foreign unless freight rates could be so arranged as to make it possible to ship from South Dakota, where some very extensive deposits of high grade iron pyrites occur. Before this could be possible, though, the price of pyrites must advance very materially or the rates of freight fall. As long as the manufacturers are at such a distance from the western country it is probable that they can import from Spain cheaper than it could be mined in the West.

A New Paper.

According to the *Droguisten Zeitung* the patent has been refused in Germany for an invention consisting in the preparation of paper made with the ordinary raw materials to which asbestos and parchment size have been added. Any writing in ink on this paper may be removed by the application of a wet sponge. The paper pulp, after having been compressed by a roller, is submerged for a period of from 6 to 36 seconds, according to the thickness of the paper, in concentrated sulphuric acid of 20° strength, diluted with from 10 to 15 per cent. of water. The paper is then pressed between glass rollers, and it is then successively tempered in water in an ammoniacal solution and a second time in water, after which it is well compressed between rollers, and dried. It is said that the final product bears a complete resemblance to ordinary paper. Its sale has been prohibited with a view to prevent the abuses to which it might easily be put.

Tinplate Production in the United States.

The report of Special Agent Ayer, recently issued by the Treasury Department, shows that from July 1st to March 31st, 1893, the aggregate production of tinplate in this country from sheets rolled in the United States was 34,632,052 lb. The aggregate amount of imported black plates which have been converted into tinplate in the United States was 39,290,282 lb., making the grand total of both kinds 73,922,334 lb. The increase of the March quarter over the December quarter of tinplate produced in this country is 3,300,000 lb., and of imported black plate 6,750,000 lb. Ten firms use their own black plates exclusively. Thirteen firms use both American and foreign plates, and nine use only foreign plates. Agent Ayer states that his figures as given are made up from the sworn returns of manufacturers. The report for the quarter ended March 31st, 1892, the last made, shows the production to have been 29,566,399 lb., of which 40 per cent. were made from American black plates.—*Engineering and Mining Journal.*

New Zealand Platinum.

It is stated that a quantity of heavy greyish sand has been discovered at Boatman's, near Greymouth, N.Z., which is said to contain platinum at the rate of 46 oz. to the ton. If this turns out to be a fair average, the find should be a very profitable one.—*Chemist and Druggist.*

The Alkali Export Business.

During the month of August Germany imported 15,908 cwt. of alkali from the United Kingdom, as compared with 9,984 cwt. in August 1892. In consequence of the increased duty on German articles, the import into Russia of coal-tar products from England has also been largely augmented. During the first eight months of this year, for instance, Russia imported 212,239 cwt. of alkali from the United Kingdom, as compared with 135,828 cwt. in the corresponding period of last year. The discrepancy would probably have been much greater still but for the fact that the new Russian tariff only came into operation in the second half of the year. During the first eight months of this year the United States imported 2,585,637 cwt. of alkali from the United Kingdom, as compared with 2,218,864 cwt. in the corresponding period of 1892.—*Ibid.*

Drug Imports into Servia.

The imports of drugs, chemicals, and colours into Servia were valued at 60,765*l.* in 1892, being 15,178*l.* in excess of the figures for the previous year. British and French articles showed a falling off, whilst most other countries—notably Austria, Italy, Germany, and Russia—have improved their position. The largest British item was indigo, which was valued at 1,663*l.* England also sent small quantities of soda, herbs, sugar of lead, and cochineal. Tea, which used to be classed under the head of groceries, is placed in the Servian statistics for 1891 under that of "drugs and chemicals," owing perhaps to the extremely high price of the commodity and to the fact that the bulk of the people look upon it as a beverage to be used only in times of illness. The value of the total amount imported did not exceed 625*l.* Amongst other articles of import are acids and salts, to the amount of 1,132*l.*; saltpetre, 4,200*l.*; litharge, 1,025*l.*; copperas, 2,232*l.*; soda, 1,702*l.*; and various made-up medicines, 6,764*l.*—*Ibid.*

Australian Native Gums.

According to a Queensland paper, Mr. T. G. Macknight, F.L.S., is endeavouring to organise the collection of gums from various Queensland trees for commercial purposes. He states that the gums from the following trees are of commercial value :—Queensland kauri pine, brigalow, gidya, grass-tree, cypress pine, bloodwood, acacia, wattle, fig, Norfolk Island pine, and the damar or kauri pine of New Caledonia, New Guinea, New Hebrides, and Fiji. The time to tap the trees is when the sap begins to rise at budding and flowering season, and the gum should be collected soon after the fruit has commenced to ripen and the sun has made the exudations firmer and easier to get off, but, of course, before the autumn rains. The tree should be wounded on one side one year and the opposite side the next year, and then on the left and right sides in succeeding seasons; the first side will then be ready again for tapping. In some cases the gum on exuding is rather liquid, and apt to run down to the ground. To keep it clean, a small piece of wood should be put into the trunk at the lower end of the cut, to direct the gum clear of the tree, so that it will fall into a kerosene tin, shell, or any other receptacle. Mr. Macknight states that gum—new, clean, free from bark and dirt—ranges in value from 20*s.* to 50*s.* per cwt., delivered in Brisbane. The fresher it is the better. Gum found in cavities in the woody part of trees is inferior.—*Ibid.*

Adulteration of Cocoa-nut Oil.

The cocoa-nut oil industry of Trinidad appears to be in imminent danger of irreparable injury through the practice of adulteration of the oil with a substance which is largely imported under the commercial name of "refined white cotton-seed" oil, which is admitted duty free. That this oil is not used for local consumption is notorious, and is, moreover, proved by the fact that of 148 different shops in which it was asked for, only seven were able to supply it. Yet the imports were 9,000 gallons in 1892 and 7,000 gallons during the first half of the present year.—*Ibid.*

The Greek Sulphur Mines.

A Greek Company, known as the Hellenic Company of Public Works, at Athens, who are the proprietors of the sulphur deposits in the island of Milo, have commenced this year to export their produce to France, where it has been pronounced much superior to the Sicilian article. The existence of the mines of Milo was known to the ancients. The Phœnicians were the first to extract sulphur, after them came the Greeks, Romans, and Byzantines, and many old borings are still to be seen. The sulphur attains at times a depth of 10 metres over an area of more than 200 metres. About 20 per cent. or 30 per cent. of pure sulphur is obtained from the deposits. The annual production amounts to some 2,000 tons, which are chiefly consumed in Greece in the treatment of vines against the oïdium.—*Ibid.*

South American Quicksilver.

A vein of cinnabar was discovered in 1786 near Quindiu, in Colombia, but after being worked for some time the mine was abandoned and all trace of it lost. In 1886 special search was made for its rediscovery, and after much trouble six levels, together with various furnaces, tools, &c., were discovered. The mine is nearly 10,000 ft. above the sea-level. The average percentage of cinnabar in the veins and seams varies between $\frac{1}{2}$ and $1\frac{1}{2}$ per cent. It is not improbable that more valuable deposits occur in the mountain. The Quindiu deposit may be regarded as impregnatious. Heated waters bearing double sulphides of iron and mercury in solution may have made their way up and along this disturbance, and then passing between the bedding-planes of the softer schists may have impregnated beds, occasionally filling joints and the fissures therein.—*Ibid.*

The German Coal-Tar Industry during 1893.

Chem. Ind. **16**, 1893, 205—210.

The coal tar industry, which in the closing months of the year 1891 began to exhibit signs of stagnation, suffered considerably in 1892 from the general depression in trade, so that most of the articles of manufacture experienced a great fall in prices. The demand in disinfectants was brisk during the summer months on account of the cholera, and the benzene and anthracene markets experienced a temporary improvement in prices owing to the formation of the Tar Products Sales Committee, a syndicate to which most of the English tar distillers belong. Judging from the short existence which similar unions have experienced in the past, it is obvious that too much confidence cannot be placed in the continuance of the new syndicate. Nevertheless such manifestations as were recently observed in the benzene market, tend to justify the efforts of the syndicate to uphold prices, seeing that benzene has fallen in value to such an extent that it has become a question whether it would not be more profitable to employ it for fuel purposes rather than inflate the market with it. To prevent further depreciation in the price of this article a combination of the German tar distillers on the one hand, and the coke-oven owners on the other, with the English syndicate, should be effected, and although the formation of an international union would of necessity be attended with many difficulties, owing to the various interests which are at stake, it is thought that the continuance of such excessively low prices is of such importance to both countries, that it should eventually be possible to combat all differences.

Light Oils and Benzene.—The imports of light oils into Germany during the past year were $1\frac{1}{2}$ million kilos. less than in the preceding year, notwithstanding the fact that the consumption was greater. This reduction is due to the increasing amount of benzene produced by the German coke ovens, and although it is stated on good authority that at current prices it does not pay to extract the benzene from coke-oven gas, this operation is still carried on, as the plant is in existence, and the owners show want of resolution to stop it. It is inferred from recent reports that at a price of 50 m. per 100 kilos. benzene is the cheapest product available for increasing the illuminating power of gas. Any further decline in its value must therefore expedite the fulfilment of this movement, so that in the course of time an improvement in price may be looked for even should the consumption for the manufacture of colouring matters remain the same.

Phenol and cresol were in good demand on account of the cholera, and prices were on the whole better than in the year 1891.

Naphthalene, in spite of an increased demand for colour purposes continued to fall in value, so that present prices scarcely cover the costs of purification.

Anthracene fell in the first nine months of the year, but subsequently returned to previous prices.

Pyridine bases.—There was no appreciable change in the value of pyridine bases, and the attempt made by the English syndicate to raise the price 25 per cent. was unsuccessful.

Ammonium sulphate was in good demand, and rose in value towards the close of the year.

Pitch and roofing tar continued to fall in value; the former commenced the year with a price of 35*s.* per ton f.o.b. London, and towards the end of the year fell to 28*s.* 6*d.*

With regard to improvements in the distillation but little advance appears to have been made during the year. The apparatus for the continuous distillation patented about two years ago does not seem to have been taken up by tar distillers, so that the distillation is carried on as before in stills of the ordinary construction worked intermittently.

Black varnish.—To utilise coal tar for protective coatings, especially metallic surfaces, all injurious sulphur compounds should be removed. This is effected according to an English patent, 10,976 by washing the tar in solutions of copper or zinc sulphate. The recovery of the metallic sulphides is said to be a tedious operation, and as the process cannot be worked without incurring some loss of metal, it does not appear to be of practical utility.

Asphalte.—To render asphalte composed of a mixture of pitch and sand impervious to acids, it is proposed to remove the phenolic (acid) oils present in the pitch before using it (Eng. Pat. 13,595.

Wood-protecting paints.—The consumption of the high boiling tar oils as paints for wood is increasing steadily. Their value for this purpose is said to be enhanced by subjecting the oils to the action of ozonised air, which has a thickening effect on the oils, and imparts greater body to them (Ger. Pat. 63,318).

Lubricating greases, &c.—According to a French patent, No, 213,529, the preparation of "mineral fats" from mineral oil is effected by adding fatty acids and milk of lime to the latter and heating the mixture.

For the removal of sulphur compounds it is recommended to subject the oils in the form of vapour to the action of steam at temperatures sufficiently high to decompose the sulphur compounds (Amer. Pat. 486,406).

Benzene from coke oven gases.—According to Heinzerling (Ger. Pat. 66,644) the separation of benzene from coke-oven gas is effected by compressing the gas and simultaneously subjecting it to extreme cold. The compressed and cooled gas is then passed into the cylinder of a motor, in which it is allowed to expand and perform work. This causes a further reduction of temperature, and the separation of the benzene in a gelatinous crystalline form. This process, although highly ingenious, is only in use at one works, and it would appear that the necessary machinery and appliances are too expensive to admit of the method being generally adopted.

Artificial indigo.—With regard to the preparation of artificial indigo from phenyl-glycocine patented about two years ago, data as to quantities actually produced are wanting. The patent must, however, be considered of great value by the owners, as during the past year it has been extended to the homologues of phenylglycocine, more especially meta-xylylglycocine and ethylorthotoluylglycocine.

General data.—Of the reduction products of benzene, which have been minutely studied by Bayer, it would appear that among others dihydrobenzene pre-exists in crude benzene and is the cause of the red coloration which sulphuric acid imparts to crude benzene.

Among the higher boiling hydrocarbons naphthalene has, as in former years, given rise to the granting of a large number of patents in connection with the colour industry. Graebe and Gfeller's researches on the oxidation of acenaphthene have shown that naphthalic acid is obtained in theoretical quantities, whilst the quinone is only yielded in small quantities as a by-product when an insufficient amount of oxidising agent is employed. The quinone reacts with caustic alkalis in a remarkable manner, which is being further investigated.

Much attention has been given during the past year to the study of the coal-tar bases. Orthohydroxy- and mono-acetylamido-quinoline, an antipyretic derivative of quinoline, has been prepared and patented. Pictet and Popovici have prepared isoquinoline by pyrogenic synthesis from benzylidene-ethyl amine, whilst Bamberger and Kitscheld have obtained the base from naphthalene by exchanging one CH group in one of the naphthalene rings for a nitrogen atom. Starting with β-naphthoquinone, the next product of the reaction is dihydroxyisocumarine, then isocumarine carboxylic acid and isocarbostyril, which latter when heated with zinc-dust in excess yields isoquinoline.

The reddening of phenol in air and light has been made the subject of further investigation, without, however, arriving at any definite conclusions (this Journal, 1893, 107).

The determination of phenol in carbolic oils gave rise to several disputes in the course of the year. Unsuccessful attempts were made to determine the percentage of phenol by titration with bromine, or weighing the bromine additive product, as the different cresols of which these oils are mainly composed absorb different quantities of bromine. The commercial method now universally adopted consists in shaking up a known quantity of the oil with a certain amount of caustic soda solution (sp. gr. 1·2) and noting the increase in the volume of the latter. Accurate results are obtained by the following method :—100 cc. of the oil are treated with an excess of a 10 per cent. solution of caustic alkali. The aqueous solution is boiled for the purpose of removing the last traces of neutral oil, after which it is acidified with hydrochloric acid.

The phenols are separated from the aqueous solution, the latter is shaken up with ether, and the ethereal solution added to the phenols. This mixture is then dried with calcium chloride, the ether expelled by distillation, and the residue weighed or measured.

Among the oxygen compounds of coal tar, cumarone has been investigated. On reduction with sodium and alcohol hydrocumarone C_8H_8O is obtained, together with ortho-ethylphenol.

Hensler (this Journal, 1892, 671), in his investigations on lignite tar, failed to detect the presence of cumarone and indene. No evidence of the presence of terpenes in the tar could be obtained, but benzene, toluene, and naphthalene were easily recognised.

In conclusion reference is made to Markownikoff and Aschan's controversy on naphthenes and petroleum acids. It is now generally accepted that the petroleum acids are not identical with hexahydrobenzoic acids and their homologues. From this it follows that they cannot be derivatives of the naphthenes, nor can the latter be looked upon as being identical with hexahydrobenzene and its homologues. Zaloziecki's view that these acids must be regarded as lacto-alcohols is highly improbable, but Ascham's suggestion of the presence of a tri-tetra or pentamethylene ring in petroleum acids is more intelligible.—D. B.

THE PHOSPHATE INDUSTRY OF THE UNITED STATES.[*]

In 1890 a resolution was passed by the United States Senate directing the Commissioner of Labor to make a special report on the phosphate industry. This report, which has just been issued, contains a number of figures and statements collected by the bureau, a summary of which is given below.

The shipments of South Carolina phosphates began with 6 tons in 1867, increasing to 11,862 tons in 1868 and 28,271 tons in 1869. From that year to 1889 the production, by periods of five years, was: 1870–74, 386,732 tons ; 1875–79, 827,955 tons ; 1880–84, 1,738,627 tons ; 1885–89, 2,435,616 tons. The figures are in tons of 2,240 lbs. For the last three years the South Carolina production is given as follows :—

—	1890.	1891.	1892.
Shipped to foreign markets	219,822	126,798	124,454
Shipped to domestic markets	250,936	295,151	242,942
Manufactured at home............	116,000	151,000	181,000
Total	586,758	572,949	548,396

The heavy drop in foreign shipments in 1891 was partly offset by the increase in home consumption, so that the total decrease, while continuous has not been rapid during the three years.

The period of the Florida industry is covered by five years, the figures given for which in the report are as follows, also in tons of 2,240 lbs.: —

—	1883.	1889.	1890.	1891.	1892.
Hard rock	..	25	17,345	88,343	202,019
Land pebble	..	..	..	2,925	17,795
River pebble...........	813	3,755	33,336	79,265	126,172
Soft phosphate.........	..	..	1,700	10,784	8,341
Total	813	3,780	52,381	181,317	354,327

Of this total in 1892 there were 307,574 tons shipped through the United States Custom-houses, 249,069 tons going to foreign and 58,505 tons to domestic ports. The balance of 46,753 tons is made up by railroad shipments and home consumption. The shipping ports were : Fernandina, 126,950 tons; Punta Gorda, 76,040 tons; Tampa, 78,140 tons; Brunswick, 19,097 tons ; Savannah, 7,338 tons.

The figures differ from those of the "Mineral Industry" for 1892 mainly in the allowances made in this report for the amount used and manufactured at home, which must be in large part estimated. It must be noted also that the figures in the table below, giving total output for 1892, differ materially from those just summarized. The cause of the differences is not explained in the report.

While the tables given above represent shipments, a different statement is given in another table in the report, where the total production of phosphates in 1892 is given, as below, in tons of 2,240 lbs. :—

—	Land Mines.	River Mines.	Total.
North Carolina	700	..	700
South Carolina...............	429,976	269,000	698,976
Florida	371,190	160,837	532,027
Total	180,866	429,837	1,231,703

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[*] Abstract from report on the Phosphate Industry, by the Hon. Carroll D. Wright, Commissioner of Labor.

Of the total number of 137 mines included in this table, there were 112 land mines and 25 river mines, as shown in the summary given below, which is taken from the report. The period for which figures are given is in general the calendar year 1892; but in some cases the years reported by different companies varied, ending with different mouths. In such cases figures are given for the fiscal year, terminating nearest to December 1892.

The tables given include for the State of Florida 88 land mines and 18 river mines, or 106 mines for the State; one land mine for North Carolina; and 23 land mines and seven river mines for the State of South Carolina, or a total for the latter of 30 mines, the whole number of mines considered being 137. In the phosphate industry production is usually measured by tons of 2,240 lbs., while sales or consumption are measured by tons of 2,000 lbs. From the general tables it is found that the total amount of phosphate mined by the 137 mines considered was 1,231,703 tons, having a value at the mine of 7,153,141 dols. Of this production 1,033,409 tons were shipped from the mines.

The number of acres controlled for mining purposes in Florida is 179,848; in North Carolina, 2,500; and in South Carolina, 69,790, or a total of 252,138 acres. The miles of river controlled for mining purposes in Florida are $163\frac{1}{2}$ in 15 mines, three mines not reporting; and in South Carolina, seven in one mine, six mines not reporting, or a total of $170\frac{1}{2}$ miles in 16 mines, nine mines not reporting. The total capital invested in plant in Florida is 2,140,582 dols., and in land 11,346,067 dols.; in North Carolina the plant is represented by 2,000 dols., and the land by 100,000 dols.; in South Carolina the plant is worth 2,563,200 dols., and the land 2,920,000 dols The capital invested, then, in plant (the facts not being given for five mines) is 4,705,782 dols., and in land (the facts not being given for 16 mines) 14,366,067 dols., or a total of 19,071,849 dols. invested in the phosphate mining of the country.

The total average number of employés engaged in the production of phosphate is 9,175. This, however, does not include all the labour in one mine and the skilled labour in two mines, these facts not being reported. The total expenditure for labour for the period covered was, in Florida, 881,711 dols.; in North Carolina, 1,215 dols.; and in South Carolina, 1,590,689 dols., or for the whole 2,473,615 dols. In this amount is included, in three mines, the expenditure for officials and clerks, which was given by the proprietors, but who declined to separate the amounts. It makes no appreciable difference, however, in the grand total. The average yearly earnings of employés engaged in production in the land mines of Florida are 211 dols., and in the river mines 347 dols.; in the land mines of South Carolina, 287 dols., and in the river mines of that State 378 dols.; in North Carolina the earnings of employés are now, on an average, 68 dols. per annum. The average in Florida, for both land and river mines, is 225 dols., and in South Carolina, 303 dols. or for the whole industry 270 dols. per annum.

It has been difficult to secure the cost of producing phosphate in various localities, and there is a very great variation in the reports. A general summary is given, the averages being made up from the returns of those companies only which give full statements of cost. For land mines, taking the total cost in Florida for the 71 mines covered by the summary, which include labour, officials and clerks, supplies and repairs, and taxes, the average cost per ton as shown by the cost for 279,499 tons, is 2,654 dols. Adding to this the cost of insurance, interest, depreciation of value of plant, royalty to owners of the soil, the transportation to place of free delivery, averaging 2,965 dols. it is found that the average total cost of a ton is 5,619 in Florida. The table giving the facts for 22 land mines in South Carolina shows that the average cost of 391,576 tons, for labor, officials and clerks, supplies and repairs and taxes, is 3,497 dols., while the addition, consisting of insurance, interest depreciation of value of plant, royalty to owners of the soil, and transportation to place of free delivery, is 0·843 dols. per ton on an average, or a total cost in South Carolina for phosphate from land mines of 4·34 dols., as against 5·619 dols. per ton. on an average, in Florida. The cost of labor in mining in South Carolina is greater than in Florida, it being on the average 2·798 dols. per ton, as against 1·878 dols. on the average in Florida, while the cost of transportation in Florida is 2·802 dols. per ton, as against 0·447 dols. in South Carolina. The South Carolina mines are more accessible than those in Florida, a fact which accounts for this great difference. The single mine in North Carolina reports for 700 tons production an average cost for labour supplies, &c., of 3·186 dols. per ton; there was no expenditure for transportation or other items.

Observing the same divisions as to elements of cost as were observed in the consideration of land mines, it is found that in Florida, for all river mines, covering 93,737 tons, the average cost of one ton is 1·954 dols. for labour, officials and clerks, supplies and repairs, taxes and royalty to the State. The total cost must be increased, however, by the addition of insurance, interest, depreciation and transportation, which amount to 2·824 dols., or a total of 4·778 dols. for phosphate from river mines in Florida. In South Carolina the cost is, for four river mines, 2·355 dols. for labor, supplies and royalty, and 0·146 dols. for insurance, transportation, &c., a total of 2·501 dols., and, as in the case of the land mines, this large difference in cost is caused by the wide difference in cost of transportation to place of free delivery. It may be added that in South Carolina the royalty paid to the State is 1 dol. per ton. The detailed tables, giving the returns from each reporting mine, show a great difference in all the different items of elements of cost of the production of phosphate. The elements showing the greatest variation are those of labour cost in mining phosphate and in transportation. In the first instance the variation occurs on account of the varying conditions attending the mining. The widest differences are shown in the Florida land mines, as compared with the South Carolina land mines. This results from the fact that in Florida the country is undulating, the depths at which the phosphate is found varying so greatly as to make it impossible to establish even an approximately uniform cost per ton; while in South Carolina the phosphate mines are located on comparatively flat lands, the overburden being more even in depth. The variations in all land mining, however, are greater than those attending river mining. As to transportation, the variation takes place, of course, relatively to distances.—*Engineering and Mining Journal.*

Arsenic and Cyanide of Potassium in New Zealand.

The Poisons Importation and Carriage Bill introduced into the New Zealand Parliament in July has been extensively amended by the select committee to which it was referred. Instead of applying to all the scheduled poisons, it is now limited in its operation to arsenic and cyanide of potassium. The elaborate precautions as to the packing of poisons are simplified, and it is to be enacted that these two articles are to be packed in hermetically-sealed iron drums or in strong wooden cases lined with zinc and hermetically sealed, and not exceeding in weight 1 cwt. All such drums and cases are to be painted red with oil-paint. It is still required that they shall be kept separate from food during transit, and the name of the poison and the word "poison" are to be on each package, the letters to be not less than 1 inch in height, and notice in writing to be given to everyone into whose hands it passes. A penalty is imposed for sending or carrying packages under a false description.—*Chemist and Druggist.*

Adulteration of Beeswax by Paraffin.

The practice of adulterating beeswax with low-class paraffin, which used to prevail extensively in Morocco, but was scotched for a while by exposure of the fraud and consequent depreciation of the adulturated article in the English market, seems to be again reviving. The British Consul at Saraiche reports than in 1892, 6,920 cwt. of candles were imported there, against 3,592 cwt. in 1891, 98 per cent. coming from England, A considerable portion of these, which are all paraffin of inferior quality, are diverted from their legitimate use in Fez, and employed in adulterating beeswax, for which purpose it is more convenient to use paraffin in this shape than in any other, as it averts suspicion.—*Ibid.*

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

Articles.	Month ending 30th September	
	1892.	1893.
	£	£
Metals.............................	1,570,592	1,687,676
Chemicals and dyestuffs............	474,727	401,322
Oils...............................	535,865	637,235
Raw materials for non-textile industries.	4,129,463	4,034,494
Total value of all imports	31,485,305	31,377,936

SUMMARY OF EXPORTS.

Articles.	Month ending 30th September	
	1892.	1893.
	£	£
Metals (other than machinery)	2,837,408	2,390,494
Chemicals and medicines	744,709	637,277
Miscellaneous articles..............	2,405,244	2,379,534
Total value of all exports.....	19,104,859	18,434,129

IMPORTS OF METALS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Copper :—				
Ore............ Tons	9,047	5,302	48,945	22,885
Regulus .... „	7,402	11,800	167,046	292,699
Unwrought .... „	3,362	4,826	153,998	218,076
Iron :—				
Ore............. „	315,985	339,416	229,156	239,552
Bolt, bar, &c.... „	6,758	6,030	66,167	55,028
Steel, unwrought.. „	583	711	5,947	6,137
Lead, pig and sheet „	15,651	15,480	169,107	152,204
Pyrites .... „	34,340	40,888	62,790	70,280
Quicksilver....... Lb.	54,965	45,000	4,784	3,833
Silver ore....... Value £	..	..	246,061	218,085
Tin .... Cwt.	46,839	48,134	222,084	194,585
Zinc .... Tons	3,312	4,277	70,591	74,305
Other articles ...Value £	..	..	123,916	140,007
Total value of metals	..	..	1,570,592	1,687,676

IMPORTS OF OILS FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut......... Cwt.	2,097	18,204	2,159	23,786
Olive .... Tuns	1,525	667	56,974	25,338
Palm .... Cwt.	81,278	106,479	82,586	130,110
Petroleum .... Gall.	7,154,843	14,374,163	136,952	233,718
Seed .... Tons	2,143	2,706	55,292	62,985
Train, &c.......... Tuns	2,463	1,569	48,062	31,763
Turpentine .... Cwt.	71,501	46,706	74,857	50,195
Other articles .. Value £	..	..	78,983	79,340
Total value of oils ...	..	..	535,865	637,235

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH SEPTEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	5,601	2,449	11,597	5,648
Bristles.......... Lb.	280,258	365,555	47,968	54.841
Caoutchouc...... Cwt.	20,920	23,762	243,178	292,004
Gum :—				
Arabic......... „	5,932	2,939	13,704	8,857
Lac, &c......... „	3,622	2,470	14,616	12,521
Gutta-percha .... „	4,006	1,264	41,112	10,726
Hides, raw :—				
Dry............ „	24,517	19,857	59,649	55,954
Wet .... „	37,771	67,444	81,949	138,683
Ivory............ „	1,014	544	46,966	24,643
Manure :—				
Guano .... Tons	1,101	500	6,131	4,696
Bones.......... „	4,281	1,679	16,842	7,413
Nitrate of soda... „	6,746	4,051	55,802	36,441
Phosphate of lime „	37,681	30,326	71,588	52,220
Paraffin.......... Cwt.	43,254	55,692	61,920	58,264
Linen rags....... Tons	618	1,776	4,242	18,057
Esparto.......... „	14,147	11,766	71,181	53,615
Pulp of wood .... „	12,011	19,054	69,750	105,423
Rosin............ Cwt.	127,296	141,113	32,269	47,442
Tallow and stearin „	90,920	149,968	116,435	214,550
Tar..............Barrels	36,071	22,753	21,576	11,281
Wood :—				
Hewn .... Loads	268,045	215,948	525,186	457,469
Sawn .... „	672,602	648,384	1,467,504	1,444,366
Staves .... „	17,383	19,884	61,479	53,040
Mahogany ..... Tons	5,830	3,960	50,578	34,692
Other articles....Value £	..	..	936,241	831,648
Total value	..	..	4,129,463	4,034,494

Besides the above, drugs to the value of 61,852*l.* were imported, as against 68,696*l.* in September 1892.

Imports of Chemicals and Dyestuffs for Month ending 30th September.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	4,341	6,011	3,237	5,494
Bark (tanners', &c.) „	45,715	36,323	18,009	12,718
Brimstone........ „	49,917	67,127	14,499	18,349
Chemicals...... Value £	..	..	127,015	98,668
Cochineal .... Cwt.	354	438	2,111	2.982
Cutch and gambier Tons	1,349	1,920	28,164	42.929
Dyes:—				
Aniline....... Value £	..	..	12,513	18.023
Alizarin...... „	..	..	37,430	31,474
Other........ „	..	..	47	1,633
Indigo .... Cwt.	3,019	729	47,331	13,938
Nitrate of potash . „	20.982	15,892	17,675	14,767
Valonia........... Tons	2,043	3,672	26,271	47,745
Other articles... Value £	..	..	140,425	92,602
Total value of chemicals	..	..	474,727	401,322

Exports of Miscellaneous Articles for Month ending 30th September.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	622,900	567,300	19,259	14,936
Military stores.. Value £	..	..	87,957	98,432
Candles.......... Lb.	1,339,500	1,493,300	25,449	28,728
Caoutchouc..... Value £	..	..	101,935	108,482
Cement.......... Tons	34,892	32,983	62,333	54,586
Products of coal Value £	..	..	104,508	94,592
Earthenware... „	..	..	156,721	119,725
Stoneware...... „	..	..	14,308	12,156
Glass:—				
Plate........... Sq. Ft.	236,416	140,514	8,904	7,114
Flint........... Cwt.	7,204	7,628	20,518	21,035
Bottles......... „	56,410	64,871	28,328	31,593
Other kinds.... „	21,221	18,277	17,779	14,154
Leather:—				
Unwrought.... „	10,718	12,288	98,229	110,268
Wrought..... Value £	..	..	37,883	35,035
Seed oil.......... Tons	4,765	4,826	91,133	106,365
Floorcloth ..... Sq. Yds.	1,265,200	1,389,300	57,556	56,141
Painters' materials Val. £	..	..	117.875	109,640
Paper .... Cwt.	73,132	76,611	123,575	122,772
Rags............ Tons	4,590	2,748	33,132	16,574
Soap............ Cwt.	40,778	51,136	44,893	54,139
Total value..........	..	..	2,405,244	2,379,534

Exports of Metals (other than Machinery) for Month ending 30th September.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass............ Cwt.	8,166	10,154	33,714	38,984
Copper:—				
Unwrought..... „	66,171	42,251	160,932	96,900
Wrought........ „	24,510	30,291	74,491	85,835
Mixed metal.... „	22,310	25,698	54,072	58,705
Hardware..... Value £	..	..	182,337	175,562
Implements....... „	..	..	99,300	105,846
Iron and steel..... Tons	267,603	233,024	1,933,965	1,601,168
Lead............. „	3,900	3,554	44,405	40,467
Plated wares... Value £	..	..	30,740	26,010
Telegraph wires „	..	..	68,944	32,865
Tin............... Cwt.	11,762	13,418	56,571	57,765
Zinc.............. „	14,337	14,074	12,764	10,673
Other articles .. Value £	..	..	85,173	59,714
Total value.........	..	..	2,837,408	2,390,494

Exports of Drugs and Chemicals for Month ending 30th September.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali........... Cwt.	519,098	350,743	184,744	114,603
Bleaching materials „	141,294	72,247	57,418	29,912
Chemical manures. Tons	29,447	36,765	177,273	201,394
Medicines....... Value £	..	..	84,037	76,645
Other articles... „	..	..	241,237	214,723
Total value..........	..	..	744,709	637,277

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, and MACHINERY.

Applications.

17,737. F. S. Cripps. Improvements in valves for tar, ammoniacal liquor, and other liquids. September 21.

18,061. I. A. F. Bang. An improved method and apparatus for charging vessels with liquefied gas. September 26.

18,341. R. Krix. Improvements in the method of and apparatus for filtering liquids under pressure. Complete Specification. September 30.

18,422. W. P. Thompson.—From W. Arnold, Germany. Improved apparatus for washing filtering media. Complete Specification. October 2.

18,573. M. M. Bair. Improvements in materials for filtering purposes, and process of manufacture thereof. October 4.

18,633. G. Tolson and J. E. Tolson. A new or improved carbonising and preparing machine for disintegration of vegetable matter from animal matter. October 5.

18,642. J. N. S. Williams. Improvements in multiple effect evaporators. Complete Specification. October 5.

18,652. C. Latarche. An improved actinometric pyrometer. Complete Specification. October 5.

18,702. J. G. Lorrain.—From G. Edeline, France. A vegetable disincrustant and its manufacture. October 5.

18,711. J. G. Crookston. Improvements in pressure gauges. October 6.

18,736. J. W. Pickles. The challenge sulphide rectifier. October 6.

19,196. A. Martin. Improved apparatus for mixing liquid, semi-liquid, and pasty substances. October 12.

19,272. T. C. Palmer. *See* Class XII.

19,275. W. P. Thompson. New or improved method of separating gases of different specific gravities, and improvements in apparatus for effecting such separation. October 13.

19,358. W. D. Gooch. *See* Class XVII.

Complete Specifications Accepted.*

1892.

20,595. F. W. Scott, E. G. Scott, and F. W. Scott, jun. Improvements in or connected with evaporating or concentrating apparatus. September 27.

22,157. J. J. Melville. Improvements in or relating to apparatus for treating solid, semi-solid, or liquid substances with gases. October 11.

23,287. B. J. B. Mills.—From A. Gilliard, P. Monnet, and J. M. Cartier. Improvements in means or receivers for the preservation and application of chloride of ethyl and other volatile liquids, to be employed principally in the production of cold. October 4.

1893.

9006. O. Guttmann. Improved apparatus for concentrating and distilling liquids. October 18.

14,274. F. Crane and J. B. B. Wellington. Improvements in apparatus for coating flexible fabrics. September 27.

14,516. A. F. W. Kreinsen. Improvements in and connected with electric furnaces. September 27.

14,967. J. B. Tröndle. Apparatus for sterilising beer, wine, and other liquids under pressure. September 27.

II.—FUEL, GAS, AND LIGHT.

Applications.

17,573. J. Stark. Improvements in the manufacture of fire lighters. September 18.

17,811. E. Mansfield. Improvements relating to the manufacture of gas. September 22.

17,829. H. J. Smith and J. Hamilton. *See* Class X.

18,125. R. Middleton. An improved admixture of, or process of mixing materials for making blocks or briquettes for fuel and analogous purposes. September 27.

18,285. H. O. A. E. Grunbaum. An improvement in fire fuel of explosive and inflammable oils, spirits, liquids and powders, absolutely safe for transport. Complete Specification. September 29.

18,286. H. O. A. E. Grunbaum. An improvement in stones for fire fuel made of inflammable materials. Complete Specification. September 29.

18,570. J. Brown and J. T. Curry. Improved renovated coal. October 4.

18,574. T. Banks. Production of carburetted hydrogen for illuminating and other purposes. October 4.

18,673. A. A. Lister and Dawson & Co. Improvements in gas retort self-sealing mouth-pieces. October 5.

18,709. T. W. Ackroyd. Improvements in fire-lighters. October 6.

19,174. C. G. Satterthwaite. Improvements in fire-lighters. Complete Specification. October 12.

19,185. S. Psaroudaki and A. Blondel. Improvements in the diffusion and distribution of light. October 12.

19,275. W. P. Thompson. *See* Class I.

19,360. J. Templeman. Improvements in the manufacture of fire-lighters and fuel blocks and in means or apparatus employed therein. October 14.

Complete Specifications Accepted.

1892.

19,753. A. G. Glasgow. Improvements relating to apparatus for the manufacture of water gas. September 6.

20,373. W. G. Hay. Improvements in and connected with the manufacture of fire-lighters. October 18.

20,709. L. Van Vestraut and M. Graham. Improvements in apparatus for charging inclined gas retorts. October 11.

21,028. W. S. Sutherland. Improvements in and appertaining to gas producers. September 27.

21,649. R. O. Paterson. Improvements in and apparatus for the manufacture of gas for illuminating or other purposes. September 27.

22,780. G. Moss. Improvements in means for increasing the illuminating power of lamp flames. October 4.

23,236. H. H. Lake.—From E. Clarenbach. Improvements relating to the smokeless combustion of fuel and to apparatus for effecting such combustion. October 18.

1893.

10,612. A. J. Boult.—From A. A. Dickson. Improved process for reducing crude peat into a marketable form. September 27.

15,174. S. W. Van Syckel. Improvements in apparatus for the manufacture of gas. September 27.

IV.—COLOURING MATTERS AND DYES.

Applications.

17,542. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in the production of oxyanthraquinone. September 18.

17,543. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of a novel colouring matter. September 18.

17,544. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Improvements in dyeing wool with sulphonic acids of anthraquinone colouring matters. September 18.

17,572. B. Willcox.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of beta-methyleurhodine. September 18.

18,317. B. Willcox.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new disazo dyes. September 29.

18,374. B. Willcox.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new dyes of the phenanthrene series. September 30.

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* *See* Note (*) on previous page.

18,769. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of colouring matters. October 6.

18,908. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Production of o-oxyanthraquinone. October 9.

18,924. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements relating to the manufacture of dihydroxynaphthalene sulpho acids, and of corresponding azo-dyes. October 9.

18,925. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture of alphabetadimethyleurhodines. October 9.

18,958. A. Bang.—From G. A. Dahl, Germany. Processes for the production of dyestuffs. October 10.

Complete Specifications Accepted.

1892.

13,029. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture of blue mordant dyeing colouring matters. October 4.

21,154. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co. Improvements in the manufacture of colouring matters. September 27.

21,166. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Application of non-sulphonated azo colouring matters insoluble in water as body colours, and in substitution for mineral colours for printing on textile fabrics. October 18.

21,167. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of blue colouring matters from orthodinitroanthraquinone. October 4.

21,168. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Improvements in the production of blue colouring matters from amidonitroanthraquinone. October 4.

22,443. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Improvements in the manufacture of tetranitroanthrachrysone. October 18.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

18,867. W. E. Heys.—From Lenique, Piquet, et Cie., France. Improvements in and connected with the manufacture of lace. October 9.

19,095. H. Jacob. New or improved process and machinery for imparting a silky appearance to cotton and other yarns. October 11.

19,177. T. Pickles. Improvement in the treatment of cotton or linen warps, or warp yarns, for weaving purposes. October 12.

Complete Specification Accepted.

1892.

20,839. A. Ambler, S. Ambler, and F. Ambler. Improvements in the cleansing, treating, or washing of wool and like animal fibres, and in apparatus employed therein. September 27.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

17,593. G. P. Gardner. An improved mordant for fixing colours to paper and rendering them fast and washable. September 19.

18,232. O. P. Amend. Improvements in the process of dyeing. Complete Specification. Filed September 28. Date applied for August 17, being date of application in United States.

18,517. J. G. Haslam. Improvements in yarn dyeing machines. Complete Specification. October 3.

19,106. J. Gardner. Improvements in printing or dyeing on cotton fabrics. October 11.

VII.—ACIDS, ALKALIS, and SALTS.

Applications.

23,101a. C. A. J. H. Schroeder and H. E. R. Schroeder. Improved methods of recovering zinc from the waste products of galvanic batteries. Filed September 29. Date claimed December 15, 1892.

17,602. F. J. Falding. Method of and apparatus for concentrating sulphuric acid. Complete Specification. September 19.

17,699. E. Dyson. Improvements in apparatus for concentrating sulphuric and other acids. September 20.

17,846. H. W. Crowther and E. C. Rossiter. Improvements in the manufacture of sulphocyanides. September 22.

18,099. G. T. Beilby. The manufacture of cyanides and other products. September 27.

18,139. J. Reich. Improvements relating to the manufacture of alkaline carbonates and silicates. September 27.

18,169. S. E. Mott, G. W. Wort, S. Wort, and E. W. Wort. "Victoria" extract of soda. September 27.

11,192. H. Morris. Improvements in and relating to the manufacture of nitric acid and other similar products. September 28.

18,194. G. T. Beilby. The manufacture of ammonia and other products. September 28.

18,355. W. G. Johnston. Process for the manufacture of alkali and acid. September 30.

18,786. J. B. Murray and M. B. Baird. An improved process for recovering alkali from a waste product. October 7.

18,831. W. Wolters. Improvements in the process of concentrating sulphuric acid in lead vessels. October 7.

Complete Specifications Accepted.

1892.

20,921. F. H. Gossage and J. Williamson. Improvements in the manufacture of sulphide of sodium or of sulphide of potassium from their respective sulphates. September 20.

21,294. T. D. Owen. Improvements in tanks for containing hydrochloric acid. October 11.

22,602. R. Dempster. Improvements in apparatus for the manufacture of sulphate of ammonia and liquid ammonia. October 18.

22,714. P. Marquart. Improvements in the manufacture of boric acid and borax. October 11.

1893.

1138. L. Tralls and E. Burmeister. A process for the utilisation of liquors containing sulphate of alumina or ferric sulphate. October 4.

6960. M. Prentice. Improvements in the manufacture of nitric acid. October 18.

8902. M. Prentice. Improvements connected with the manufacture of nitric acid, muriatic acid, or the like, where sulphuric acid is employed, and of superphosphate of lime. October 18.

9042. M. Prentice. Improved means for use in the manufacture or production of sulphurous acid and sulphites. October 18.

11,581. W. P. Thompson.—From C. C. Bartlett. Improvements in the production and separation of sulphide of nickel from ores of nickel and copper. October 11.

15,895. F. B. Hacker and P. S. Gilchrist. Improvements in apparatus for the manufacture of sulphuric acid. October 11.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

18,050. W. J. S. Lewis and A. C. Towers. Improvements in receptacles for molten glass. September 26.

18,388. C. Copeland, Improved seggars for use in enamelling, hardening on, lustre, and majolica kilns. October 2.

18,453. T. Brooks, jun., and J. A. Holt. Improvement to china and earthenware. October 3.

19,277. J. C. Spragg and J. Battersby. Improvements in the preparation of glass for colouring the rays of transmitted light. October 13.

Complete Specifications Accepted.

1892.

21,945. E. P. Lee. Improvements in kilns for burning bricks, tiles, and other clay goods; also for burning sanitary ware and for salt glazing. October 18.

23,640. W. West. Improvements in the manufacture of moulded clay, earthenware, and ceramic articles, such as flower and other pots, basins, pans, dishes, and the like, and apparatus for that purpose. October 18.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

17,514. W. Smith. Improved means of protecting timber structures. Complete Specification. September 18.

17,558. T. Lehmann. Improved process for making thin partition walls of plaster or cement mortar. Complete Specification. September 18.

17,562. J. Walker and H. Carver. Improvements in covering substances or materials for wall papers, paper-hangings, walls, or other fabrics or structures. September 18.

17,764. T. Brown. Improvements in the construction of bricks or blocks for building and other purposes. September 21.

17,776. J. H. W. Stringfellow. Improvements in the manufacture of fireproof fabrics. September 21.

17,844. E. A. Jeffreys.—From L. Marie, France. Improved imitation of ivory, coral, tortoiseshell, marble, and the like natural substances. September 22.

17,992. C. Jost. An improved composition and the production therefrom of blocks, slabs, tubes, vessels, or like articles, more especially intended for the production of paving blocks or slabs, or conduits for electric cables. September 25.

18,040. A. J. B. Ward. Ventilated fireproof floor. Complete Specification. September 26.

19,011. H. J. Haddan.—From C. B. Judd, United States. An improved process for finishing wood veneers. Complete Specification. October 10.

19,087. J. Robbins and E. Robbins. An improved cement and means and method of producing same. October 11.

Complete Specifications Accepted.

1892.

20,132. H. D. E. Earl. Improvements in paving for streets, roads, and other places. September 27.

21,851. J. Ferguson. Improvements in or relating to fireproof building construction. October 11.

1893.

5938. R. J. Doyle. Improvements in fireproof paint or composition. October 18.

8518. R. Stone. Improvements in the manufacture of fireproof plastic material for cement, also applicable to smelting and various other useful purposes. October 18.

14,429. H. Perkins. Improvements relating to the repair of asphalt pavements, and to apparatus therefor. October 4.

X.—METALLURGY, MINING, Etc.

Applications.

1892.

23,101A. C. A. J. H. Schroeder and H. E. R. Schroeder. *See* Class VII.

1893.

17,541. A. Rodig. Manufacture of composite plates, slabs, sheets, and the like of metals welded together. September 18.

17,623. R. I. Roman. An improved solder for use with aluminium or aluminium alloys. September 19.

17,725. E. L. Mayer. Improvements in the treatment of ores or other materials containing precious metals for the obtainment of the said metals therefrom. September 20.

17,829. H. J. Smith and J. Hamilton. Improvements in the methods of the manufacture of pig iron, blast furnace operations, and in the coking of coal. September 22.

18,489. G. W. Jaques. Improvements in apparatus for use in applying the coating to tin, terne, and other metal plates. October 3.

18,641. J. B. Torres. Improvements in and connected with the smelting, reduction, refining, dephosphorisation, and desulphuration of ores, mattes, slags, metals, and alloys, and constituting of metallic alloys. October 5.

18,744. H. L. Sulman. Improvements in or relating to the treatment of ores containing zinc and antimony. October 6.

18,806. C. Hyde. Improvements in or relating to the treatment or purification of iron. October 7.

18,850. S. O. Cowper-Coles and Sir B. W. Walker, Bart. New alloys. October 7.

19,235. R. Brown. Improvements in apparatus for treating ores of precious metals with chemical agents. October 13.

19,375. W. F. Berner. Improvements in the manufacture or production of metals from their ores, and in plant or apparatus therefor. October 14.

Complete Specifications Accepted.

1892.

18,892. F. O'Connor Prince. From J. Dixon, F. J. Blades, W. S. Douglas, and D. Garlick. Improvements in and connected with the smelting of the sulphurets of sulphides of certain metals, and in apparatus to be used therewith. October 18.

21,202. P. Robinson. Improvements in the manufacture or production of channelled or troughed iron, steel, and other metals. September 27.

22,672. H. H. Lake. From H. A. Harvey. Improvements in the manufacture of armour plates. October 18.

22,843. W. R. Taylor. Improved application of aluminium and its alloys. October 18.

1893.

4114. J. C. Richardson. An improved method of converting metallic copper into copper oxide. September 27.

11,581. W. P. Thompson. From C. C. Bartlett, United States. *See* Class VII.

12,588. A. J. Boult. From W. A. Koneman, C. G. Singer, and A. F. Hatch. Improvements in or relating to the conversion or purification of iron and steel. October 18.

17,111. W. E. Case. Improvements in processes for the manufacture of aluminium compounds. October 18.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

1892.

23,101b. C. A. J. H. Schroeder and H. E. R. Schroeder. New or improved galvanic batteries. Filed September 29. Date claimed December 15, 1892.

1893.

17,564. A. Koch. Improvements in electric accumulators. Complete Specification. September 18.

17,804. F. L. Berners and J. L. Higgs. Improvements in or connected with secondary batteries. September 22.

17,830. G. Abbott.—From J. J. Pearson, United States. A new and improved galvanic battery, to be called a cartridge-shell battery. September 22.

17,866. L. W. Schöffer and G. E. W. Schöffer. An improved manufacture of electric accumulators. September 22.

17,867. H. Guthrie and M. Guthrie. Improvements in apparatus for the electrolytical decomposition of brine and other liquids. September 22.

17,980. P. B. W. Kershaw. Improved process and means used therein for the electrolytical production of gases. September 25.

18,323. H. H. Leigh. — From A. Chevallier, France. Improvements in electric batteries. Complete Specification. September 29.

19,145. H. Guthrie and M. Guthrie. Improvements in apparatus for the electrolytical decomposition of brine and other liquids. October 11.

19,152. R Beavan. Mercurial voltmeter. October 12.

Complete Specifications Accepted.

1892.

16,919. J. Swinburne. Improvements in and connected with alternating current electric motors. September 27.

21,696. T. L. Willson. Improvements in electric smelting of aluminous and other refractory ores or compounds. October 4.

21,701. T. L. Willson. Improvements in the reduction or treatment of refractory metallic compounds by electric smelting. October 4.

23,007. W. Walker and F. R. Wilkins. Improvements in galvanic batteries. October 18.

24,071. E. L. C. Schiff. Improvements in the application of an electric current in the boiling or evaporating of solutions or liquids. October 11.

1893.

1918. H. Imray.—From La Société Anonyme pour le Travail Electrique des Metaux. An improvement in secondary voltaic batteries. October 4.

12,291. A. J. Boult.—From H. Woodward. Improvements in secondary batteries. September 27.

12,662. E. Andreoli. Improvements in electrolysis. October 18.

13,081. J. Pitkin. Improvements in the construction of plates for secondary batteries. October 4.

14,315. C. W. A. Hertel. Improvements in galvanic elements. October 4.

15,257. S. Marcus. Improvements in and connected with galvanic batteries. October 4.

15,669. N. Browne.—From A. Vogelsang. Apparatus for the electrolytic treatment of liquids. October 11.

15,681. G. H. Roe and G. Sutro. Improvements in electric accumulators or storage batteries. October 18.

16,136. A. J. Boult.—From R. T. E. Hensel. Improvements in or relating to electrodes for primary and secondary batteries. October 11.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

17,565. M. Ekenberg. An improved method of separating fats. Complete Specification. September 18.

17,566. M. Ekenberg. An improved fat emulsion and method of producing the same. Complete Specification. September 18.

18,466. R. Bramwell. An improved dip for sheep and other animals. October 3.

18,639. T. Routledge. An improved cleanser and lubricator for cycle chains, &c. October 5.

18,658. J. Mellinger. Improvements in soap for removing hair from the skin. Complete Specification. Filed October 5. Date applied for March 16, 1893, being date of application in United States.

18,767. F. B. Aspinall, R. W. Hoar, and G. H. Wise. Improvements in bleaching, sweetening, and purifying oils and fats. October 6.

18,938. W. C. Brumleu.—From L. Brumleu, United States. An improved process of purifying seed oils and obtaining certain products therefrom. October 9.

19,272. T. C. Palmer. Improvements in the purification or treatment of oils, nitro-glycerin, and like liquids, and apparatus therefor. October 13.

19,298. M. J. Palmer. Improved apparatus for and process of making soap. Complete Specification. October 13.

Complete Specifications Accepted.

1892.

21,414. J. Kennedy. An improved soap. October 4.

21,817. J. D. Barnett. Improvements in the process of cleaning and extracting oil and grease from cotton waste and other fibrous materials. October 4.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

17,581. J. E. Bedford and C. S. Bedford. Improvements in the manufacture of a drying medium for paints and of oil varnish. September 19.

17,609. J. V. de Fleury. A process of making water colours permanent against damp, noxious gases, and light. September 19.

17,711. H. Müllerson. "Terpentina," a chemical preparation for cleaning and reviving all kinds of clothing. September 20.

17,763. I. S. McDougall and J. T. McDougall. Improvements in artificial rubber. September 21.

18,003. R. G. Bennett. Improvements in varnish. September 25.

18,047. R. G. Bennett. Improvements in varnish. September 26.

18,373. N. Thorning and C. W. Kriens. The manufacture of an improved animal charcoal. September 30.

18,400. J. H. P. Johnstone. The metallic colourette. October 2.

18,726. R. L. Young. Improvements in the manufacture of black paint and inks. October 6.

18,845. A. J. Marquand. Improvements in protective coatings, especially applicable to iron and steel. October 7.

19,115. R. G. Bennett. Improvements in in varnish. October 11.

19,163. Louis Le Brocquy. A new substitute for india-rubber and gutta-percha. October 12.

19,284. M. Gerber. Improvements in devulcanising india-rubber and other like gums. October 13.

Complete Specifications Accepted.

1892.

17,739. R. Hutchison. Improvements in treating or preparing gutta-percha and rubber for various purposes. September 27.

20,891. R. Matthews and J. Noad. Improvements in the manufacture of white lead and coloured pigments. September 27.

21,639. J. Horadam. Improvements in the manufacture of water colours. September 27.

1893.

12,863. J. Bibby and J. Bibby. An improvement in the manufacture of printing ink. October 11.

13,450. W. P. Thompson.—From T. G. Hojer. Improvements in the manufacture of preservative driers and drying compounds for varnishes, oils, and the like, September 27.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

17,716. E. de Meulemeester. The manufacture of an improved glue or cement. September 20.

18,560. T. H. Taylor. A new or improved material which may be used in substitution for leather and for other analogous purposes. October 4.

18,949. J. T. Hardy. An improved method or process of fastening the colours upon and within coloured leathers. October 10.

Complete Specification Accepted.

1892.

23,233. J. M. E. Fontenilles and H. G. J. R. Bagnenier-Desormeaux. Improvements in purifying and clarifying tannic liquids. October 18.

XV.—AGRICULTURE and MANURES.

Applications.

18,600. W. C. Currie, and W. E. Rowlands. An improvement in manures. Complete Specification. October 4.

19,060. S. Blenkinsop. A new process or means for treating manure for the purpose of extracting straw therefrom. October 11.

19,255. J. Morten. The universal weed, seed, worm, grub, and insect destroyer and fertiliser. October 13.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

17,632. C. Steffen. Process for purifying and decolourising saccharine juices and sugar solutions generally. September 19.

18,378. B. S. J. Mackay. Improvements in treating kauri gum, and the utilisation of the by-products. September 30.

Complete Specification Accepted.

1893.

15,301. W. Smith.—From H. Kidd. Improvements in machinery for forcibly feeding crushed, shreaded, or comminuted sugar cane to crushing mills. October 4.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

17,520. W. S. Squire. Improvements in the manufacture of yeast. September 18.

17,912. A. W. Billings. Improvements in apparatus for the manufacture of beer. September 23.

18,910. E. H. Cook. An improvement in the manufacture of malt. October 9.

19,043. J. T. Connell. Improvements in the treatment of hops. October 10.

19,358. W. D. Gooch. An improved method and apparatus for the distillation of alcohol and its allies. October 14.

Complete Specifications Accepted.

1892.

20,773. A. Jenik. Improved construction of dephlegmators or apparatus for condensing and separating aqueous constituents and impurities from alcoholic vapours. September 27.

1893.

14,120. J. E. Johnson-Johnson. Improvements in the manufacture of materials for the production of alcoholic and non-alcoholic beverages, and in apparatus therefor. September 27.

14,967. J. B. Tröndle. *See* Class I.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

17,732. E. Maris. Improvements in and in apparatus for the treatment of alimentary substances. September 20.

18,044. J. F. Duke. An improved method of preserving eggs. September 26.

18,592. W. Eitner and B. Trenckmann. A substitute for the yolk of eggs and process for its manufacture. October 1.

B.—Sanitary Chemistry.

18,416. L. Archbutt and R. M. Deeley. Improvements in the purification of sewage. October 2.

18,796. C. F. Veit. Improvements in means for disinfecting and deodorising. October 7.

19,069. H. Lockwood. Improvements in the construction of tanks for the subsidence of the precipitate or sludge resulting from the chemical treatment of sewage or other foul waters. October 11.

19,216. H. von der Linde and C. Hess. Method of purifying water by oxide of tin. Complete Specification. October 12.

19,345. P. Dvorkovitz. Improvements in and apparatus for the purification of sewage and other foul waters or liquids. October 14.

C.—Disinfectants.

17,567. M. Ekenberg. An improved preserving agent and method of producing same. Complete Specification. September 18.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

21,038. L. E. Asser and L. A. Hartogh. Improvements in the treatment of bananas and plantains for the production of meal and flour therefrom. September 27.

21,637. G. Dierking. Improvements in or relating to the enriching of milk and other beverages. October 11.

22,189. G. C. Legay. An improved process for the sterilisation of milk. October 11.

1893.

5957. G Popp and J. H. Becker. An improved process of sterilising liquids and apparatus to be used therefor. September 27.

B.—Sanitary Chemistry.

1892.

19,785. W. Oldfield. Improvements in the method of purifying sewage and trade effluents. October 4.

22,458. J. Hanson. Improvements in apparatus for burning town refuse or like objectionable matter. October 11.

1893.

15,036. F. A. Black. An apparatus for purifying, disinfecting, and deodorising the contents of sewers, drains, cesspools, and the like. October 11.

C.—Disinfectants.

1892.

18,498. J. McHardy and M. E. A. Wallis. Improved disinfecting toilet paper. September 27.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

18,423. W. B. Daw. Improvements in or relating to paper. October 2.

18,519. L. S. Langville. Improved process for treating the black ash residuum of wood-pulp manufacture. Complete Specification. October 3.

18,538. E. J. Lusby. Improvements in and relating to the manufacture of paper. October 3.

18,793. E. Hollyer. Medicated pilewort toilet paper. October 7.

Complete Specifications Accepted.

1892.

18,498. J. McHardy and M. E. A. Wallis. *See* Class XVIII., *C.*

1893.

15,180. J. B. Howard.—From E. Fischer. Improvements in appliances for moulding and shaping pasteboard. September 27.

15,830. O. Imray.—From V. B. Banker and A. de Bary. An improvement in the manufateure of waterproof paper material. October 1.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

17,539. J. C. W. F. Tiemann. Production of substances suitable for manufacture of perfumery and aromatics. September 18.

17,540. J. C. W. F. Tiemann. A process for converting compounds of the citral series into isomers. September 18.

17,703. A. Baur. Production of artificial musk from hydrogenated aromatic hydrocarbons. September 20.

17,781. A. Baur. A process for the production of artificial musk. September 21

Complete Specifications Accepted.

1892.

20,499. C. D. Abel.—From the Haarmann and Reimer Vanillin-Fabrik. Manufacture of mono-basic acids having the composition $C_9H_{14}O_2$ of dibasic acids having the composition $C_9H_{14}O_2$ and of anhydrides of the latter having the composition $C_9H_{12}O_3$. September 27.

22,442. O. Imray.—From the Farbwerke vormals Meister, Lucius and Brüning. Manufacture of peptones free from albuminous matters. October 18.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

17,606. J. V. de Fleury. Producing artistic designs by a process of nature printing. September 19.

18,237. E. Edwards.—From R. Reissner and G. C. F. Hauser, Germany. Improvements in the process of making photographic films. September 28.

19,199. A. Zimmermann.—From R. E. Liesegang, Germany. Improvements in photography. October 12.

21,622. H. W. Vogel and J. Weinberg. A new or improved paste for prevention of discolouration of photographs mounted upon Bristol-board. September 27.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

17,692. E. Coustau. An electric match. September 20.

19,140. J. W. Swan. Improvements in and apparatus for the manufacture of gun-cotton. October 11.

Complete Specifications Accepted.

1892.

20,880. A. H. Durnford. An improvement in the manufacture of explosive and other compounds containing dissolved nitrated cellulose. September 27.

22,739. H. Kolf. Improvements in the manufacture of gunpowder. October 18.

1893.

14,726. J. Clark. Improvements in percussion fuzes for explosive projectiles. October 18.

15,566. O. Imray. From the Westfalisch Anhaltischen Sprengstoff Actien Gesellschaft in Coswig. Manufacture of explosives. September 27.

15,865. F. G. du Pont and P. S. du Pont. Improvements in and relating to the manufacture of smokeless explosives. October 18.

15,866. F. G. du Pont and P. S. du Pont. Improvements in and relating to the manufacture of smokeless explosives. October 18.

15,867. F. G. du Pont. Improvements in and relating to the manufacture of smokeless explosives. October 18.

15,997. T. Malson, S. R. Malson, W. A. Malson, and E. Smith. Improved electric high-tension fuse head for use in blasting. October 4.

16,609. H. H. Lake. From W. Adams, jun. Improvements in the manufacture of high explosive. October 11.

◆◆◆

Printed and Published by Eyre and Spottiswoode East Harding Street, London, E.C., for the Society of Chemical Industry.

THE JOURNAL

OF THE

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No. 11.—Vol. XII.]

NOVEMBER 30, 1893.

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NOTICES.

PATENT LAW COMMITTEE.

The attention of members is directed to the report of a Committee of the Society formed to consider the whole question of the Patent Laws. This report has been received and adopted by the Council, which has ordered it to be laid before the various sections with a view to elicit an early discussion of the points therein raised. In order that advantage may be taken of next session of Parliament to raise the subject, the reports of discussions and the resolutions formulated should be sent to the General Secretary not later than February 1st, 1894. A copy of the report will be found in the last issue.

Foreign and Colonial Members are reminded that the subscription of 25*s*. for 1894, payable on January 1st next, should be sent in good time to the Treasurer, in order to ensure continuity in the receipt of the Society's Journal. Any changes of address to appear in the new List of Members now in course of preparation, should reach the General Secretary not later than January 15th, 1894.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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SESSION 1893-94.

Dec. 4th:—
  Adjourned Discussion on Mr. H. G. Watel's paper (see Journal, 1893, 491).
  Mr. H. Harris. "Copper Mines of Singhbhoom."
1894:—
 Jan. 8th.—Discussion on the state of the Patent Law.
 Feb. 5th:—
  Mr. W. P. Dreaper. "Theory of Dyeing." Part I. "Ingrain Colours."
  Dr. A. Dupré. "Note on an interesting explosion caused by peroxide of sodium."

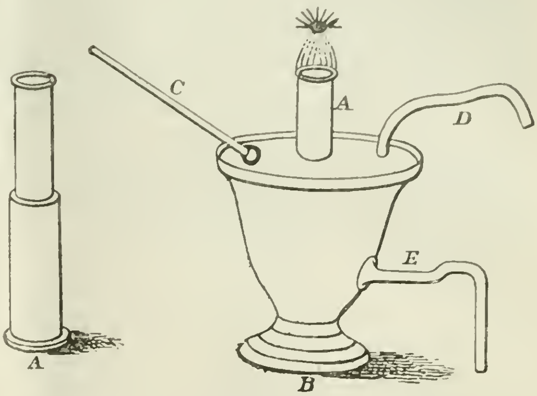
SPIRIT ASSAYING BY WEIGHT.

BY J. SCARISBRICK.

In the treatment of this subject it will be advisable to furnish a brief historical sketch of spirit assaying, then examine minutely the system at present employed for revenue and trading purposes in the United Kingdom, and afterwards lay before you the proposals for improving our system.

The rise and progress of British alcoholmetry forms a curious chapter in our commercial and fiscal history. Our forefathers of the Plantagenet, Tudor, and Stuart periods "tried the spirits" by means of burning rags, moistened with the liquid to be tested, and then held in a flame. A quaint English writer in 1527 gave directions for employing this test. "Take a p'toune if the aqua vite be good and ryghtfull, tha wet a small lynen clothe and holde it in the flame of a candell, and than if the watir brenneth of the lynen clothe than it is good, but if it brenneth not of, than it is nat good nor ryghtful, and it is of lytell vertue." Sometimes the density of spirit was compared with that of oil; if the spirit on being mixed with oil floated uppermost, then it was "strong"; if the oil rose to the surface, then the spirit was "weak." After the introduction of gunpowder the "proof" test came into vogue: a small quantity of powder would be moistened with the spirit being assayed, and a light applied. If the powder burned languidly or refused to ignite, the spirit was inferior or "below proof." If, however, the powder flared up rapidly with a strong "poof," then the spirit was "strong proof" or "high proof." Other methods were sometimes resorted to, sometimes as original tests, sometimes as confirmatory. For example, a quantity of spirit would be placed in a cylinder (see Fig. 1) and ignited: the proportional bulk of water left unconsumed would be noted, and the strength inferred. The "bead" test consisted in shaking some spirit in a phial, and observing the number and size of the small bubbles formed on the surface, as well as the extent of duration and mode of disappearance. If the beads remained a short time and then disappeared suddenly, the mixture was "bead proof" or "glass proof." Strict veracity compels one to say that the test of "taste" was not unknown, for Boord, in his "Breviary of Health," issued in 1547, speaking of the "spirits of the buttery," says "such spyrites doth trouble a man so sore that he can not dyuers tymes stande upon his legges," a tribute to the strength of the Tudor whisky which needs no confirmation.

Fig. 1.



A, cylinder used for burning spirit. B, vessel containing water. C, thermometer to test heat of water to see whether vessel can stand the heat. D, charging pipe (water). E, discharge pipe (date, 16th century).

One cannot help wondering why our forefathers never resorted to the simple mode of weighing the spirit. Scales, weights, and measures were most common, and rigorously inspected by authority. If a pint of proof spirit had been kept as a standard, and its weight ascertained, the weight of a pint of any other spirit being compared therewith would have given a better idea of the relative strength than the loose tests employed. But the Elizabethan Englishman was like Elizabethan architecture—he had a character of his own, and if he wished to journey, say from London to Bristol, he preferred to go round by Dover, thence to Liverpool, and so by a leisurely trip down the Irish Sea.

In the 17th century, when spirit taxes began to be levied systematically from year to year, and the commercial value of alcoholic liquors was considerably enhanced in consequence, these interesting studies of flaming rags and flaring gunpowder were superseded by more accurate methods, in

Fig. 2.

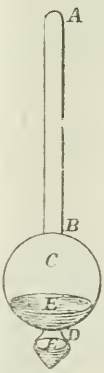


Fig. 3.

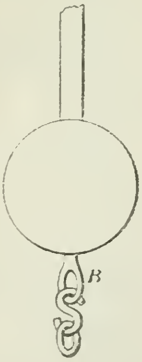


Fig. 4.

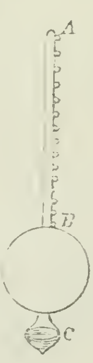


Fig. 2.—Boyle's Bubble.—Made of glass. A, point touched when testing strong spirit. B, water point. C, bulb. E, water. D E, mercury. (Date, 1667.)

Fig. 3.—Moncony's Areometer.—Of glass. B, ring, carrying hook S, on which silver rings are hung. Nine rings used of various weights. (Date, 1679.)

Fig. 4.—Common Areometer.—A B, stem carrying bits of glass in divers colours. C, mercury. (Date, 1700.)

which the areometer or hydrometer was employed. This instrument is generally supposed to have been invented by Hypatia, but on comparing the various ancient writers on the subject, whose works have very kindly been brought under my notice by a classical scholar of wide research, Mr. Robert Pierpoint, M.P. for Warrington, there appears to be little doubt that Archimedes was the inventor, several generations before Hypatia's day. For many centuries the hydrometer lay forgotten, until Robert Boyle re-invented it, about the year 1667, and applied it to testing spirit. Boyle's idea was improved upon by Moncony, Hooke, Clarke, Martin, Dicas, and others. At the present time we have nearly 60 distinct types of the instrument, and if we have not arrived at a satisfactory stage in spirit assaying, it must be because alcohol is as wilful as the hat-band of a certain Lancashire worthy, which encircled his head 19 times, and still refused to tie gracefully.

Fig. 5.

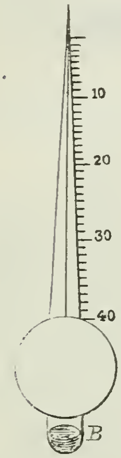


Fig. 6.

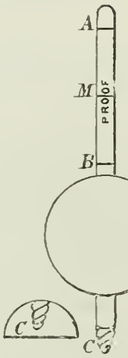


Fig. 7.

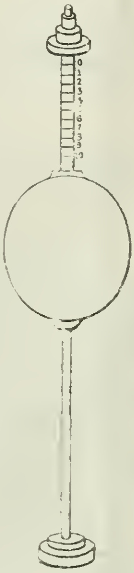


Fig. 5.—Improved Areometer.—Of ivory or boxwood. B, mercury or lead. Zero, immersion point in spirit of wine. 40, floating point in water. (Date, 1730.)

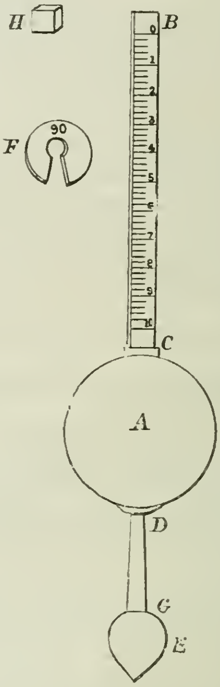
Fig. 6.—Clarke's Hydrometer.—Made of copper. 54 weights used—23 ordinary, 11 for weak spirit, 11 for temperature, and 9 for imported spirits to give closer readings. A = flotation mark for spirit $\frac{1}{10}$th over-proof; B, for spirit $\frac{1}{10}$th under-proof; M, proof mark; C C, weight and adjusting point. (Date, 1730.)

Fig. 7.—Martin's Hydrometer.—Of metal or glass. Nine weights used. Scaled stem to indicate specific gravities, each sub-division representing $\frac{1}{1000}$th of weight of instrument. (Date, 1759.)

So much by way of historical retrospect: now for a close examination of the system of spirit assaying which is almost exclusively adopted for fiscal, commercial, and trading purposes in the United Kingdom. This system is known as Sikes', was first brought under public notice in 1803, and has been used ever since.

It is not generally known that Sikes' system was contrived solely to meet a fiscal need of great importance to the Customs and Excise, but makes no provision whatever for the requirements of trade, commerce, or science. Sikes elaborated his system so as to show the proportion by volume of standard alcohol which would be contained in a spirituous liquid if that liquid were raised or lowered to one particular degree of heat; in other words, he furnished the power of *identifying a given spirit at all temperatures.* There has been so much misapprehension as to the purposes which he meant his system to serve, and blame has in consequence been dealt with such an unsparing hand, because his system does not do what it never professed to do, that it is necessary in all fairness to him to raise a word on his behalf. Regarded in the whiter light of to-day, the defects of Sikes' principles underlying his system of assaying are serious enough, without attempting to exaggerate them or to charge him with egregious folly. His hydrometer and tables have proved of immense service to the revenue of the United Kingdom, because they furnish officers with means for detecting spirit frauds, and if they have not served the scientist and spirit merchant so well, it is because they were never designed to serve other than strictly revenue purposes.

Fig. 8.



Sikes' Hydrometer.

(Used for Revenue purposes.)

B C, sealed stem. A, spherical bulb. D, point where weight F slipped on and dropped to G. E, pear-shaped counterpoise. Nine weights (10 to 90). Gives 500 indications. H, cap fixed at B to show difference between water and proof spirit. (Date, 1802.)

Let us glance for a moment at the circumstances which led to the production of Sikes' system, and the functions it is capable of discharging.

In consequence of a general desire for a better system of spirit testing, which prevailed among the revenue staffs and spirit interest rather more than 100 years ago, the Government approached the Royal Society and requested them to investigate the whole subject of assaying alcoholic liquors for revenue purposes. Prior to this time there had been no exhaustive inquiry into the subject of alcohol and its combination in various proportions with water. So the Society resolved to meet the wishes of the Government to the best of their power. Numerous and protracted experiments were begun somewhere about the year 1790 and concluded in 1794, when the final report was issued by the Society, together with 51 sets of valuable and comprehensive tables. The latter had been compiled by Gilpin from data obtained by him and Sir Charles Blagden during the investigation. They show the specific gravity of numerous mixtures of ascertained weights of alcohol (sp. gr. 0·825) and water, and the corresponding bulks both before mixing and after.

It is unnecessary to say anything at the present day in favour of Gilpin's tables; their accuracy has been verified over and over again, and as a sound and unimpeachable basis for a perfect system of alcoholmetry they cannot be surpassed. The investigation of Gilpin and Blagden was the first scientific attempt at a solution of the spirit-assaying problem, and in obtaining reliable data was successful beyond expectation.

When the tables of Gilpin were presented to the Government, the latter felt that the time had come for placing revenue spirit-testing on a more rational footing. Accordingly, students of the subject were invited to submit their proposals to a committee of experts, with Dr. Wollaston at their head. The various systems presented were examined by the committee in the year 1803, and ended in Sikes' being accepted as the best, although the committee withheld their certificate of approval, which would have been given had the hydrometer and tables given full satisfaction.

A curious and noteworthy circumstance connected with the Treasury competition was that the chosen system did not comply in important particulars with the conditions which had been laid down, or were generally understood by the competitors as governing the competition.

Conditions.	Features of Sikes' System.
1. Standards of proof to be of sp. gr. 0·920 (water at 60° F. = 1); standard temperature, 60° F.	1. Exact proof standard specific gravity never known, but supposed to be 0·92366; standard temperature, 51°.
2. Gilpin's tables to be used as far as possible.	2. Only one of Gilpin's tables used.
3. Strengths to be true at each temperature.	3. Strengths true at one temperature out of 51.
4. Hydrometer to indicate units of specific gravity.	4. Hydrometer scale merely arbitrary.

Here we have the strange fact of a man entering a competition, ignoring nearly every important limitation imposed on the competitors, yet carrying off the prize and satisfying the examiners. Such a result is almost unique. To ignore deliberately specified conditions was sublime, but to convert the examiners was a miracle! How was Sikes justified?

Two circumstances presented themselves to his mind, namely, the *Treasury desire* and the *Revenue necessity*. The Treasury wish was that the system should furnish true alcoholic values of every spirit mixture at each temperature. The imperative necessity of the Revenue was that the system should furnish means for identifying a spirit mixture at all temperatures. He could not furnish the former, but he could and did present the latter. His tabular numbers are practically the same for a spirit mixture at all temperatures, and are such as would be found true at one temperature only. He disregarded the effect of expansion or contraction in spirit, due to increase or loss of heat, but he furnished identifying power in a superb manner, and this constitutes the marked excellence of a remarkable system. Had this power not been furnished so completely, Sikes' system would almost certainly have been superseded 60 years ago.

In issuing tables which altogether ignore the expansions and contractions of such a mobile substance as alcohol, it is obvious that Sikes could neither define his standard of strength nor adhere to it. An Act of 1816, which first legalised his system, attempted a statutory definition. It declared "proof" to be a "spirit which at the temperature of 51° F. weighs exactly twelve thirteenth-parts of an equal measure of distilled water." But inasmuch as the temperature of the water of comparison was not stated, the definition was useless in fixing a standard. A spirit mixture at 51° weighing twelve-thirteenths as much as an equal volume of water at 40° or 80° would have a specific gravity of 0·92394 or 0·92085, according to whether the water was taken at the lower or the higher temperature, and the specific gravity of the standard would as a matter of fact differ with every degree of temperature of the water upon which it was founded. The definition was inconclusive, and therefore no definition at all, so when the Act of 1816 was superseded by another Act in 1818, the imperfect definition of the standard was dropped and not re-enacted.

Another difficulty that befell Sikes referred also to his standard. If the strengths, true at one temperature, were to appear in the tables for each temperature, it followed that in his 51 tables he would have 51 different standards. Such is actually the case. He shows 51 different proofs in his tables, each differing in specific gravity from the rest. A moment's examination of his table book will verify this beyond dispute.

Sikes' Tables.

Temp.	Sikes' Tabulated		Specific Gravity of Proof.	Temp.	Sikes' Tabulated		Specific Gravity of Proof.
	Hyd. Ind.	Strength.			Hyd. Ind.	Strength.	
° 30	65·2	Proof.	0·93240	° 56	59·7	Proof.	0·92154
31	64·9	„	200	57	59·5	„	111
32	64·7	„	159	58	59·3	„	069
33	64·5	„	118	59	59·0	„	027
34	64·3	„	077	60	58·8	„	0·91984
35	64·2	„	035	61	58·5	„	941
36	63·9	„	0·92996	62	58·3	„	898
37	63·7	„	956	63	58·1	„	854
38	63·5	„	915	64	57·9	„	810
39	63·3	„	876	65	57·6	„	766
40	63·1	„	833	66	57·4	„	723
41	62·9	„	791	67	57·2	„	679
42	62·7	„	749	68	56·9	„	634
43	62·5	„	705	69	56·7	„	590
44	62·3	„	664	70	56·5	„	544
45	62·1	„	620	71	56·2	„	504
46	61·9	„	578	72	56·0	„	457
47	61·7	„	535	73	55·7	„	412
48	61·5	„	493	74	55·5	„	367
49	61·3	„	450	75	55·3	„	321
50	61·0	„	408	76	55·0	„	277
51	60·8	„	366	77	54·7	„	232
52	60·5	„	324	78	54·5	„	186
53	60·4	„	281	79	54·3	„	140
54	60·1	„	238	80	54·0	„	0·91094
55	59·9	„	0·92196				

The principle by which he chose to be governed leads of necessity to such a result as the foregoing, and would perplex any inventor who formulates a scheme of assaying for identifying purposes only, and wishes to use only one series of numbers.

It is obvious, from the principle of construction of the tables, that when they are used for trade purposes, in which accuracy of assessment is required and identification at a fixed temperature finds no place, they lead
results. They cannot furnish true numbe
temperature out of 51, and at other tem
account taken by them is more or less erro
to the extent of divergence from the standa

Two instances will serve to illustrate t
A spirit merchant buying 30 casks of b
0·827 at 55° F., each containing 100 bul
pay 75*l*. for each cask, if he bought at

SCARISBRICK'S SPIRIT TABLES (OUNCES PER GALLON).

(*Temp.* 60° *Fahr.*)

The full Table contains 840 Indications.

Hyd. Ind.	Standard Spirit per Gallon. Ozs.	Specific Gravity at 60°.
790	..	Same as Hydrometer Indication.
1	..	
2	..	
3	..	
¼	..	
½	257·9	
¾	·8	
·79381	·8	
794	·7	
¼	·6	
½	·4	
¾	·3	
795	·2	
¼	·0	
½	256·9	
¾	·8	
796	·6	
¼	·5	
½	·4	
¾	·3	
797	·1	
¼	·0	
½	255·9	
¾	·7	
798	·6	
¼	·5	
1½	·3	
¾	·2	
799	·1	
¼	254·9	
½	4·8	
¾	4·7	
800	4·5	
1	4·0	
2	3·4	
3	2·9	
4	2·3	
5	1·8	
6	1·2	
7	0·6	
8	0·0	
9	249·4	
10	8·8	
1	8·1	
2	7·5	
813	246·8	Same as Hydrometer Indication.
4	6·2	
5	5·5	
6	4·8	
7	4·1	
8	3·5	
9	2·8	
820	2·1	
1	1·4	
2	0·7	
3	0 0	
4	239·3	
5	8·6	
6	7·8	
7	7·1	
8	6·3	
9	5·6	
830	4·8	
1	4·1	
2	3·3	
3	2·5	
4	1·8	
5	1·0	
6	0·2	
7	229·4	
8	8·6	
9	7·8	
840	7·0	
1	6·2	
2	5·3	
3	4·5	
4	3·7	
5	2·8	
6	2·0	
7	1·2	
8	0·3	
9	219·5	
850	8·6	
1	7·8	
2	6·9	
3	6·0	
4	5·1	
5	4·1	
6	3·2	
7	2·3	
858	211·4	Same as Hydrometer Indication.
9	0·5	
860	209·6	
1	8·7	
2	7·7	
3	6·8	
4	5·9	
5	5·0	
6	4·1	
7	3·2	
8	2·2	
9	1·3	
870	0·3	
1	199·3	
2	8·4	
3	7·4	
4	6·4	
5	5·5	
6	4·5	
7	3·5	
8	2·5	
9	1·5	
880	0·5	
1	189·5	
2	8·5	
3	7·5	
4	6·5	
5	5·5	
6	4·5	
7	3·5	
8	2·4	
9	1·4	
890	0·4	
1	179·3	
2	8·3	
3	7·2	
4	6·2	
5	5·1	
6	4·0	
7	3·0	
8	1·9	
9	0·8	
900	169·7	
1	8·7	
2	7·6	
903	166·5	Same as Hydrometer Indication.
4	5·4	
5	4·3	
6	3·1	
7	2·0	
8	0·9	
9	159·7	
910	8·6	
1	7·5	
2	6·3	
3	5·2	
4	4·0	
5	2·9	
6	1·7	
7	0·5	
8	149·3	
9	8·1	
·91984	147·1	
920	146·9	
1	5·7	
2	4·5	
3	3·3	
4	2·0	
5	0·8	
6	139·6	
7	8·3	
8	7·0	
9	5·8	
930	4·5	
1	3·2	
2	1·9	
3	0·6	
4	129·3	
5	8·0	
6	6·6	
7	5·3	
8	3·9	
9	2·5	
940	1·1	
1	119·7	
2	8·3	
3	6·8	
4	5·3	
5	3·8	

SCARISBRICK'S SPIRIT TABLES (OUNCES PER GALLON)—*Continued.*

(*Temp.* 60° *Fahr.*)

The full Table contains 840 Indications.

Hyd. Ind.	Standard Spirit per Gallon.	Specific Gravity at 60°.	Hyd. Ind.	Standard Spirit per Gallon.	Specific Gravity at 60°.	Hyd. Ind.	Standard Spirit per Gallon.	Specific Gravity at 60°.	Hyd. Ind.	Standard Spirit per Gallon.	Specific Gravity at 60°.
	Ozs.	Same as Hydrometer Indication.		Ozs.	Same as Hydrometer Indication.		Ozs.	Same as Hydrometer Indication.		Ozs.	Same as Hydrometer Indication.
946	112·3		964	80·4		982	36·2		996¼	6·5	
7	0·8		5	78·3		3	3·8		½	6·1	
8	109·2		6	6·2		4	1·5		¾	5·6	
9	7·7		7	4·0		5	29·2		997	5·2	
950	6·1		8	1·7		6	7·0		¼	4·7	
1	4·4		9	69·3		7	4·9		½	4·3	
2	2·8		970	6·8		8	2·7		¾	3·8	
3	1·2		1	4·3		9	0·6		998	3·4	
4	99·5		2	1·8		990	18·5		¼	3·0	
5	7·8		3	59·2		1	16·4		½	2·5	
6	6·1		4	6·5		2	14·4		¾	2·1	
7	4·3		5	3·9		3	12·4		999	1·7	
8	2·4		6	51·3		4	10·6		¼	1·2	
9	0·6		7	48·8		5	8·8		½	0·8	
60	88·6		8	6·3		¼	8·3		¾	0·4	
1	6·5		9	3·8		½	7·9		1,000	Water.	
2	4·5		980	1·3		¾	7·4				
3	2·5		1	38·7		996	7·0				

SCARISBRICK'S SPIRIT TABLES (PERCENTAGE VALUES).

(*Temp.* 60° *Fahr.*)

The full Table contains 840 Indications.

Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.	Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.	Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.	Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.
	Per Cent. of Proof.	Same as Hydrometer Indication.		Per Cent. of Proof.	Same as Hydrometer Indication.		Per Cent. of Proof.	Same as Hydrometer Indication.		Per Cent. of Proof.	Same as Hydrometer Indication.
790	..		796½	174·2		804	171·5		822	163·7	
1	..		¾	4·1		5	1·1		3	3·2	
2	..		797	4·0		6	0·7		4	2·7	
3	..		¼	3·9		7	0·3		5	2·2	
¼	..		½	3·9		8	169·9		6	1·7	
½	175·3		¾	3·8		9	9·5		7	1·2	
¾	5·2		798	3·7		810	9·1		8	0·7	
·79318	5·2		¼	3·6		1	168·7		9	0·2	
794	5·1		½	3·5		2	8·3		830	159·6	
¼	5·0		¾	3·4		3	7·9		1	9·1	
½	4·9		799	3·3		4	7·4		2	8·6	
¾	4·8		¼	3·2		5	6·9		3	8·1	
795	4·7		½	3·2		6	6·5		4	7·6	
¼	4·6		¾	3·1		7	6·0		5	7·0	
½	4·6		800	3·0		8	5·5		6	6·5	
¾	4·5		1	2·7		9	5·0		7	6·0	
796	4·4		2	2·3		820	4·5		8	5·5	
¼	4·3		3	1·9		1	4·1		9	4·9	

SCARISBRICK'S SPIRIT TABLES (PERCENTAGE VALUES)—*continued.*

(*Temp.* 60° *Fahr.*)

The full Table contains 840 Indications.

Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.	Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.	Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.	Hyd. Ind.	True Strength or Value.	Specific Gravity at 60°.
	Per Cent. of Proof.			Per Cent. of Proof.			Per Cent. of Proof.			Per Cent. of Proof.	
840	154·3	Same as Hydrometer Indication.	885	126·1	Same as Hydrometer Indication.	928	93·2	Same as Hydrometer Indication.	973	40·1	Same as Hydrometer Indication.
1	3·8		6	5·4		9	2·3		4	38·3	
2	3·2		7	4·7		930	1·4		5	6·5	
3	2·6		8	4·0		1	0·6		6	4·8	
4	2·0		9	3·3		2	89·7		7	3·1	
5	1·4		890	2·6		3	8·8		8	1·4	
6	0·9		1	1·9		4	7·9		9	29·7	
7	0·4		2	1·2		5	7·0		980	8·0	
8	149·8		3	0·5		6	6·1		1	6·3	
9	9·2		4	119·8		7	5·2		2	4·6	
850	8·6		5	9·0		8	4·3		3	3·0	
1	8·0		6	8·3		9	3·3		4	1·4	
2	7·4		7	17·6		940	2·3		5	19·8	
3	6·8		8	6·9		1	1·3		6	18·3	
4	146·2		9	6·2		2	0·3		7	16·8	
5	5·5		900	5·5		3	79·3		8	15·3	
6	4·9		1	4·8		4	8·3		9	13·9	
7	4·3		2	4·0		5	7·3		990	12·5	
8	3·7		3	3·2		6	6·3		1	11·1	
9	3·1		4	2·4		7	5·3		2	9·8	
860	2·4		5	1·6		8	4·3		3	8·5	
1	1·8		6	0·9		9	3·2		4	7·2	
2	1·2		7	0·2		950	2·1		5	5·9	
3	0·6		8	109·5		1	1·0		¼	5·6	
4	0·0		9	8·7		2	69·9		½	5·3	
5	139·3		910	7·9		3	8·8		¾	5·0	
6	8·7		1	7·1		4	7·6		996	4·7	
7	8·1		2	6·3		5	6·4		¼	4·4	
8	7·5		3	5·5		6	5·2		½	4·1	
9	6·9		4	4·7		7	4·0		¾	3·8	
870	6·3		5	3·9		8	2·8		997	3·5	
1	5·7		6	3·1		9	1·5		¼	3·2	
2	5·0		7	2·3		960	0·2		½	2·9	
3	4·3		8	1·5		1	58·8		¾	2·6	
4	3·6		9	0·6		2	7·4		998	2·3	
5	2·9		·91984	Proof		3	6·0		¼	2·0	
6	2·3		920	99·7		4	4·6		½	1·7	
7	1·7		1	8·9		5	3·2		¾	1·4	
8	1·0		2	8·1		6	1·7		999	1·1	
9	0·3		3	7·3		7	0·1		¼	0·8	
880	129·6		4	6·5		8	48·5		½	0·5	
1	8·9		5	5·7		9	6·9		¾	0·2	
2	8·2		6	4·9		970	5·3		1,000	..	
3	7·5		7	4·1		1	3·6				
4	6·8					2	1·9				

proof by Sikes. If the temperature were lowered to 35° before purchase he would pay 27*l.* less, but if the temperature were at 80° he would pay 58*l.* 10*s.* more. Thus he would be charged 85*l.* 10*s.*, or 4 per cent. more if he bought at 80° than if he bought at 35°, although the brandy would be precisely the same in both cases. The full effect of this principle of Sikes' system can perhaps be more clearly seen in relation to the quantity of spirit in bond at one time. A rise or fall of 1° F. makes a difference of 50,000 proof gallons chargeable. In other words, if the whole quantity in bond were cleared at one time, an account taken at 80° would yield 1,100,000*l.* more as duty than if taken at 35°. And this large difference would arise in connection with the same spirit, nothing added, nothing lost. Similar discrepancies vitiate more or less every account taken by Sikes when his numbers for revenue identification are used as factors for proportional value. Such discrepancies would be sufficient to condemn any system of assaying used for trade and scientific purposes, and would long ago have condemned Sikes', but for the fact that his numbers have been found convenient for identification. His system was formulated at a time when identification of taxable goods was more important than accuracy of assessment; when revenue frauds were great crimes, and the amount of punishment greater still. At the time he launched his system Englishmen were liable to capital punishment, without benefit of clergy, for certain offences against the revenue. In Scotland a man was hanged for breaking into a revenue office, and in Ireland death was the punishment for revenue officials not delivering up books of account. We can easily see that the protection of the revenue from fraud dominated Sikes in framing his system, and accuracy of account at different temperatures was in his eyes either unattainable, or else a less important detail.

The fact that Sikes' system does not meet the requirements of trade, commerce, or the laboratory, and the additional fact that it can be immensely improved for revenue purposes, have induced me to turn attention to the matter, and to make an attempt to meet the requirements of all concerned. We need a system that shall answer for purposes of identification of spirit and furnish accurate numbers for assessment at all temperatures, thus satisfying the wants both of the revenue, the spirit trader, and the scientist.

Such a system must apply equally well to all spirituous liquids, be easily understood and quickly applied without previous training, be absolutely accurate, and make little or no alteration in the standards. The suggested system is applicable to testing the purest alcohol as well as the weakest grog known.

The tabular numbers furnished serve to identify spirits at all temperatures, thus meeting an important revenue requirement; at the same time they show true alcoholic values in each table, thus supplying a want of the trading, commercial, and laboratory interests, which has never been met in this country so fully before. In addition, the revenue departments will be able to charge duty correctly at all temperatures. The tables are suitable for use with either the gravity bottle, spirit balance, hydrometer, ordinary scales and weights, or any instrument capable of ascertaining specific gravities from water to sp. gr. 0·790. They have been built exclusively from the invaluable material of Gilpin and Blagden; for spirits of lower specific gravity, and therefore greater alcoholic strength, the numbers obtained by Tralles, Fownes, Drinkwater, and Squibbs, have been utilised.

For the standard alcohol, Sikes' proof spirit at 60° F. has been adopted. It has a specific gravity of 0·91984 at that temperature, as determined by Drinkwater's synthetical analysis. 60° is a convenient standard for reference in our climate; it is also the standard temperature for specific gravities, and the one adopted by Gilpin and Blagden, upon whose tables these are largely founded.

The general principle proceeded upon in building up the system is the recognition of weights and not volumes. Weight does not change with temperature but volume does, and in the case of alcohol, with its great expansibility for slight increments of heat, the change of volume is very marked. These weights may be expressed either as pounds and ounces or as percentages. The former are preferred, because the sooner we come to recognise the principle of weighing generally in trade affairs the better for both buyer and seller. However, be that as it may, values both in ounces and percentages are furnished, and one series is derivable from the other by simple multiplication or division.

A comparison of Sikes' method and values, with those proposed in lieu of his, can be made in a few figures. Take for instance Gilpin's alcohol of sp. gr. 0·825 at 60°, shown by Sikes' as 62·0 over proof. Let us view it as he shows it in his tables for 30°, 60°, and 80° respectively.

Temperature.	Sikes'.	
	Hydrometer Indication.	Strength.
F.		O.P.
30°	13·8	62·0
60°	5·8	62·0
80°	0·0	62·0

Temp.	Scarisbrick.			
	Hydrometer Indication.	Standard Spirit per Gallon.	Percentage of Proof.	Specific Gravity at 60°.
F.		Ounces.		
30°	838¼	242·6	164·9	0·8250
60°	825	238·6	162·2	0·8250
80°	815¾	235·7	160·2	0·8250

Sikes shows Gilpin's alcohol as of the same strength at 30° and 80°, but in reality it is 4·7 per cent. stronger at 30° than at 80°, owing to the great concentration.

The weight of a gallon of proof or standard spirit at 60° has been obtained as follows:—The experiments of the Standards' Office (Board of Trade), carried on from 1878 to 1889, and made known in their report of November in the latter year, have established the fact that a cubic inch of water at 62° weighs 252·286 grains, and not 252·458 grains, as declared in the Weights and Measures Act of 1824.

Grains. Grains.

$$252 \cdot 286 \times 277 \cdot 274 = 69952 = \text{weight of gallon of water at } 62^\circ.$$

Drinkwater's analysis of proof spirit at 60° shows its specific gravity to be 0·91984, referred to water at the same temperature as unity. The following computation yields us, therefore, the weight of a gallon of standard proof spirit, expressed in ounces at 60°. The specific gravity of water at 62°, referred to unity at 60°, is 0·99981.

Ounces of Water
in Gallon at 62°, as per
Act of 1824.

$$160 \times \frac{69952}{70000} \times \frac{\text{[illegible]}}{100000} \times \frac{100000}{99981} = 147 \cdot 1 =$$

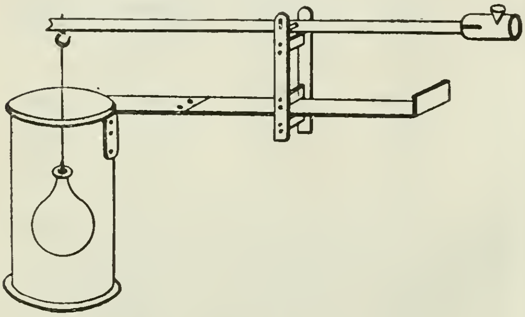
weight per gallon of proof spirit at 60°.

In the calculation, 160 represents the number of ounces in 10 lb., the superseded weight of the gallon at 62°. Since the gallon really contains 69952 grains of water instead of 70000, as declared by the Act of 1824, 160 ozs. multiplied by $\frac{69952}{70000}$ yields us the actual weight of a gallon of water at 62° expressed in ounces. To find the weight of a gallon at 60°, multiply the weight of a gallon at 62° by 1 and divide by 0·99981, the specific gravity of water at 62°. Then, since proof spirit at 60° is to its own bulk of water at 60° as 0·91984 to 1·00000, multiply the weight of a gallon of water at 60° by 0·91984, and the final result is obtained, 147·1 ozs., as the standard unit of weight per gallon of proof spirit at 60°.

The weights or percentages are expressed in terms of a standard mixture of alcohol and water rather than absolute alcohol, because of a desire to leave the standard spirit practically undisturbed. In addition, alcohol has not been obtained in a state of absolute purity, so far as we know, and if we had it, its unstable nature and absorbent quality will always render it unfit for employment as a standard.

It will be observed that the identifying numbers in the third column of each table are specific gravities, instead of Sikes' over-proofs or under-proofs. It is submitted that identification by specific gravity at a fixed temperature is a simpler and more intelligible method than by numbers which convey no rational notion to the mind, such as over- and under-proofs. It will also be observed that the numbers in the first column of the tables are hydrometer indications, expressed as units of specific gravity, and halves and quarters. The instrument used may be either the hydrometer, or spirit balance, or any other that will determine specific gravities. The spirit balance is preferred, constructed on an improved model of Ramsden's (see Fig. 9), but both revenue officers and traders have become so accustomed to hydrometers that two have been designed by me (see Figs. 10 and 11) embracing several novel and valuable features, so that either balance or hydrometer may be used.

Fig. 9.



Ramsden's Hydrometric Balance.

In applying the system for fiscal purposes, means must be furnished by which a sample of spirit shall accurately represent the whole bulk to which it relates. This difficulty does not seem to have been overcome hitherto, but thanks to the ingenuity of Mr. Thomas May, Supervisor of Inland Revenue, Warrington, a "holder" has been invented which is simple, handy to use, and really gives the perfecting touch to a system of assaying based on specific gravities. The "holder" shown herewith (see Fig. 12) is designed for sampling casks and testing by hydrometer, but with a very slight modification can be rendered equally useful in sampling any vessel whatever, for testing by gravity bottle, spirit balance, or scales and weights.

What would be the financial effect of these proposals if adopted.

1st. A substantial increase in the spirit revenue, for which the liquor interest could be compensated by the rate of duty being lowered correspondingly.

2nd. The revenue levied more equitably, because due allowances would be made for expansions and contractions of alcohol at temperatures above or below the standard.

3rd. More equitable dealings on the part of the spirit trade. At present the man who sells spirit above 55° charges for more alcohol than his spirit contains, and if he sells at lower than 55° he realises too little.

Before closing this paper, it is only a simple measure of justice to acknowledge the kindness and courtesy of the Board of Inland Revenue, and of their able secretary, Sir Robert Micks, in allowing the hydrometers now submitted to be subjected to severe and exhaustive tests in the Somerset House Laboratory. I would also express my satisfaction with the result of those tests.

Fig. 10.

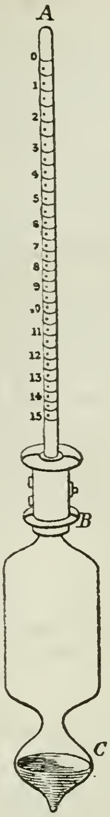


Fig. 11.

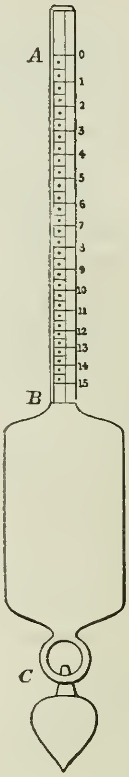


Fig. 12.

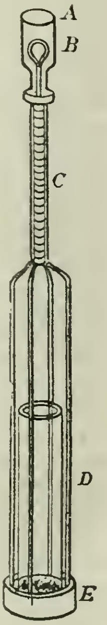


Fig. 10.—Scarisbrick's Areometer.—Range of indication, from sp. gr. 0·790 to sp. gr. 1·000; made of glass, with 13 metal poises adjusted by slipping on at A, and sliding down to B, or by opening the poise and fixing on at B. C, mercury. (Date, 1893).

Total number of indicated strengths, 42,840. Sikes' total, 25,500.

Fig. 11.—Scarisbrick's Universal Densimeter (42,840 strengths).—Range of indication, sp. gr. 0·790 to 1·000. Metal instrument, with 14 poises, adjusted at C. Scale A B, includes 15 units of specific gravity, halved and quartered. (Date, 1893.)

Fig 12.—May's Sample Holder.—Brass tube inserted perpendicularly at A, contains a piston, which is pressed on B and raises the tube. It also raises the sample glass D. Sample flows in at E and fills D. Hydrometer is then immersed in D.

Discussion.

Mr. Benjamin Biggs said he was rather surprised at the statement that Sikes paid no attention to temperature, because the instrument was accompanied by a book in which all reasonable temperatures were provided for. It seemed to him that if he had a cask of spirit at 50° it would pay the same duty as if it were raised to 60° or 70°, and he could not at all understand how the author could maintain that Sikes had no regard to temperature. It was always taken so as a matter of commercial dealing. If a cask were raised in temperature of course the bulk would gain a little. A man might sometimes buy spirit by weight and sometimes by bulk. In Germany it was bought a good deal by weight, but here chiefly by bulk. It wanted a little more consideration before he could make up his mind, whether if a man bought by measure he would have to pay duty on the extra quantity which any increase in temperature would shew. Of course naturally the duty would be levied in the same way, but now a great deal of the spirit was taken by weight, and the duty was in some cases calculated by weight. The only thing he had seen in Sikes' instrument lately, was that the government had now provided an extra instrument to register high over proof strength. Formerly when Sikes' hydrometer was first introduced it was not supposed that spirit could be got above 65° or 66° over proof, and, therefore, it did not register over 67°, but now that spirit was being obtained of a very high strength, in the case of wood spirit up to 99½ per cent., the Inland Revenue had introduced a supplemental instrument to deal with those high percentages.

Mr. **David Howard** said that for many years he had worked with Sikes' hydrometer and had always treated it with the same respect as an Act of Parliament which has to be accepted whether accurate and comprehensible or no. He could not agree that the indications meant nothing; they expressed with perfect clearness the duty one had to pay. An indication of 60° over proof meant that on every hundred gallons of the spirit one paid 160 times the duty on one gallon of spirit, and that was a very definite amount. But if he understood it rightly the *question* was, was the amount so stated the right amount at all temperatures? would the addition of 60 gallons water to 100 gallons testing 60 over proof, when cooled to the standard temperature give 160 gallons of proof spirit? If it would not the tables were clearly wrong though Gilpin's tables afforded the basis for true tables. In the case of 100 gallons of spirit at 80°, if taken at 60°, would there be the same number of proof gallons chargeable as at 80°?

Mr. **Millard** thought the instrument shown would prove of considerable interest, particularly as the statement was made that it would effect a saving in the year of a good many thousand pounds to the Inland Revenue. If that was so it was evident that the class of persons or the public who used spirit to that extent would be under a disadvantage. He should have liked to hear an exact or even an approximate idea of the difference in payment to the Inland Revenue on a specific specimen of spirit. He thought there was some misunderstanding with regard to Sikes' method. It was pretty generally acknowledged to be inaccurate from the fact that it made no proper allowance for expansion. There were plenty of tables for various temperatures, but he thought it was the question of expansion which Mr. Scarisbrick referred to. There was one point which was of considerable interest to revenue officers. He understood that very often in large separate vats there was a variation of 2° or 3° in the temperature of a sample taken from the top or from the bottom. He presumed in such a case the officer had no alternative but to take several samples so as to get an exact idea as to the amount of alcohol present.

Mr. **Scarisbrick**, in reply, said, with respect to the point that Sikes' tables did not make provision for various temperatures, he had distinctly stated that Sikes' numbers were correct at one temperature—in one table—but there were 51 tables, and his contention was that 50 out of the 51 were inaccurate, the extent of error being measured by the extent of divergence from the standard temperature. There was some doubt as to the exact temperature which Sikes took as his standard, but the balance of probability favoured the idea that it was 55° F. In cases where account was taken of spirits above 55° F., the charge would therefore be too great, and where it was lower than 55° F. the charge would be too low. Mr. Howard had asked: "In the case of 100 gallons of spirit at 80°, if taken at 60°, would there be the same number of proof gallons chargeable as at 80°"? There would not, and if taken at 30° there would be a still less number of gallons, although the quantity of alcohol would be precisely the same at each degree of heat. As a matter of fact, accounts taken by the aid of Sikes' hydrometer and tables varied in the same spirit mixture, with each degree of temperature. He had not sufficient data upon which to pronounce a confident opinion as to the average temperature at which spirits were tested, but it was probably 7° or 8° degrees below 55°. Whether this was so or not the mere fact of the system being inaccurate in a country like this where spirits were taxed almost as heavily as anywhere in the world led him to think there ought to be a change; that there should be an accurate system showing on any particular quantity of spirit, which received neither addition nor diminution, the same proof gallons at all temperatures. At present, as he had shown, at 51 different temperatures there would be 51 different amounts.

Dr. **Rideal** would like to ask if there were any means of ascertaining what was done in continental countries on this question?

Mr. **Scarisbrick** said in one or two continental countries the estimation was made by volume. In France Gay-Lussac's system was in force, which was tolerably accurate. That was by volume, but allowances were made for changes due to expansion or contraction. The only defect in that system was this: he valued to express proportions of absolute alcohol, but the alcohol which he regarded as absolute had a specific gravity of 0·794, if he recollected aright. Since then, alcohol of greater purity had been obtained, and therefore the proportional numbers in Lussac's tables were simply of a spirit mixture and not of pure alcohol. At the time the system was devised it had the greatest accuracy then obtainable, seeing that it expressed proportions of the purest alcohol then known.

Liverpool Section.

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A. Smetham.
Frank Tate.
H. Tate, jun.

Hon. Treasurer: W P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893-94.

December 6th, 1893:—
Dr. F. Hurter. "The Comparative Efficiency of Absorbing Apparatus."
Mr. J. H. J. Dagger. "Aluminium Alloys."

Meeting held Wednesday, November 1st, 1893.

SOME OBSERVATIONS ON THE ORGANISATION AND MANAGEMENT OF A CHEMICAL WORKS.

BY EUSTACE CAREY.

The discussion of new processes, or improved processes, whereby chemical action may be utilised for manufacturing purposes, must always be regarded by us as of the first interest to this Society, but as I have not for some time past been practically engaged in the actual working of technical operations, I am unable to bring anything new before you for your consideration this evening. For this I am very sorry, but I shall venture to submit to you a few observations on the general organisation of chemical works, observations which have been drawn from my own personal experience, and which may, I hope, occupy half an hour or so without weariness to you.

In speaking about the manufacture of chemicals, I ought to explain that I shall refer only to works where what are known as heavy chemicals are produced.

The production of fine chemicals (an equally important branch of chemical industry, and one which is often even more interesting from a strictly scientific point of view) is a realm which is practically unknown to me, a realm in the rich pastures of which I dare not trespass.

First, among so-called heavy chemicals, it, naturally perhaps, occurs to me should be placed alkali and chlorine products, but surely glass and sugar may be granted a place, as also the more useful and commoner metals, such as iron and copper; and I believe most of the remarks which I shall venture to make to-night will apply to them as well as to alkali and chlorine products, with which latter I am of course more particularly familiar.

Let us at once take a plunge into the middle of our subject.

Suppose we desire to establish an alkali works capable of making and decomposing 600 tons of salt-cake per week—a very moderate works—one which in the old days of prosperity (long since past) might have been contemplated with satisfaction, if not with anticipations sanguine of success. What are the conditions required for the successful management of a works of this considerable, if not by any means colossal size? What are the solid materials with which we have to deal? They are approximately as follows each week:—

	Tons.
Pyrites	300
Salt	500
Limestone and lime	600
Fuel	2,000
Timber, iron, bricks	200

besides other materials, which, though small individually, mount up into something considerable collectively.

Let us say then that we have 3,600 tons of materials to receive per week. Let us now look at our outgoings. We have, we will say, 300 tons of caustic soda, 250 tons of bleaching powder, 80 tons of sulphur, 900 tons of Chance's mud, 200 tons of lime refuse, 600 tons of cinders and other rubbish, say a total of 2,330 tons, or say in round numbers a total in and out of nearly 6,000 tons per week, or 1,000 tons per day.

It is obvious at a glance that traffic facilities are of great importance to such a works.

I need say nothing about geographical situation, for the nearness or otherwise to raw materials and to the place where products are consumed or shipped, is obviously of the first importance, and a few miles, even only a dozen miles, may mean all the difference between ultimate ruin and a substantial success. Upon this obvious fact I need not dwell, but granted that we have a plot of land with favourable conditions geographically, traffic facilities within and about that plot of land are clearly of supreme moment. Twopence per ton on 6,000 tons means 50*l*., and 50*l*. per week means an average charge of say 2*s*. per ton on our total produce for sale, and is easily lost, though 2*s*. per ton is not so readily won.

Let me take an instance. I knew a works, a small works, which was laid out in such a way that the siding into which the waggons containing the fuel delivered by the railway company was so situated that the coal could be discharged from the trucks directly into the place where the fuel was used. The effect of this was that the waggons were discharged at once and returned to the colliery so quickly and regularly that for months together they made one complete trip per working day. Each waggon therefore carried—they were 10-ton waggons—60 tons of fuel per week.

The same works a few years afterwards had grown. The railway company's engines no longer delivered the coal on to the siding where it was used, but the coal had to be taken by horses or locomotives into the interior of the works, involving haulage and delay. In haulage I include all expenses of horses or locomotives, or both, and repair of permanent ways and roads. This haulage may be taken to be, on the average, 2*d*. a ton (if by cart it costs more). In addition to the haulage, the waggons, owing to the delay, made three trips instead of six per week. The waggon hire paid for that particular distance was 3*d*. per ton. Each waggon, therefore, under the later order of things, earned 7*s*. 6*d*. a week less than it did before, or, in other words, there was an additional charge put upon the fuel of 3*d*. per ton.

I have mentioned this instance amongst a number of others that might be named, only as an example which shows the enormous importance of good traffic arrangements. The same remarks of course that apply to fuel will apply to all other materials, and to the rubbish which has to be removed as well as the finished products. In short, the difference between well and badly laid out traffic arrangements may amount to some shillings per ton upon the finished product.

In the instance which I have named it will be noticed that the small works had an advantage over the larger one. My engineering friends may say, "Yes, that was only because the large works were badly laid out. Given sufficient and proper mechanical appliances, and your waggons might have been kept running at six trips a week." Perhaps so, but still those sufficient and proper appliances of which you speak so glibly would have cost something to erect and maintain, and therefore some advantage to the small works in this case would still remain.

This kind of argument naturally leads us to the general question of small *versus* large works. It is a common idea that a large works must be more cheaply conducted than a small one. This, in my experience, is by no means always the fact. I am prepared to admit that, other things being equal, a large works ought to be more cheaply conducted than a small one, but things in chemical works, as elsewhere, are not always what they ought to be. Let us compare a little further the advantages possessed by small and large works respectively. One fact in favour of [the small works is that which I have before mentioned, that all parts of a small works are of necessity nearer its boundaries than all parts of a large one. The railway company therefore performs a proportionately larger service to the small works than it can do to a large one. Then, again, as to internal management. The proprietor of a small works personally performs a larger proportion of the work of the establishment than the proprietor of a large one, and, granted equal ability in both cases, one is justified in concluding that a larger proportion of work would be performed in the best way in the small works than in the large one. In addition to this, I think I am justified in saying that the successful management of a large works requires a higher and therefore a rarer order of ability than the successful management of a small one. Other considerations I might adduce in favour of the comparatively small establishment, and I may add that as a matter of fact I have found from experience—and I have had exceptional opportunities—that in many cases a comparatively small works has thoroughly beaten a large one. But, on the other hand, if the proprietors of a large works possess the requisite capital and skill, I think that, notwithstanding some disadvantages under which a large works lies (an example or two of which I have already given), there can be no doubt that the large establishment has facilities and advantages which are not and cannot be possessed by the smaller concern.

In the early days of an industry, when the profits are good, and before great competition has rendered necessary the introduction of refinements, and of a careful scientific method of constructing plant and of manufacture, the rule of thumb and rough-and-tumble methods will pass muster, and the small works with the good old-fashioned "practical man" as its guide, philosopher, and friend, may be, and often has been, eminently successful.

But the time comes sooner or later when rule of thumb has to give way, and inventions appear in their countless numbers, many of them bad, few of them good, involving scientific knowledge and skill of a high order to distinguish between the good and the bad, and large capital to manage the good effectively. Then it is that the large works, with its capital and its staff of trained experts, walks in an easy winner, for while the small works with its traffic facilities and other similar minor advantages may save its pence or even its shillings per ton, the large, well-organised works, with its highly trained staff, may, by the quick perception and prompt adoption of the best and newest processes, save pounds. Instances of this must be patent to you all. We see then that in the early and barbarous stages of an industry a small works has a good chance of beating a large one, but afterwards, when the period of refinement and invention has set in, it is the large and well-equipped establishment that carries off the prize.

But at the same time we must not be doctrinaires.

In 1867 or 1868 I visited a large works, a very large and successful works, the owners of which were well-educated, enterprising men. However, the managing partner at that time had got an idea that mechanical appliances were about to supersede hand-labour—it was the time when black-ash revolvers were first successfully introduced—and he told me that his aim was "to do away," as he termed it, "with spades and wheelbarrows." These humble implements were henceforth to be banished. Hoists, railways, and conveyers were to be the order of the day. So expensive appliances were erected, and money was irretrievably locked up in these appliances. But unforeseen changes of manufacture took place. The works had to be remodelled in consequence of those changes, and the splendid appliances were relegated to the scrap-heap long before they had paid for themselves. This works has since then completely disappeared. I have often thought that if the owners had been content to run their hobby with more discretion this melancholy termination would have been avoided.

A chemical works is a place of constant change, and it requires the keen insight and foresight of the practical man, who keeps his eye open to see coming changes, and who avoids heavy expenditure in too substantial or expensive plant, to see that these spades and wheelbarrows, although they are not all that can be desired, are at all events simple tools, which can be as readily used for new processes as for old ones.

I have said that a chemical works is a place of constant change. There may be, and there seem to be, some exceptions to this rule, for to the outside observer some works—for instance, copper works—appear to be less addicted to change than others are, and if we may judge by the extremely substantial character of the buildings of some copper works that have been recently erected, the proprietors would seem to be of the opinion that for at least 50 years to come they will not be called upon to make any radical changes in the general arrangement of their buildings. I know, however, that this has not been the case with alkali works.

Just for a moment look at the history of the alkali trade since 1867 or thereabouts. Mr. Weldon comes round in 1867 or 1868 with his manganese recovery process, necessitating a complete alteration of chlorine-producing apparatus. About the same time black-ash revolvers were found to be more economical than hand furnaces, and forthwith, or as soon as possible, hand furnaces had to be swept away, roofs had to be raised, sheds altered, new chimneys built, and I know of one firm who in the course of a short time removed 10 black-ash furnaces, some of which had only just been erected, replacing them with revolvers at a cost of not less than about 40,000*l*.

Then came the Deacon chlorine process, which for the few who adopted it involved large and most expensive alterations of buildings, plant, and machinery.

In 1880 it began to be seen that, notwithstanding black-ash revolvers, Weldon processes, Glover towers, and all the bewilderingly frequent alterations of the previous 15 years, we were all wrong. Alkali could be better made by another and altogether different process.

Once again pulling down and building up, and so it will be to the end of the chapter, not to speak of trifling additions to our task in the shape of Chance's sulphur recovery process, which, though very young, has already suffered considerable change from the form in which the plant was first designed and erected. There are other equally and even more important changes within sight, which will in all probability involve the utter annihilation of many of our existing works.

Am I not right, then, in saying that as a chemical works is a place of continual change, it therefore behoves the prudent manager to be careful not to commit himself to plant of a very substantial character?

Chemistry *v.* engineering, engineering *v.* chemistry, the two pursuits, like the Siamese twins, will be inseparably attached and mutually dependent. The Le Blanc soda process is a chemical process, and engineering plays second fiddle. The ammonia-soda process is essentially an engineering process, the chemistry of which is comparatively simple. Some processes must be more engineering than chemical, other processes more chemical than engineering, but though we admit this, we must also admit, I think, that after all chemistry takes the first place as a rule, and it is the far-sighted chemist rather than the enthusiastic engineer who wins in the long run in chemical manufacture.

The chemists of the alkali trade who 20 years ago foresaw the part chlorine processes were to play, and who steered their course accordingly, have avoided disaster more successfully than those who devoted themselves to doing away with "spades and wheelbarrows."

Chemical reactions and mechanical appliances are not the only factors with which we have to deal. There is the human element, and a very large and important factor this is, has always been, and will always be. The manager of the old type, the good old-fashioned practical man, to whom I have before alluded, is nearly extinct in the alkali trade as a manager. I can well remember an example of this class of practical man. The works in question was a small but a rapidly growing one. The managing partner was a very able, far-seeing man, but he had a manager who was a specimen of the kind of practical man to which I am alluding—strong, energetic, industrious, and honest, but ignorant, narrow-minded, and of an intolerably jealous disposition. A new hydrochloric acid condenser had to be erected, and the proprietor thought it time to begin to have drawings made to assist the manager and artisans; especially as the condenser in question was to embody some new notions of his own. The plans were drawn, and when they were shown to the manager he worked himself into a fury of excitement and said: "We don't want no —— drawings." The word "drawings" was qualified with an adjective of strong flavour; indeed your practical man of those days was, like sea-captains of old, much addicted to the use of strong language, particularly when addressing the men, who, he would affirm, could not understand or obey orders without it. That was but a sample of the practical man of that day, who in plenty of cases had a good supply of strong mother wit, but who often utterly lost himself and was the helpless cause of great losses to his employers through the want of a more liberal education and disposition.

But there is the practical man of the present day—what is he, or rather, what should he be? He must have the foundation of strong mother wit with that faculty of *savoir faire* without which learning and accomplishments are but as sounding brass or a tinkling cymbal; granted this natural ability, the more corn he can carry in the shape of scientific knowledge, the better. He may soar into the clear blue of the higher mathematics; if he can, so much the better. He must at all events, however, have a sound grounding in chemistry and physics, a practical knowledge of mechanical and civil engineering, a knowledge of men and of things, and above all, perhaps, the common sense to know what he can do himself and when to call in specialists and experts who can help him over unfamiliar ground. The practical man of to-day should be all that I have indicated, and is as different from and as superior to the practical man of 30 or 40 years ago, as the magazine rifle is to Old Brown Bess.

After the manager come the foremen, those non-commissioned officers of industry, and what an amount of real power they sometimes possess, for generally they have earned promotion from the ranks by dint of superior industry, energy, integrity, or skill; they are men who by their natural genius have often risen to positions of high trust and emolument, though without education.

I knew a man, who was by trade a blacksmith, who could neither read nor write, but who was by nature a mechanical engineer of exceptional power, who, when a break-down occurred, could improvise, on short notice, out of rude material, and with surprising success, some temporary but effective arrangement which would tide over the difficulty, and in many instances save the management from the disgrace of an unfulfilled contract. I have often been profoundly indebted to that kind of man; but oh! how narrow-minded, how jealous of his colleagues, and how suspicious of those a little below him, and how difficult to deal with, except in a time of emergency, when he would be roused, and show the real, true metal of his character. In ordinary times he would be, I regret to say, sometimes drunk and incapable, and, in the case of which I am thinking, this weakness led to the man's discharge, to the loss of several situations, and ultimately to his death in miserable poverty.

The always slow and plodding foreman is a character of another type. This man will, in the most meritorious way, try to improve himself by attending mechanics' institutes and evening classes, but he is often deplorably deficient in "go" and in ability to deal with emergencies. However, of the two I prefer the foreman who is slow but sure; it is the manager himself who should supply the invention and the self-sacrificing *élan* which in exceptional times of difficulty enables him to push things as only a man of power and resource can push them.

I have just said that the human element is a large and important one. I think you will admit this when I remind you that in our supposed works of moderate size, where 600 tons per week of salt-cake are made and used, we shall require at least 600 men and boys. For every ton per week we therefore require one person at the very least. We must admit that these 600 persons must be so worked, managed, and paid as to be kept in a satisfactory state of efficiency. Lord Brassey has very conclusively shown that low wages does not necessarily mean cheap work, and that, roughly speaking, labour, whatever the rate of wages, is much the same in cost all the world over. I remember a remarkable instance of this. Many years ago my senior, the late Mr. Deacon, visited a French alkali works which was of about the same capacity as our own was then. He compared the rates of wages, the number of men employed, and work done, with those obtaining in our works. He found that the general rate of wages was not more than about half ours, but that the works kept just about double the number of men. Low wages does not mean cheap work, and I do not hesitate to say that if at a piece of ordinary labour a gang of men cannot each of them at least earn 4*s.* per day, they are not worth keeping.

A good many years ago artisans and yard labourers used to work 60 hours a week. This was reduced to 54, and I, in common with many others, thought that that of necessity meant a rise of wages for the work done, but though I have no actual statistics prepared on that point, I believe we were entirely wrong, and that no appreciable rise in the cost of work was brought about by this alteration in the hours of labour. But Mr. Hadfield has lately collected some facts and figures which throw a very bright light on this subject. In a book entitled "A Shorter Working Day," compiled by himself and Mr. Gibbons, he shows conclusively, I think, that our working day has been too long to get the best results out of our men, and I very earnestly recommend the careful perusal of this very interesting little book. Let me give you a few examples. He says on page 127, "One great bugbear is that a shorter working day will seriously increase continental competition against us. If so, "he says, why has not the shortening of the working day from 10 to 9 hours affected us more?"

Mr. Mundella says, "It is rather the long hours of labour in other countries that saves us from their competition, because long hours impair the personal efficiency of their labour, and competition between nations is growing more and more every day to be mainly a competition in personal efficiency."

John Stuart Mill says, "General low wages never caused any country to undersell its rival, and general high wages never hindered it from doing so."

Mr. Hadfield gives some practical samples. The first he quotes is that of an engineering firm in London. Now, of all manufacturing trades, I should imagine that mechanical engineering is one which involves the keenest competition, but the firm has been working on the eight hours' system for $3\frac{1}{2}$ years, and they have come to the conclusion by actual working that early morning work, *i.e.*, work before breakfast, "costs 50 per cent. more" than similar work done after breakfast.

In reply to definite questions—"(1) this firm answers that, there has been no increase in the cost of production, but, on the contrary, a decrease; (2) the change is much appreciated by the men; (3) we have now a more intelligent set of men; (4) there are many incidental savings by shorter hours; (5) we get out more work; and (6) more time is afforded to the men and lads to improve themselves. They attend technical classes in the evenings."

Mr. Hadfield also cites Messrs. Brunner, Mond, & Co., who reduced their 12 hours' shift to 8. The managing director of that Company says, "We have never had any reason to regret the change. To the men it has been the greatest boon, and has had a most material effect in improving their health and decreasing the amount of drunkenness, which before the adoption of the system was very great indeed. The interference of the police is not called for now as it used to be."

Mr. J. T. Brunner has very kindly sent me a letter bringing the subject up to date so far as Messrs. Brunner, Mond, and Co. are concerned. He says:—

"You are at liberty to add to what we told Mr. Hadfield the following facts:—

"1. The sickness amongst the shift-men, as measured by the works sick club payments, is exactly half what it was under the whole system. There is a marked improvement in the gait of the men as they come to and leave their work.

"2. Although I am unable to measure the improvement, or to value it in money, with accuracy, there can be no doubt that the work done per hour by these men is greater than before, and the net result to-day is that the cost of shift-men's wages per ton produced is no more now than under the old shift, notwithstanding the fact that the men are now paid for eight hours as much as, four years ago, they were paid for 12.

"I am bound to add that the shorter shift has led us to expend large sums in providing improved appliances, and that, for the satisfactory character of the result, we are largely indebted to the great care and skill in organisation consistently displayed by our managers."

Similar evidence has been given by other firms, one of which adds: "We scarcely have one absentee under the new arrangement, whereas by the old, 20 per cent. of our men lost the first quarter every morning."

In support of all the foregoing, I am glad to say that, so far as my own knowledge goes, I am now strongly in favour of a shorter day. Let me give you one or two examples. Mr. Morrison, of Widnes, informs me that in his district the eight hours' shift has been tried with salt-cake men. You know, probably, that a salt-cake furnace is calculated to turn out about 10 tons of sulphate of soda or salt-cake per 24 hours.

Until lately the 12 hours' shift was usual in Widnes, but for some time past three shifts instead of two in the 24 hours have been tried. The work is done at the same rate per ton of sulphate, and the result is that 12 tons in the 24 hours are got out of the furnace instead of 10, but we have to divide the wages for 12 tons between three men, *i.e.*, they do four tons apiece per day, whereas under the old arrangement two men did 10 tons, or 5 tons apiece. The men therefore go home with 20 per cent. less wages per day than before. But mark this, when the 12-hour system was existing the men were frequently away a day, whereas the result now is that the men work more regularly, and if they do not earn as much per day, they do earn as much per week, and have the incalculable advantage of time to themselves for rest, recreation, and attention to their families.

Now here comes a point on which some will differ from me. Give a working man more leisure and he will get more drink, is frequently affirmed. Well, gentlemen, all I can say is most emphatically that is not my experience. The man who is over-tired, and who goes home night after night with his nerve and muscular force exhausted, who has hardly time for anything except working, sleeping, and eating, it is he who turns to intoxication for change and excitement, and not the man who, after an honest and reasonable day's work, has strength of mind and body left to take an interest in something better than the beer jug, and self-respect enough to be thrifty and decent.

Gentlemen, I have seen, and carefully watched, more than one generation of workmen, and can testify from my own positive knowledge that excessive labour results, not only in the degradation of the individual labourer, but in distinct diminution of the physical, mental, and moral power of his descendants.

There is one argument against the three-shift system, that is that more men must be employed, and, consequently, when labour is scarce it will be difficult to man your furnaces and carry on your works; but, on the other hand, we may reply that the easier work of the eight-hour day can be performed by ordinary men, whereas the 12-hour day requires for furnace work of this kind men of exceptional physique. The 12-hour shift require fewer men, but your choice is limited. The eight-hour day requires more men, but there are more men who can do it; the field is wider. The one argument about balances the other, and you have with the eight-hour system the great advantage of getting more work, and more regular work, out of your plant.

I will now, with your permission, conclude my observations by some remarks upon a subject which has engaged the attention of the public lately, and upon which the public has been grossly misled by well-meaning but misinformed journalists. I allude to the health of workpeople in alkali works. The Labour Commission has had evidence brought before them on the side of those who believe that alkali works are essentially unhealthy, and evidence on the side of those who, like myself, believe that an alkali works is a place where men may work and thrive in health and comfort. Figures prepared by my friends Mr. Stewart, Mr. Morrison, and Mr. Wylde prove conclusively that the death rate amongst "process workers" in an alkali works is absolutely less than that obtaining with ordinary artisans or even with ordinary artisans who are engaged side by side in the same alkali works. As these figures have been already published, I must not reproduce them here, but I may say that they have not been contradicted or even questioned. Why, then, these onslaughts against alkali works which have appeared in some daily papers? I regret to say that these attacks have proceeded from persons who are so practically ignorant of the whole matter, that they readily swallow all they are told by anybody whom they may meet, so long as what they are told chimes in with their own imagination. Let me give you an example or two. Take the "Daily Chronicle" of January 13th last. Its correspondent, writing on "Death in the Workshop," states: "I regret to say that the chemical men are the victims of disease and premature decay and death to an extent that is simply appalling." . . . .

"And the facts are, I repeat, that this wretched town is a hot-bed of pestilence, and that the strongest men, drawn fresh from the country, in the very prime of life, die at least ten years before their time, and are prematurely worn out and thrown upon the rates, or gasp away half their time in the grip of bronchitis."

I do not dispute the good faith and good intentions of this paper, but I do dispute its right to publish a series of articles compiled by a special commissioner, who, while exhibiting enthusiasm and ability worthy of all praise, at the same time demonstrates that he is one of that well-known class of individuals who joyfully rush to conclusions which are, to those who are better informed, obviously impossible and absurd.

A good many years ago a member of Parliament, who was very distinguished and successful in his advocacy of our sailors, thought that the cause of bleaching-powder packers required his aid, and an article appeared in a leading medical journal in which the hardships of bleaching-powder packers were graphically pourtrayed. It was said that at a certain works in the neighbourhood of Glasgow bleaching powder was made in large quantities, and that the packing of this bleaching powder was so deadly an occupation that by it many men were slaughtered annually. In fact, it was represented that droves of poor Highlanders came year by year to labour and to die at this works. The result of these representations was that the leading medical journal aforesaid appointed a commissioner, a professor of chemistry at one of the London hospitals, to investigate the matter. He came, he saw, and frankly admitted that they had found a "mare's nest," and thereupon the agitation collapsed. Now another similar agitation has been set on foot—and will subside in due course. The late Government, very properly I think, empowered the Home Secretary, if and when he deems it desirable, to issue special rules for the guidance of those manufactories which may be deemed by him to be dangerous to the health or life of those employed therein. The present Home Secretary has, in accordance with this Act of the late Government, been making inquiries through a committee of independent men, and will shortly issue some special rules for the guidance of manufactories which appear to him to be dangerous within the meaning of the Act, and I do not doubt that these rules will be the result of much careful consideration, and will be useful, but I venture to think that so far as alkali works are concerned, no such atrocities as those depicted many years ago in the medical journal to which I have alluded, or those described in recent newspaper articles, will be found to exist; and that the rules, when they become law, will be found not to insist upon sweeping and drastic alterations, but to be such as will recommend themselves to the good sense of employers and employed, and of all who are practically acquainted with the subject with which they deal. I must perhaps apologise for saying so much as to the health of the men employed in chemical processes, but the subject is one of importance, and so much public attention has lately been bestowed upon it, especially with regard to alkali works, that I have ventured to make the foregoing remarks, which I sincerely hope may meet with your approval. We must, I think, admit than an occupation in which, at all events, shelter from the weather and an unlimited supply of fresh air is provided, cannot be especially unhealthy.

The statistics to which I have alluded support this argument, and I contend that so long as the hours of labour are not prolonged to a stage where they become exhausting, the lot of the chemical labourer is far more satisfactory than that of the labourer in many other and less suspected occupations.

Now, gentlemen, I would conclude my paper, which I sadly fear has been but desultory and uninteresting, by summing up the conclusions to which our observations seem to me to lead—conclusions to which every member of this Society may have arrived long ago—but though that may be the case, I hope an hour this evening has not been wasted in considering them anew.

We have discussed the importance of internal traffic arrangements in a works; we have in a rough way and to some extent stated the advantages and disadvantages of a small works as compared with a large one: we have seen, I think, with sufficient clearness, that when the youth of an industry is past, with all its glamour of hope and of expected but rarely realised achievements, it is the large organisation, with its thorough scientific equipment, which is likely to win in that eternal conflict resulting only in the survival of the fittest. We have touched also upon the human element, and I hope I have said enough to indicate that in operations where there is continuous and exhausting labour, a shorter day than 12 hours is desirable, both in the interest of labour and of capital; and, further, that the aspersions that have been cast upon some of us from time to time who have the misfortune to be alkali manufacturers, as to the deadly nature of the risk to which our workers are exposed, are aspersions made by individuals who may be well intentioned, but who are signally and singularly ignorant of the facts about which they speak. We have spoken of the multitude of inventions, mostly bad ones, which beset us on every side, and of the trained skill and knowledge which is required to sift the good from the bad, to winnow out the few grains of wheat from the interminable mountain of chaff, and I venture to say, gentlemen, that it is the privilege and the special function of the Society of Chemical Industry to help the members in this winnowing process, but this cannot be done unless members are willing to trot out their hobbies and submit to criticism, which, if courteous and friendly, as such criticism should always be, is at the same time thorough and searching.

Now, gentlemen, when some pet plan of ours is pulled to pieces and shown to rest upon an insecure foundation, when our premises are alleged to be untenable or our conclusions unsound, we should not be annoyed, except perhaps at ourselves, but should hail such unreserved and honest criticisms as a sign that our Section is really alive and doing its legitimate work.

It appears to me that two things are wanted, otherwise our Liverpool Section will die of inanition. One is a little more freedom in divulging improvements, and a great deal more freedom and hard hitting in criticising them. I know that it is awkward to come here and tell important secrets; in fact, hardly anyone who has his bread and cheese to earn can afford to do it. It in consequence comes to this, that good things are kept back, and the Society is regaled from time to time either with hashed-up remnants of old and mouldy materials, or if the matter is new it is often so trivial as to be worth next to nothing. Occasionally of course we get a highly interesting scientific paper, but from the nature of things the manufacture of such productions is limited.

I see no real way out of this difficulty. The only practical suggestion that I can make is that those members who are fortunate enough to hit upon valuable improvements, should protect them by letters patent, and then they will be free to talk about them here and have them discussed. I firmly believe that the policy of obscurantism, if I may use the term, is as a general rule a wrong policy in manufacture. Protect your inventions by all means: a man is a fool who shows his hand before he has properly played it, but when that is done a full, free, and fearless discussion can only result in benefit to all concerned. It is only the conceited man who thinks that in such discussions he always gives more than he receives.

Gentlemen, I sincerely hope that this session will be a good one, and that there will be many useful papers and plenty of hard hitting, and that in the give and take of our friendly combats we shall always keep our tempers.

I have only now to thank you for your patient attention to my remarks.

Manchester Section.

Chemical Theatre, Owens College.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.

Committee:

G. H. Bailey.
F. H. Bowman.
R. F. Carpenter.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
P. Hart.
J. M. Irving.
E. Knecht.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
C. Truby.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893-94.

December 1st, 1893:—
Discussions:—
(*a.*) "The Patent Laws."
(*b.*) "Flashing Point of Mineral Oils."
(*c.*) "Burning of Liquid Fuel and its value compared with Coal."
Dr. B. W. Gerland will exhibit Kuhlmann's New Model Technical Balance.

Meeting held Friday, November 3rd, 1893.

THE CHEMICAL INDUSTRIES WITH NOTES ON THE DEVELOPMENT OF THE PRODUCTION OF ARTIFICIAL INDIGO AND INDIGO CARMINE ILLUSTRATED BY EXPERIMENTS.

BY IVAN LEVINSTEIN.

Since our last meeting certain events have occurred which have exercised a more or less adverse influence on the trade of this country.

The financial and industrial crisis in the United States, the instability of the price of silver, the continued political disturbances in various South American markets, an indifferent harvest, and, not least, the great and prolonged coal strike, have each and all injuriously affected our trade. Our imports for the nine months ending 30th September, as compared with the corresponding period of 1892, have decreased by 15,293,715*l.*, and our exports in the same period have diminished by 5,087,167*l.* All the more gratifying must it be that, notwithstanding these exceptionally unfavourable circumstances, our chemical industries are able to show an increase in exports of 372,952*l.* for the first nine months of the present year, as compared with the corresponding period of 1892, and this increase would have been still more marked but for the falling off in the month of September, which month shows a decrease of 107,432*l.*, as compared with the same month of 1892, due principally to shipments to America being very much curtailed in consequence of the stoppage of a number of industrial establishments in that country. This increase in value is the more surprising when we take into consideration the fact that prices for the principal articles ruled lower during January to September this year than for the corresponding period of 1892 that the quantities exported were not correspondingly larger, and the only way we can account for it is the probability that we have converted part of our crude materials formerly exported as such, into finished products commanding higher values. Other signs, however, are not wanting, which also indicate that we are now emerging from the stagnation of trade to which I had occasion to refer last year, and that the outlook for the coming year is on the whole more favourable. It is true that 58 per cent. alkali, an important article of commerce, has fallen to hitherto unheard of low value, viz., from 6*l.* 5*s.* per ton, the quotation of last and previous years, to about half this price, notwithstanding the great scarcity of fuel during July to October, and also that very large contracts have been made at these low values, not only up to the end of this year but even for supply over the whole of next year, and that this reduction in price will make in the case of one firm alone a difference in profits of probably more than a quarter of a million sterling. On the other hand, hard as this may be for one or two firms, there can be no doubt that the lower value of an article largely entering into multifarious general consumption must, especially if its price has been artificially kept above its legitimate value for a number of years, re-act with advantage on a number of other branches of industry. The low prices now prevailing will not only stimulate consumption and lead to an increased export of the article itself, but will also materially benefit printers, dyers, paper-makers, soap-makers, glass-manufacturers, and many other large consumers of this commodity, and put them in a stronger position to meet foreign competition. We have at last regained the advantage formerly possessed, viz., we once more have alkali cheaper than our neighbours, and it may be opportune to consider how far these low prices, which within certain limits are likely to continue, may disorganise certain branches of the alkali industry, and influence the value of other chemicals.

In the first instance, it is most likely to cause the entire stoppage of the manufacture of soda ash and soda crystals by the Leblanc process, and to limit the production of sulphate of soda to obtaining the necessary chlorine (as long as there is no cheaper source available) for manufacturing bleaching powder, chlorates, &c., but as there must be a sufficient outlet for the sulphate, it may become necessary to convert the whole surplus into caustic soda. That such changes may be looked for in the near future may be assumed from the fact that soda-ash equivalent to 58 per cent. alkali cannot be profitably produced at 3l. per ton, or even a higher price than this, by the old process, and that the already existing works for producing ammonia soda are capable, when fully developed, of supplying the demand. Such dislocations in the arrangement of manufacturing operations will also no doubt influence the market values of such articles as caustic, salt cake, nitre cake, chlorine, bleaching powder, and other derivatives of chlorine.

At the opening of last year's session, I referred to another great fall which had taken place in the price of an imported article, viz., benzol, and to its cause; since then our export to Germany, the principal consumer, has still further decreased, and, from the less favourably situated shipping districts, altogether ceased. The recovery of benzol from coke has further extended on the Continent, and it is reported that there are now at work in Germany and Austria at least 3,000 coke-ovens, saving the subsidiary products and yielding, even at the present low prices, as it is stated, a net profit of 400,000l. There is, however, one consolation in the fact that the recovered products contain practically no toluol, and that, for the supply of this hydrocarbon at least, Germany will have to rely upon us to some extent.

The respective market values of this article and benzol will presumably change places, and already 50 per cent. benzol commands as high a price as 90 per cent., or, in other words, toluol is already as dear as benzol, and this change will, it may be hoped, afford some compensation to our tar distillers and refiners.* This continued extension of the erection of plant for the recovery of these waste products on the Continent, and the consequent cheaper production of coke will, however, force our coke-oven proprietors to adopt, to a very much larger extent than has hitherto been the case, the recovery of their waste products, and this, if generally carried out, would represent an annual saving to this country of several millions. That this more economical manner of working must and will be generally adopted can scarcely be doubted, nor is the present low price of benzol, or a further likely fall—owing to increased production—a real hindrance, as the recovered products contain, besides benzol, other valuable articles of commerce for which a ready market may be found. The recovery of waste products from the coke ovens is looked upon even by outsiders as deserving attention, which is evident from a recent report of the United States Consul at Frankfort to his Government. Comparing the growth of the iron and steel production in Great Britain and Germany, from 1880 to 1892 inclusively, he states that whereas England shows an increase of only 70 per cent., Germany has achieved during the same period a net growth of nearly or even quite 400 per cent., and he attributes this remarkable result (1) to the introduction of the basic process, which enables the iron and steel makers of Westphalia, Silesia, and the Saarbruck district to use their cheap native ores, and (2) to the chemical skill of the Germans, whereby they have succeeded in saving the by-products of coke manufacture, thus deriving a revenue from processes which in other countries entail a waste of material and financial loss. The Consul, however, exceeds the facts in his last statement. In the first instance, the recovery of these products was not so much the work of chemists as of engineers, and second, inasmuch as France was really the pioneer in the recovery of these products, next followed England with ovens of an improved type, and Germany was the last to adopt them, having as such the great advantage of the experience gained by its predecessors, further improving upon which they brought them to a perfection which resulted in their more general adoption in that country and Austria. It is, however, satisfactory to know that our engineers have not altogether lost sight of the advance made abroad in the construction of these ovens, and if I am rightly informed, a well-known Manchester engineer has put up in the North recovery-ovens constructed in accordance with his own latest improvements.

Taking a retrospect of the general position of the industry which uses as its primary materials benzol and other aromatic hydrocarbons, and builds up from these more complex compounds which find their principal use either in the form of intermediary products or as colouring matters or medicinal preparations, we may consider the results as, on the whole, satisfactory. Manufacturers of coal-tar derivatives have been fully employed. The demand has been constantly increasing, and the introduction of new products and the cheapening of the methods used in the production of already established articles have fully compensated for lower prices, and it is certainly most satisfactory to note that this country has participated, if only yet to a modest extent, in the development of this important industry. A large number of patents has again been applied for during the past 12 months, of which the greater part deals with improvements on old or substitutes for existing colours, but there is nothing of an exceptional character to report. I cannot, however, pass from this subject without calling attention to the continued efforts which have been and are being made by chemists to further improve the methods for the production of artificial indigo, which so far possessed only a scientific value, for the reason that this country has a twofold interest in this question. In the first place, we are the principal producers of natural indigo, the annual outturn of which represents a value of about four millions sterling; and, secondly, we are one of the largest, if not the largest, consumers of this colouring matter.

It is now several years since Professor Bayer made the startling discovery of the synthetical production of one of the most important colouring matters hitherto solely supplied by the agency of nature. The first patent taken out in the name of the Professor for the production of artificial indigo was in 1880, then followed a number of patents in rapid succession from 1880 to 1884, having as their primary material either orthocinnamic acid or its homologues or products of substitution. Considerable sums were spent during these years with the object of perfecting the technical methods, and reducing the cost of the necessary intermediate products, but all these efforts were in vain, and artificial indigo remained so far more a chemical curiosity than anything else, excepted perhaps the very limited use of the orthonitrophenylpropiolic acid.

Little was heard of it by the outside world for sometime until attention was again directed to it by Professor Heuman's beautiful discovery in 1890, which I had an opportunity of illustrating by experiment shortly after, on the occasion of addressing the chemical students at the opening of the session of the Manchester Technical School. Heuman's discovery in the production of artificial indigo proceeded on different lines from those first followed by Bayer, and afterwards by others. Heuman heats phenylglycocine with caustic alkalis at about 260° C., when indigo white is the result, which may then readily be oxidised to indigo blue. Here again, unfortunately, notwithstanding the great simplicity of the process, the large destruction of the principal raw material made this process also too expensive for trade purposes.

With all these negative results, so far as the profitableness of the various processes is concerned, chemists have preserved in their efforts to solve the great problem which offers so great a prize, and I will now illustrate a process which might almost be called an extension of Heuman's discovery. In December 1890, the Farbenfabriken of Elberfeld discovered that when phenylglycocine is treated with anhydrous sulphuric acid, an oxidation accompanied by an evolution of sulphurous acid takes place, converting almost instantaneously phenylglycocine into indigo sulpho acid or indigo carmine. I have here some phenylglycocine (produced by the action of mono-chloracetic acid on aniline) which has been ground up with 20 times its weight of sand in order to moderate the reaction. I now put some of this into a large excess of 70 per cent. anhydrous sulphuric acid. You will notice a yellow colouration, which already indicates the formation of artificial indigo, but in order to make the real colour appear it will be necessary to remove the anhydrous acid (SO_3) by absorbing it in a large quantity of ordinary sulphuric acid, when you will notice an intense blue colouring matter. I am now pouring this blue acid solution on a block of ice, when the characteristic colour of indigo carmine will be more easily perceptible to the eye and we will dye some woollen cloth with this solution after first neutralising the excess of acid contained therein.

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* Since this address I see from the very latest market reports that already 50 per cent. benzol is quoted at a higher price than 90 per cent.

In the year 1882 the Badische Anilin und Soda Fabrik patented a process for manufacturing artificial indigo by treating the solution of orthonitrobenzaldehyde in acetone with alkali. Bayer and Drewsen in the same year further investigated this reaction, and they found that when nitrobenzaldehyde in presence of acetone is treated with very diluted alkali that first a product of condensation is formed, viz., the orthonitrophenyllactoketone, which on further treatment with alkali is instantly converted into indigo. I have here some orthonitrobenzaldehyde, and am now dissolving it in acetone, we will add to it some water, and put to it a few drops of a caustic soda solution; the ketone is first formed, which you will see will be almost immediately converted into artificial indigo on adding a little more of the alkali solution. This reaction, simple as it appears in its execution, was also doomed to failure, on account of its costliness, notwithstanding Eugene Fischer's process, patented in 1888, for a cheaper method of producing orthonitrobenzaldehyde from orthonitrobenzylchloride.

It was, moreover, impracticable to apply the ketone direct to yarn or cloth and then develop the indigo blue direct on the fibre, on account of its comparatively small solubility in water. Some of these difficulties in the way of the practical application of Bayer and Drewsen's discovery have now been overcome by Kalle and Co., of Biebrich, and though their process may not so far be cheap enough to produce indigo direct, the development of indigo in the fibre appears to me likely to find some application in the arts, on account of the superiority of the shades produced, and the greater resistance to light of the lighter shades, and for the reason that new effects can be obtained by it in printing which would be difficult to produce by following the old process, always providing that means be found to reduce the strength of the caustic soda solution which the patentees specify as being necessary for developing the indigo, as a solution of 21° Bé., as recommended by the patentees mercerises the cotton.

A few months ago Messrs. Kalle and Co. found that when Bayer and Drewsen's ketone is treated with bisulphite of soda, the bisulphite compound of the ketone is formed, viz., the orthonitrophenylactoketone bisulphite, and this compound has the great advantage over Bayer and Drewsen's of being easily soluble in water, and hence can readily be applied to the fibre; moreover, to obtain the ketone in a pure state by Bayer and Drewsen's method is more costly. I have here the bisulphite ketone; we will dissolve some of it in water, when you will at once observe its conversion into indigo on the addition of a diluted caustic solution. I will now illustrate the application of this compound to the production of indigo shades on the fibre.

This hank of cotton yarn we will pass several times through a solution of the ketone; squeeze it and then take it through a caustic soda solution, when it will be dyed a deep indigo blue. I have also here some cloth that has been prepared by printing upon it a solution of the ketone thickened with dextrin. We will now pass it through caustic soda, when the cloth which was previously practically colourless will be coloured indigo blue in all parts which had been impregnated with the ketone.

Now, gentlemen, in bringing under your notice this evening a few reactions illustrating next to artificial alizarin one of the most beautiful discoveries made within the domain of chemistry, I have one sincere regret to express, and that is, that this country has had so little part in the work that has enabled chemists to achieve these brilliant results.

Unfortunately we have in the past too long and too much neglected the study, more especially of organic chemistry; our neighbours have beaten us in the knowledge of this science and in its application to industrial purposes. I have pointed out on frequent occasions the need for training chemists of the very highest class, and I am glad to see that efforts are at last being made in various directions to improve our position. This college has appointed as successor to the late eminent Professor Schorlemmer, a gentleman who has already shown, by a number of very valuable researches, that he is the right man in the right place, and before long the authorities of this great educational institution will be in a position to place at the disposal of Professor Perkin, jun., F.R.S., a laboratory which will be exclusively devoted to research work in organic chemistry. Two difficulties will, however, I fear, stand in his way, though I hope that they will not discourage him in pursuing with spirit and with good heart the paths he has marked out; the first difficulty is the insufficient preparatory knowledge of the average student entering the college, the next the brief time he devotes to his studies.

Chemists are not made in a day, or in two years either, and it is to these two points that the success of the Germans must be largely attributed, viz., the careful preliminary training and the longer time passed in the chemical school, and as long as secondary education is not placed on a higher level, and as long as parents and guardians cannot appreciate the necessity of retaining the youth for a longer period at school or at the University, I am afraid our schoolmasters will have a hard nut to crack in successfully competing with the standard education of our neighbours.

There has been quite recently a discussion in the papers between some of the headmasters of our schools and others. I am totally unable to see that the fact of a few boys passing from the board school direct to the University, even with distinction, out of a number of more than 70,000 attending school, is any proof of efficient teaching. Indeed, it would be very interesting to enquire at what expense and detriment to many thousands of other boys these specially picked and sharp boys have achieved these results. Speaking generally, and without reference to any special school, I am of opinion that the obtaining of a few scholarships, exhibitions, or medals is no criterion of the efficiency of any school, so long as cramming or prize-hunting is the order of the day, and so long as the individual training of the average boy is neglected for the purpose of nursing a few specially gifted scholars. Such a system is diametrically opposed to the elevation and methodical development of the mind, which is the primary object of education.

The number of subjects taught in our preparatory science schools is also far too extended, as no average boy can possibly master or digest them in the time generally allotted to him for school education, and it would be far more to the lasting advantage of our boys to teach fewer subjects, and those thoroughly, instead of many in an indifferent manner, as is now the case. A few years ago I ventured to point out the want of co-operation and co-ordination existing between our educational institutions, and that a great deal of money might be saved and much more satisfactory results be obtained if the overlapping and misplaced rivalry now existing were done away with as far as practicable.

In a report of the Technical Institution Committee which has been accepted and approved of last week by the council of the Manchester Corporation it is recommended to appoint a representative committee to consider this question of co-ordination in all its bearings. Let such schools teach advanced science subjects as have the most competent teaching staff and the most perfect appliances at command, whilst those which have not, ought to confine themselves to thoroughly and efficiently preparing our youths for the advanced work carried on by the former. There must be a "give and take" in regard to this matter, and I doubt not that even some of our technical schools and similar institutions could also with advantage dispense with certain subjects at present taught, and leave them to those whose special province it is to teach them.

The plans for our municipal technical school are completed, and before long we may expect that the erection of the building will be proceeded with. This school will be constructed and equipped with the experience gained with other schools of a similar character in this and foreign countries, and it may reasonably be expected to be probably one of the most perfect institutions of the kind here or elsewhere. May we not hope that by that time co-operation and co-ordination will have rendered service in preparing our youth for entrance into this school in a manner more efficient than is at present the case?

A NEW DYE-BATH ARRANGEMENT FOR EXPERIMENTAL DYEING.

BY WM. MARSHALL, F.I.C.

In making comparative dye-trials it is necessary to have some arrangement by which several samples of any textile material can be dyed simultaneously under the same conditions of temperature. Two kinds of apparatus may be used. One in which the water in the dye vessels can be heated to the boiling point and another in which the temperature may be lower.

The following are some of the arrangements which have been employed with varying degrees of accuracy. I will take them in the order of their introduction.

1st. The method universally adopted in large calico print and Turkey red works, and used for a long time, viz., a metal water bath with holes in the lid for the insertion of dye vessels; heated formerly by a charcoal furnace and later by perforated steam pipes. These were made to hold from 20 to 30 dye-vessels of earthenware or copper. Others used a circular vessel with metal pots fitting tightly into the holes and heated by direct steam, that is a steam bath instead of a water bath. They were used for dye trials with madder garancin and other dyestuffs.

2nd. Oil baths heated by gas.

These have been in use for a considerable time at many works, as it is often necessary to make experiments when the steam is off. They are made of copper, in rectangular shape. The sizes vary somewhat, but they are about 24 × 16 × 6½ and contain holes for the insertion of dye-vessels. They are supported by an iron stand of sufficient height to allow the gas burner to be placed under them. During late years calcium chloride and glycerin have been used instead of oil. In each case a temperature is obtained sufficiently high to boil the water in the dye-vessels. For low temperature experiments a similar bath containing water and heated by gas, is also used, with glass beakers as dye-vessels.

The disadvantages in connection with this bath are as follows—

(*a.*) It is impossible to obtain regular heating of all the dye-vessels, as, owing to the construction of the bath, the circulation of the liquid whether water, calcium chloride, glycerin, or oil be used, is very imperfect. This is most marked when $CaCl_2$ is used.

(*b.*) The danger of fire when oil is used. If from any cause, say the breaking of a pot, a small quantity of water is introduced into the bath, the hot oil at once boils over and comes in contact with the flame.

(*c.*) The disagreeable smell from heated oil or glycerin.

3rd. Calcium chloride baths, heated by closed steam pipes and containing holes for the insertion of beakers or thin porcelain dye-vessels. These are used in the dyehouses of various colour manufacturers where boiling is necessary, a water bath heated by an open steam pipe being used for low temperature dyeing.

4th. Meister, Lucius, and Bruning's arrangement.

It consists of large copper pipes with enamelled dye-vessels clamped down in holes at the top of each pipe. The pipes are heated by low pressure steam and have a tipping arrangement so that the pots can be emptied without removal from the bath. Over the dye-vessels are small revolving porcelain reels, which are readily bent upwards and out of the way. These reels are very useful in hank dyeing, &c. I understand that they still use this arrangement and have thin porcelain vessels instead of enamelled copper ones, as the enamel chips off and they become corroded.

5th. Dawson and Broadbent's arrangement.

It consists of a long fixed steam-pipe with high pressure steam. On the upper side of the pipe are fixed a number of iron cups, forming part of it. Glycerin or oil is put into the cups and the earthenware dye-vessels are then heated in the cups. Another form is a square tank arrangement on similar principle. By this method the water in the dye-vessels can be boiled.

6th. Professor Hummel's arrangement, combining the advantages of the two last mentioned, viz., tipping arrangement, and sufficiently high temperture. The dye pots are arranged in rows of three in two iron castings, in each of which are three cups containing glycerin. The pots are clamped down in the glycerin and the joints made by india-rubber washers. The heat is supplied by high-pressure steam, 60 lb. pressure to the square inch being found to be sufficient. The dyepots can be tilted over in their castings and thus emptied without removing the pots from the glycerin. This arrangement is used at the Yorkshire College.

7th. Whiteley's arrangement, full details of which are given in the Journal of the Society for June 1891. It consists of two parts.

(*a.*) The outer vessel, made of copper and measuring 21¼ in. × 15½ in. × 6 in. It is provided with an internally projecting rim on the inside, so that if the temperature of the oil should rise to the boiling point, it will be thrown towards the centre.

(*b.*) Part 2 is tray-shaped and has six copper cups containing glycerin fixed into it to receive the dyepots. At either end projects a handle by which certain flaps are moved which stir up the oil in the bath.

8th. Dyeing experiments are also performed in specially made porcelain bowls supported on a tripod stand and heated by a Bunsen. Exact comparative results cannot be obtained by this method.

9th. Sand-baths are also sometimes used, with beakers as dye vessels.

In fitting up the dyehouse at the Rochdale Technical School I had to adopt some method of heating by gas, there being no provision made for steam heating. Knowing the defects of the rectangular baths I decided to try a circular one heated by a circular burner. Instead of a flat bottom like the old baths I concluded that to obtain perfect circulation this must also be somewhat rounded, but the difficulty of too much liquid stood in the way. The cone in the centre obviated this difficulty, as well as improved the circulation of the liquid. From this developed the idea of a revolving lid containing the dyepots, which is the chief feature of the bath before you. It consists of—

(*a.*) A circular support or outer casing on which the bath proper is placed, and provided with a number of holes at the bottom for the entrance of air and for lighting. These holes are placed much below the tops of the Bunsens in order to prevent any oil from reaching the flame.

(*b.*) A circular pipe in which are inserted six Fletcher's safety burners which can be turned down quite low without lighting back. These burners are arranged at equal distances from each other and are placed as nearly as possible under the centre of each dyepot. They are also raised some 6 inches from the surface of the table, so that if owing to any accident the oil comes over, it cannot reach the flame.

(*c.*) The dye-bath proper. This is in circular form with flange and inner cone. The flange is for support and also prevents the oil from getting near the flame. The edge of the flange is turned up to prevent waste. The cone is an improvement in several ways. (1.) It improves circulation. (2.) The vessels hold less liquid and therefore require less gas. (3.) It takes away the products of combustion which can be conducted into a flue.

(*d.*) The lid which contains holes for the six dyepots, thermometer and the cone. It rests on the flange of the bath and is made to revolve round the cone. The dyepots are at equal distances from each other and from the sides of the bath. From the construction of the bath and from the fact that the dyepots are all under the same conditions it will be seen that there is little likelihood of irregular heating. However, by the simple arrangement of the lid and dyepots being made to revolve and thus continually mix up the liquid, irregular heating is impossible. I ought to state here that I started with the idea of using oil in the bath, hence the special precautions taken to prevent fire. However, owing to the disagreeable smell which is given off from oil and also from glycerin I decided to give $CaCl_2$ a trial. Ten of these baths have been placed in the dye-house at the above school and are working very satisfactorily. So far as I can see at present it is quite unnecessary to use either oil or glycerin.

The following figures show the temperature of the water in each pot during the process of heating. The calcium chloride was just melted, then the pots, each containing a litre of water, were inserted.

SIX DYE-POTS WERE USED.

—	Experiment I.	Experiment II.	Experiment III.
Temperature of H_2O on introducing into $CaCl_2$	9° C. all	11° C. all	10° C. all
After 5 minutes	21° all	22° all	22° all
„ 10 „	32·5° all	36° all	33° all
„ 15 „	50·0° all	53° all	49° all
„ 20 „	63·5° all	65° all	63·5° 3 64·0° 3
„ 25 „	79·5° 3 80·0° 2 80·5° 1	79° 5 80° 1	79·5° 5 80·5° 1
„ 30 „	93° 3 94° 3	90° 5 91° 1	93° 1 92½° 5
„ 33 „	Boiling All boiled within 25 secs.	Boiled in 34 min. All boiled within 45 secs.	Boiled in 34 min. All boiled within 40 secs.

In experiment I., I mordanted the samples of woollen cloth each with 3 per cent. of bichromate of potash, boiling them one hour and washing. In experiment II., I dyed the samples with 8 per cent. of logwood extract and on examination by a good light they will be found to be alike.

I am not in a position to give data as to the amount of gas consumed when $CaCl_2$ is used, but with oil 23 feet of gas was registered on a 3 light metre in heating a litre of water in each pot to the boiling point, the oil being cold to commence with.

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Members who desire to read Papers, exhibit Apparatus, &c., or introduce Discussions during Session 1893—94 are requested to give early notice to the Hon Local Secretary in order that the programme may be arranged.

SESSION 1893-94.

Glasgow:—
  January 9th.—Discussion on Patent Law.
  March 6th:—
    Mr. James F. Tocher.—"Oil Gas."
    Prof. E. J. Mills and Mr. W. Macfarlane.—"On the Oxidation of Aniline."
  May 1st.—Prof. E. J. Mills and Mr. Sawcis.—"On the Action of Alums on Gelatin.

Edinburgh:—
  December 5th:—
    Mr. John Laing.—"Manufacture of Oil Gas."
    Mr. W. I. Macadam.—"Inflammability of Coal-dust."
    Dr. J. B. Readman.—"Atmospheric Moisture in Paper Pulp."
  February 6th.—Vacant.
  April 3rd.—Vacant.

Meeting held in the Philosophical Society's Rooms, 207, Bath Street, Glasgow, on Tuesday, November 7th, 1893.

CHAIRMAN'S ADDRESS.

BY C. A. FAWSETT.

It may be of interest to trace the advance which has taken place in industrial chemistry, to compare our position in that department with other nations, and to consider the means of improvement in the future.

Statistics prove an advance in certain directions, as following table showing the imports and exports for 1880 and 1890 shows, but it has been in those processes which are in the domain of inorganic chemistry, and more in the construction of the apparatus and labour-saving appliances than in the processes involved.

VALUE CHEMICAL PRODUCTS IMPORTED.

—	London.	Liverpool.	Hull.	Newcastle.	Glasgow.	United Kingdom.
	£	£	£	£	£	£
1880	503,755	224,645	66,266	5,418	86,954	1,139,335
1890	555,245	432,581	87,622	2,340	45,909	1,441,909
..	9 % Increase	92 % Increase	32 % Increase	56 % Decrease	47 % Decrease	26 % Increase

VALUE CHEMICAL PRODUCTS EXPORTED.

—	London.	Liverpool.	Hull.	Newcastle.	Glasgow.	United Kingdom.
	£	£	£	£	£	£
1880	837,770	518,172	270,517	48,762	240,078	2,384,021
1890	720,828	1,351,134	319,483	57,599	240,623	3,237,426
..	14 % Decrease	160 % Increase	18 % Increase	18 % Increase	0·23 % Increase	36 % Increase

In organic industrial chemistry there has also been advancement, and that in quite new processes, but when looked at in money value, it is insignificant compared with that of our more commonly occurring chemicals.

At the time of the 1851 Exhibition specimens of some of our chemical products were shown in a state of great perfection—quite as much so as it would be possible to produce them at present; and any improvement which has followed has been in the cheaper production. For instance, splendid specimens of bichromate, prussiate of potash, alum, stannate of soda, and iodine were shown; whilst as new manufactures, paraffin oil, bisulphide of carbon, and red amorphous phosphorus were prominent.

At this time in the sulphuric acid manufacture we find little or no pyrites vitriol, no Gay-Lusac or Glover tower; but before the 1862 Exhibition these two aids to the vitriol-maker were introduced, along with the platinum concentrating apparatus, which, however, did not take a firm hold in this country at that time. In recent years we have had the gold-plated platinum still; but the improvements have been mainly in the arrangement and construction of apparatus.

As regards the alkali trade; in 1851 it was an established industry of much importance, chiefly owing to the exertions of Charles Tennant, of St. Rollox, so much so that soda crystals all over the country were known as "Scotch soda." But all hand furnaces were used, the revolver which performed the work of 20 hand furnaces in one-sixth the space being invented shortly before the 1862 Exhibition. The mechanical sulphate and carbonating furnaces followed soon after, and in more recent years the Chance process. All these improvements are due more to the chemical engineer than the chemist, with the exception of the Chance process, which does credit to both.

It is a fact worth noting, that although the Leblanc process has now been in existence for over 100 years, it still holds the field in the matter of alkali production.

As regards the manufacture of bleaching powder; in 1851 we find the industry established on a firm basis, but with no process for the recovery of manganese, which was however soon after accomplished, as far as St. Rollox was concerned, by Dunlop, and this process is still worked in preference to others at these works. It was only in 1870 that the Weldon process was adopted, and since then almost universally.

The bleaching of wool and silk, however, was not so easily accomplished, and it is only within a comparatively recent period that it has been satisfactorily performed. I have often found it stated that if peroxide of hydrogen could be produced cheaply, it would be the "beau ideal" of a bleaching agent: for some time past this has been the case, but the prophecy has not been fulfilled. It is no doubt very valuable and much used for bleaching "Tussah" silk and wool, but for ordinary cotton goods, where rapidity and cheapness are two essentials, it cannot compete with the ordinary bleaching powder.

In the report of the 1851 Exhibition there is no mention of the ammonia soda process, and although it is mentioned in that of 1862, it was not established as an industry until after 1870; since then it has increased enormously, and the credit is very much due to our former president, Mr. Mond. I give in the following table the amount of alkali produced by the Leblanc and ammonia processes for the last eight years, and the ratio of the one to the other.

—	1885.	1886.	1887.	1888.
Leblanc	598,096	584,323	577,381	590,312
Ammonia	115,032	137,220	158,636	212,181
Ratio	5·2 to 1	4·2 to 1	3·6 to 1	2·8 to 1

—	1889.	1890.	1891.	1892.
Leblanc.........	584,203	602,769	567,863	519,593
Ammonia	219,279	252,269	278,528	304,897
Ratio	2·6 to 1	2·4 to 1	2 to 1	1·7 to 1

So in eight years the ammonia process has had an increased production of from 115,032 tons to 304,897 tons, whilst the quantity made by the Leblanc process has slightly decreased.

The triumphs in this process, however, belong more to the department of chemical engineering.

In 1851 the exhibits representing organic chemistry were few, and mostly classed as drugs; no aniline dyes or artificial alizarin or the large number of pharmaceutical preparations which now serve such a useful purpose; but in the exhibition of 1862 the aniline colours were the principal attraction, and I will read you the words of the reporter, as they show what great things were expected of us as a nation:—"There is fair reason to believe that before another decennial exhibition arrives England will have learned to depend for the materials of the colours she so largely employs mainly, if not wholly, on her fossil stores. Instead of disbursing her millions for costly dye materials, England will beyond question at no distant date become herself the greatest colour-producing country in the world."

Has this prophecy of Dr. Hofmann become a truth?

In 1862 there was no mention of alizarin, a colour which has quite supplanted several of the dye-stuffs which were used formerly.

In 1869 madder was imported to the value of 1,000,000*l.*; now the amount is practically nil, and the artificial colour has produced finer and faster shades, and also been the means of ridding our rivers of much pollution, owing to at least two-thirds of the madder roots getting into their waters.

In 1879 the output of alizarin in Germany alone was about 12,000 tons, equal in tinctorial power to 120,000 tons of madder roots. The introduction of this colour has also cheapened very much all materials in which it is used. I will render this clearer. Madder roots containing 1 per cent. of colour cost 5*d.* per lb., while 20 per cent. alizarin paste costs 10*d.* per lb.; so 1 per cent. of colour in madder costs 5*d.*, in alizarin paste ½*d.*, or only one-tenth the price.

An industry closely allied to the West of Scotland, and which has made enormous strides, is that of the distillation of shale. Liebig once said, "It would certainly be esteemed one of the greatest discoveries of the age if anyone could succeed in condensing coal-gas into a white, dry, solid odourless substance, portable, and capable of being placed upon a candlestick or burnt in a lamp." Now this problem was solved by James Young. The following table shows the increase:—

—	1871. End Second Period.	1879. End Third Period.	1887. End Fourth Period.	1893. During Fifth Period.
Number of works employed....................	51	18	13	10
Shale distilled..................................	800,000 tons.	850,000 tons.	1,869,000 tons.	1,604,846 tons.
Crude oil produced	25,000,000 galls.	29,000,000 galls.	52,876,700 galls.	44,935,674 galls.
Naphtha and burning oil	11,250,000 tons.	11,400,000 „	21,680,000 „	18,310,000 „
Paraffin scale....................................	5,800 „	9,200 tons.	22,846 tons.	17,653 tons.
Sulphate ammonia.............................	2,350 „	4,750 „	18,483 „	21,493 „

One of the most surprising details of the above table is the sulphate of ammonia produced. For although the amount of shale distilled in 1893 as compared with 1871 has only been doubled, the amount of sulphate has increased nearly 10 times, showing that shales richer in ammonia have been used.

A new industry has originated in the West of Scotland, namely, the recovery of the ammonia and tar from the waste gases of the blast furnaces. It has already assumed large proportions, and is likely to increase. From the alkali inspector's report I extract the following numbers relating to the amount of sulphate of ammonia produced from the different sources :—

——	1886.	1887.	1888.	1889.	1890.	1891.	1892.
Gas-works	82,480	85,022	92,896	100,711	102,138	107,950	110,748
Iron-works	3,950	5,098	5,280	6,145	5,034	6,290	11,000
Shale-works	18,080	21,098	22,092	23,953	24,730	26,600	23,105
Coke-works	2,100	2,678	2,537	2,795	2,325	2,766	4,973

This shows that the yield of sulphate from the blast-furnaces has been trebled during the last six years.

Besides the sulphate there is the oil and pitch which form a valuable adjunct to the profit of the recovery plant.

Analogous to the recovery of the bye-products from the blast furnaces is that from the coke ovens—with this exception, that in the latter benzol is found. This is being vigorously worked in Germany, and it seems as if the Germans were not only going to supply us with colours, but produce their own raw material. No doubt colours will become so much cheaper in the future that it will be possible to replace indigo and logwood by those artificially produced.

We hear also of the recovery of the cyanogen from coal-gas in the form of ferrocyanide. At one gas-works alone it is being produced in a fair quantity and is found to be of good quality. Anything which will cheapen the production of cyanides will mean a much larger demand for the extraction of gold.

In all the processes for the recovery of these bye-products, the chemical engineer deserves the credit. It had long been known that this waste was going on, but until a suitable apparatus was designed the chemist was powerless.

It may not be known to some of you that artificial rubber has been produced; at first sight it would appear to be a difficult problem, owing to the structure of the native article; but it has been found by Bouchardat and Tilden that the most volatile portion of the distillate from oil of turpentine contains "isoprene," which, in contact with acids, gives an elastic compound, which has analogous chemical and physical properties to rubber. It seems to consist of two substances, one more soluble in bisulphide of carbon than the other, and it vulcanises with sulphur in a similar manner to the native product. Tilden also noticed that the distillate from turpentine containing isoprene was by spontaneous polymerisation converted into artificial rubber. If the production of this article could be introduced so as to compete with the natural product it would come as a great blessing, as the price of rubber, and consequently the quality of the goods produced, is only kept down by the use of inferior and very often injurious substitutes. Professor Tilden informs me that so far he has not been able to get it into a form which can be worked commercially.

We constantly hear of the keenness of foreign competition, and it is a natural state of matters. It was shortly before the Franco-German war that Germany was beginning to make herself felt, but on the outbreak of hostilities we were again left without rival. On the termination of the war it was no wonder that a country so much poorer than our own, and with such a splendid system of education, should seek for an outlet for her talent, and gradually there has been built up a large industrial community; and, as water always flows from a high to a low level, so knowledge from a higher level is flowing to us in the form of German manufactures. We are very much to blame, however, in not being in a position to supply our own wants; for instance, the aniline dye and alizarin manufacture were first started in this country, and for several years we imported little or no alizarin, thanks to Dr. Perkin, but there seemed to be no one able to extend the industry and it left us; now we import nine-tenths of the colours we use. We must meet this competition with the same weapons which have been forged against us, *i.e.*, intelligence promoted by a better system of education, whereby our young men may, if desired, obtain a scientific knowledge to fit them for any position in our industries.

Until recently it was impossible to gain a science degree without a knowledge of Latin and Greek, and even yet it is impossible to do so in some of our universities without the former subject. If we wish to train our youths in science we should be able to do so without their spending time in learning the dead literature of the past. To evolve new chemical processes, and the requisite machinery requires knowledge of a special kind, and if we are to attain to a healthy industrial life we must be able to supply the proper food.

There is no doubt a general advance in the teaching of science in the board schools, where both theoretical and practical chemistry are taught. I incline however to the belief that the teaching should be confined to the former, as it is scarcely possible to give the latter in a manner sufficiently thorough without infringing the rights of our technical schools and universities. A youth who is taught practical chemistry at a board school will, if he intends to come out as a chemist, require to commence again at the beginning when he enters a higher grade institution. If any practical work is done it should, I think, be in the direction of manual exercises, as learning to construct apparatus, glass-blowing, and making chemical preparations.

Again, inorganic chemistry is almost exclusively taught in these schools; why not organic also? The majority of things we come in contact with in every-day life belong to organic, yet pupils and teachers shrink from it. It might a few years ago have been urged that the literature of this branch was scanty, but now the same argument would better apply to inorganic. If in board schools a really good groundwork in inorganic and organic chemistry and chemical physics were given, the practical side would be better left to our technical schools and universities.

But it is not in our board schools alone that the teaching of organic chemistry is neglected, it has not been brought sufficiently forward in our universities and technical schools. The difference between our system of education for chemists and that of Germany differs in that we stop at the point where a German student is taught to call upon and train his thinking powers and cultivate his individuality by a two years' course of original work. This is of great value, and is sufficient to lift him above his British competitor, as is evidenced by our very unenviable position in all industries connected with organic chemistry.

Professor Perkin of Owens College advocates, in a paper recently read, that a two years' course of original work should be a necessity for the B.Sc. and D.Sc. degree. This would certainly be a step in the right direction, and would ensure of the recipients of the degrees being able to perform laboratory work which specially fits them for works, and of which at present they are often quite ignorant.

The West of Scotland is an important centre of chemical industry. Besides the more prominent manufactures of alkali, bleaching powder, sulphuric acid, bichromates, prussiates, explosives, shale and coal-tar products, manures, seaweed products, borax, and wood distillation, there are several smaller industries; but one notes with disappointment the almost entire absence of the manufacture of organic products, by this I mean aniline colours, alizarin or those pharmaceutical preparations which are so much imported. This is specially to be regretted, as there is here so much of the raw material produced and so much of the finished articles consumed. It is to be hoped that some means may be found and adopted to remove the disgrace which at present hangs over our heads.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

PATENTS.

A Method and Apparatus for Drying Colour Paste and other Strongly Aqueous Materials. E. Passburg, Moscow, Russia. Eng. Pat. 6326, April 12, 1884.

The invention has reference to a method and apparatus for drying colour paste and other strongly aqueous and semi-liquid bodies or materials *in vacuó* by introducing into the vacuum apparatus a heat reservoir containing stored heat more than sufficient for the total evaporation of the water contained in the bodies. The semi-liquid material is spread on trays or pans, which are alternated with trays of strongly heated sand or other convenient material, the whole being fitted in a carriage, which is then wheeled into a cylindrical steam-jacketed vacuum apparatus. The air pump is now put into action and evaporation commences The material keeps below a temperature of about 50° C., and by the time it is dried the sand trays have lost most of their heat; the material is then removed and a fresh quantity inserted in the cylinder. An oven for heating the sand trays, provided with rails for the carriage supporting the heat reservoirs, is described and illustrated.—E. G. C.

Improvements in Machines or Apparatus for Grinding or Reducing Phosphates, Bones, or other Substances. J. U. Askham, Sheffield. Eng. Pat. 15,924, September 5, 1892.

Figures 1 and 2 show one form of the machine in sectional end and side elevation respectively. A number of cutter arms C, provided with cutters E^1, revolve within a casing A^1, the latter having a number of teeth E carried upon an internal ring B. The material to be treated is fed in through the opening *a*, and is broken up by the beater arms C, being also thrown against the periphery of the ring B by centrifugal action. The cutters E, E^1, then come into action, reducing the material by a grinding, cutting, shearing, or shredding process until the required fineness is obtained. The material escapes by means of the side outlets *b*, b_2, furnished with grids or screens *c*, of a mesh suited to the fineness of the material required. The driving shaft is carried on suitable pedestal bearings H, and driven by means of the pulley K. Modified forms of cutters are shown and described.—E. G. C.

Fig. 1.

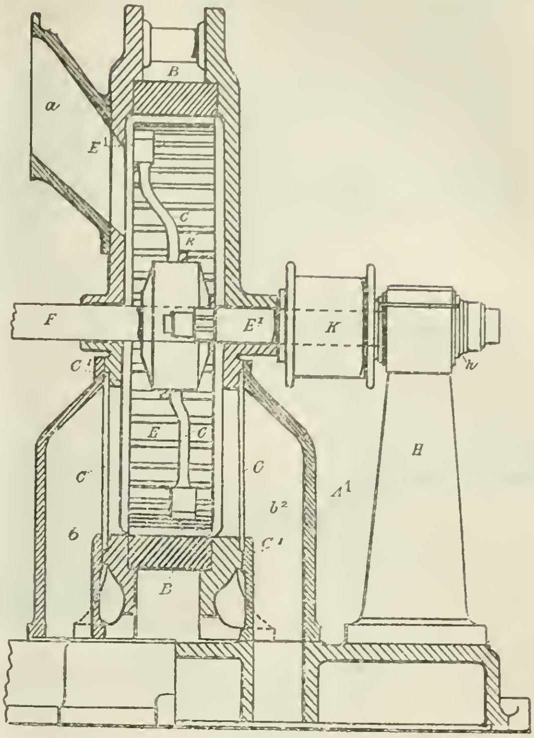
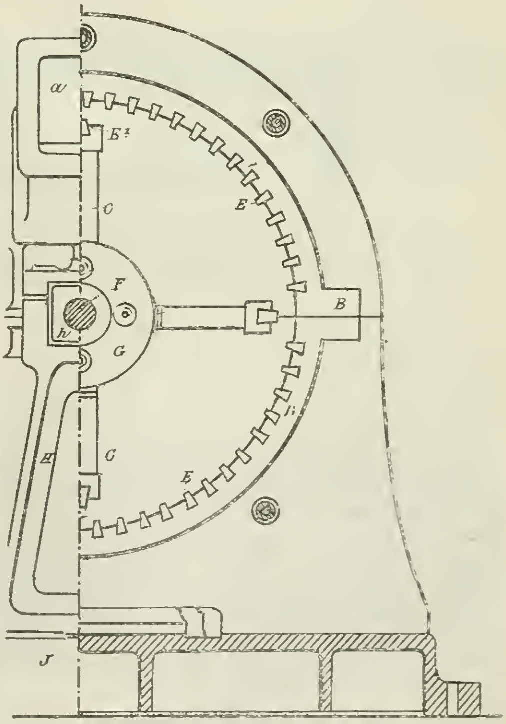


Fig. 2.



Centrifugal Grinding Machine.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

An Appliance for making Infusions or Extracts of Vegetable or other Matters. F. T. Bond, Gloucester. Eng. Pat. 18,325, October 13, 1892.

The material to be infused is placed in a tube provided with a perforated bottom and closed at its upper end by a stopper. The tube is then immersed in the liquid to be used for making the infusion. By furnishing the upper end of the tube with a piston or an elastic capsule, the infusing liquid can be drawn backwards and forwards through the material contained in the tube to promote the infusing process.—E. G. C.

Filtering Machinery. J. M. Smales, Leavesden. Eng. Pat. 20,027, November 7, 1892.

The object of the inventor is to produce a number of portable filtering units immersed in the water to be filtered, and arranged for easy removal for the purpose of cleaning and subsequent re-insertion in regular succession.

The illustrations will give a general idea of the arrangement. The filtering body is composed of the filtering substance A, surrounding a perforated pipe F, resting with its ends on rollers or wheels C, which run on rails E placed along the bottom of the filtering tank. The ends of the tank are sloping and the rails are laid up the inclines and along the upper floor level. Outside the tank and along its full length is placed a trough H containing the filtered water M at a lower level than the unfiltered water L within the tank, into which dip the long arms of siphon pipes G, the shorter arms of which are joined each to one of the perforated pipes F. The action of the siphon can be started by aspirating through the taps I, and it will then continue to deliver the filtered water into the trough H until the action is interrupted by the filtering body being pulled or pushed up the incline at one end of the tank. At the same time newly prepared units are brought down the incline at the other end of the tank, whereby the continuous working of the apparatus is secured.—B.

Fig. 1.

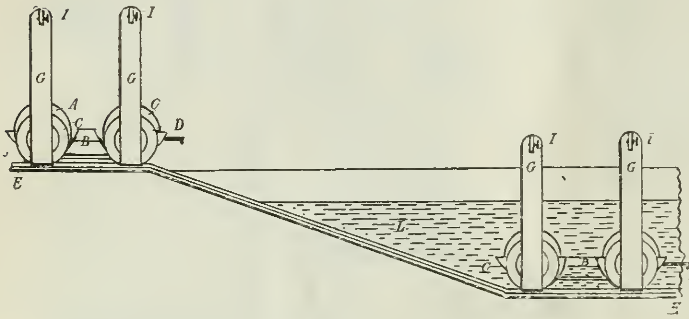


Fig. 2.

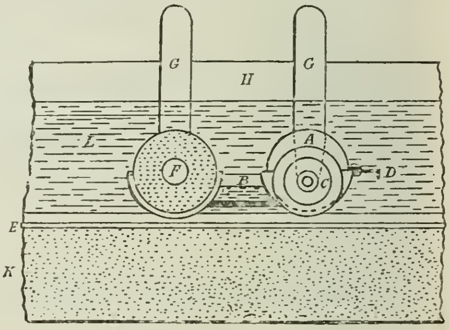
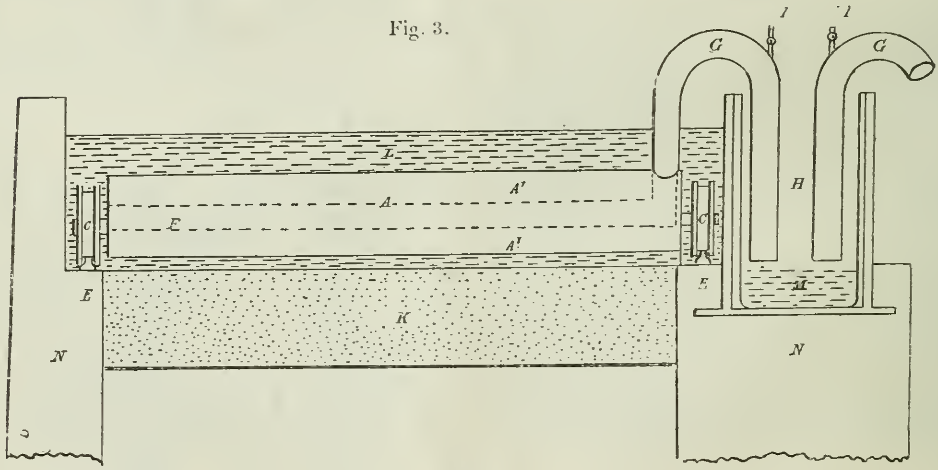


Fig. 3.



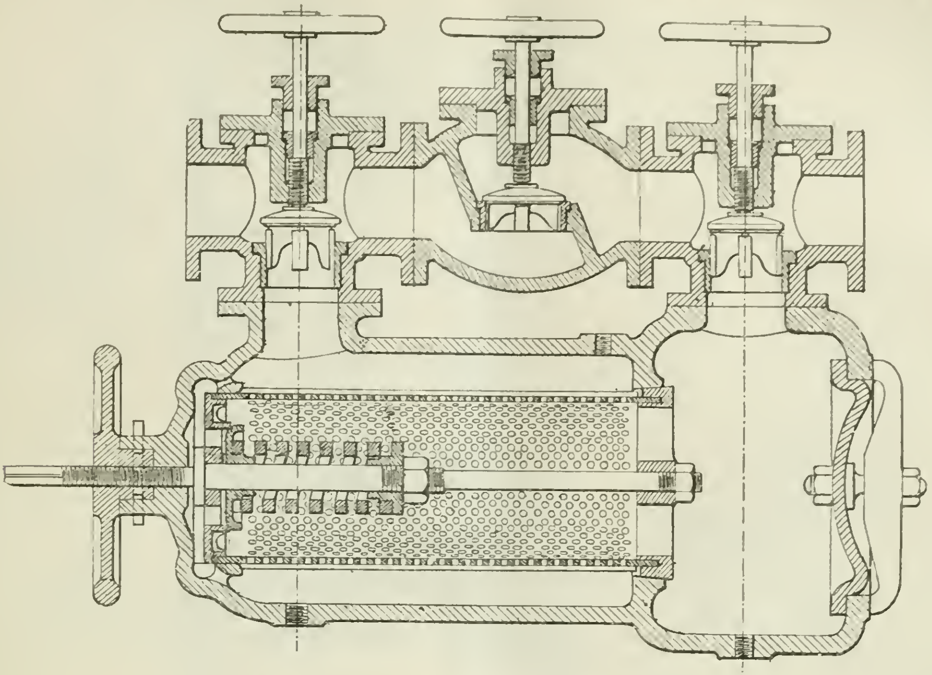
Filtering Machinery.

Improvements in or relating to Apparatus for Filtering Sewage Sludge and other Substances. J. B. Alliott and J. M. C. Paton, Nottingham. Eng. Pat. 20,118, November 8, 1892.

This invention relates to apparatus called filter-presses of the kind in which the head of the press is brought tightly against the plates by means of hydraulic pressure exerted through an accumulator. To prevent sludge from being lost on account of the head being released through any break in the hydraulic connection between it and the accumulator, the sludge supply valve is automatically closed by a stopping device fixed to the accumulator, which comes into action as the accumulator ram nears its lowest position. Or a double-piston sludge valve may be used, arranged for the pressure in the sludge pipes tending to close it, but kept open by the greater opposing pressure in the accumulator pipes. In the case of the latter pressure being removed by the bursting of a pipe or in any other way, the valve will immediately shut and cut off the supply of sludge.—B.

Improvements in Apparatus for Filtering Water, especially applicable for Filtering Feed-Water for Steam Generators. D. A. Rankine, Liverpool. Eng. Pat. 20,494, November 12, 1892.

This filter consists of a perforated metal cylinder, closed at one end and open at the other, covered with a sheet of filtering material and inserted in a casing in such a way as to allow the filtered water to percolate to the inside and to reach the outlet passage by the open end of the cylinder. On release of a man-hole cover the cylinder with the filtering material can be removed by unscrewing the central spindle, which also carries a safety-valve for preventing the collapse of the thin metal cylinder through over-pressure. A by-press valve between the inlet and outlet passages enables the filter to be put out of use without interrupting the supply of unfiltered water.



Apparatus for Filtering Feed Water.

The general construction is indicated in the accompanying drawing.—B.

Improvements in or connected with Evaporating or Concentrating Apparatus. F. W. Scott and F. W. Scott, jun., both of London, and E. G. Scott, Liverpool. Eng. Pat. 20,595, November 14, 1892.

The object of the present specification, is to claim in connection with Eng. Pat. 6478 of 1892 (this Journal, 1893, 347), the combination with the discharge valve as described and figured, *loc. cit.*, for effecting the continuous removal of the substances deposited in a vacuum evaporating or concentrating apparatus, means for exhausting the air from the recesses or troughs of the discharge valve, with the arrangement of mechanism therefor.—E. G. C.

Improvements in Funnels for Filtering Liquids. H. Krocker, Berlin, Germany. Eng. Pat. 15,058, August 5, 1893.

The filtering funnel is provided with a series of ribs upon it interior, so arranged as to form sinuous channels and thereby prevent the adhesion of the filtering paper to the funnel. At the junction of the truncated part with the cylindrical neck of the vessel, external ribs are formed, to allow air to enter the vessel receiving the funnel neck.
—E. G. C.

Improvements in Filters. H. Koch. Halle a/d Saale, Germany. Eng. Pat. 15,831, August 21, 1893.

The inventor prepares a filtering material by granulating quenched coke which has been thoroughly dried. He then melts down three parts of caustic alkali, or of a carbonate of an alkali, and stirs into it two parts of the powdered coke. After cooling, the mass is again powdered, the alkali washed out with hot water and diluted hydrochloric acid, and, after repeated washing until the reaction becomes neutral, is finally dried for use in the filter. The filter is composed of two or more concentric cylinders, the annular spaces between them being filled with the described powder. The unfiltered water is admitted first to the inner cylinder and passes in alternate directions through any number of the annular spaces formed, finally issuing in a purified state from the outer annulus.—B.

II.—FUEL, GAS, AND LIGHT.

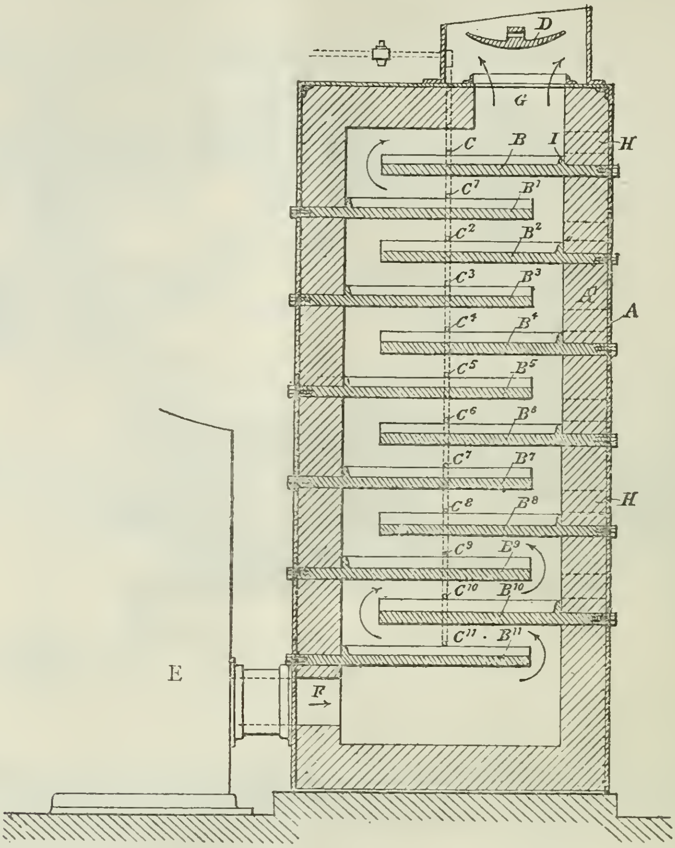
The so-called Auer Light. Polis. Chem. Zeit. 1893, 612.

The author has instituted a series of experiments with the Auer hoods, and confirms Auer's assertion that it is possible to impart to the Auer light any desired tint, from the purest white to the intense yellow of incandescent electric light, by the use of various oxides of the rare metals. He further finds that the life of the hoods lately brought into the market has increased considerably, and that the decrease of light amounts to only 12—15 per cent. after 500 hours' use. As to the heat developed by an Auer burner, it is said to constitute only one-fifth of that developed by a fish-tail burner. Finally, a set of experiments proved that the "Auer-mass," with which the hoods are impregnated, is non-volatile.—J. L.

PATENTS.

Improvements in and appertaining to Gas Producers. W. S. Sutherland, Birmingham. Eng. Pat. 21,028, November 19, 1892.

This apparatus is for supplying the steam required in making water-gas, and replaces the steam boiler usually used. It consists of a rectangular chamber lined with fire-brick, and fitted with a series of trays B F is a port connecting the apparatus with the regenerator of the plant E, and D is a discharge valve.



Improved Steam Generator for Gas Producer.

During the process of "blowing up," the hot gases leaving E pass along the zigzag passage formed by the shelves B, and out through D, by which the interior of the apparatus becomes highly heated. When the blowing up is finished D is closed and water fed on to the top tray, or on to all of them, through the inlet pipes C. The water spreads out over the trays, and, trickling down from one to another, becomes converted into steam, which passes out through the port F into the regenerator, where it becomes highly heated, and then into the producer.—R. B. P.

Improvements in Means for Increasing the Illuminating Power of Lamp Flames. G. Moss, Birmingham. Eng. Pat. 22,780, December 12, 1892.

The use of a specially-shaped piece of sheet metal fitting over the lamp flame, which is thereby increased in size and intensity, is claimed.—R. B. P.

Improved Process for Reducing Crude Peat into a Marketable Form. A. J. Boult, London. From A. A. Dickson, Cote St. Antoine, Canada. Eng. Pat. 10,612, May 30, 1893.

The peat as it comes from the bog has first all sticks and other obstacles removed from it and is then placed in the hopper A. From A it passes through the squeezing cylinders B, which express from it most of the water it contains. The two lower cylinders are hollow, the shells of them being of perforated wood or metal covered with a heavy coating of felt; C is a bridge-piece which serves to convey the peat after it has passed one of the lower cylinders, under the other. All three cylinders are geared together. N N are rollers which, by pressing against the felt coverings of B, expel most of the water they have absorbed. From the squeezing cylinders the partially dried peat goes to the "tempering chamber" D, or if dry enough it may be immediately pressed into fuel. D has preferably the form of a hollow cylinder and is rotated by suitable gearing. It is about 25 feet long, and has a number of ledges, E, on the inside, to assist the turning over of the material passing through it. It is slightly inclined so that the material fed in at the inlet travels along to the outlet by gravitation.

Passing along D is a perforated tube F, through which dry air, preferably heated, is forced by means of a fan. If found necessary the tempering process in D may be assisted by the application of heat externally. The comparatively dry, but still fibrous peat then goes to the drying chamber, Fig. 2.

This consists of a series of concentric truncated hollow cones I J arranged alternately, so that the peat fed into the smaller end of the central cone gradually travels to the larger end, where it falls through suitable openings into the next cone, and travelling backwards and forwards through successive cones, finally leaves the outer cone sufficiently dry for pressing into fuel blocks of suitable form by the press, shown to the right of the figure, the construction of which is also described. The drying chamber is heated in the manner illustrated.

Fig. 1.

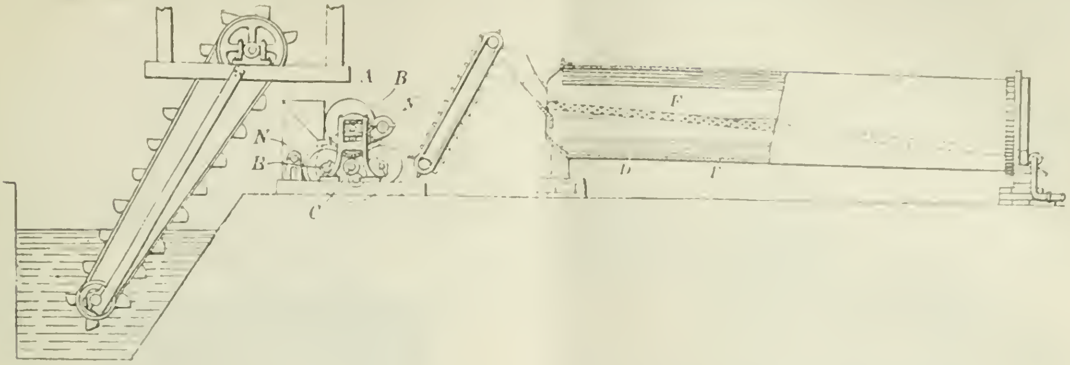
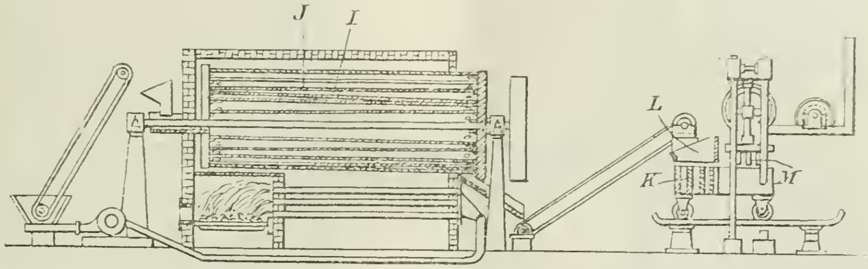


Fig. 2.



-R. B. P.

Improvements in Apparatus for the Manufacture of Gas. H. H. Lake, London. From A. C. Humphreys, Philadelphia, U.S.A. Eng. Pat. 13,482, July 11, 1893.

These improvements relate to the "Lowe" apparatus and methods of gas manufacture, and are described as consisting in making the use of soft, or bituminous coals and the heavy oils, of which "Lima" oil is a type, practicable, in place of the anthracite coal and light oils hitherto used.

According to the claims of the inventor, they consist essentially in economically generating high temperatures by reducing the waste heat to a minimum, and in treating the oils so that the solid residues from them are as small as possible, and their liability to impair the surfaces for superheating the steam greatly reduced, whereby a highly favourable degree of steam superheating, of carburetting, and of fixing duty is accomplished at each run of the apparatus. The carburettor is heated by diverting a portion of the products of combustion from the superheater and gas-fixing chambers, leaving the main portion to pass through them, as much higher temperatures should be used therein than are necessary in the carburettor. The heavy oils, before they are injected into the carburettor, are heated by the outgoing gas as it leaves the fixer. This causes a cooling of the gas and thereby reduces the cost of scrubbing and condensing. In order to obtain a desirable combustion of gaseous matter in the steam superheater and in the carburettor during the heating up, an air blast, heated by such products of combustion as leave the steam superheater and carburettor, is used. The plant for carrying out the process is described and illustrated with eleven figures.—R. B. P.

Improvements in Apparatus for the Manufacture of Gas. S. W. Van Syckel, Newark, New Jersey, U.S.A. Eng. Pat. 15,174, August 8, 1893.

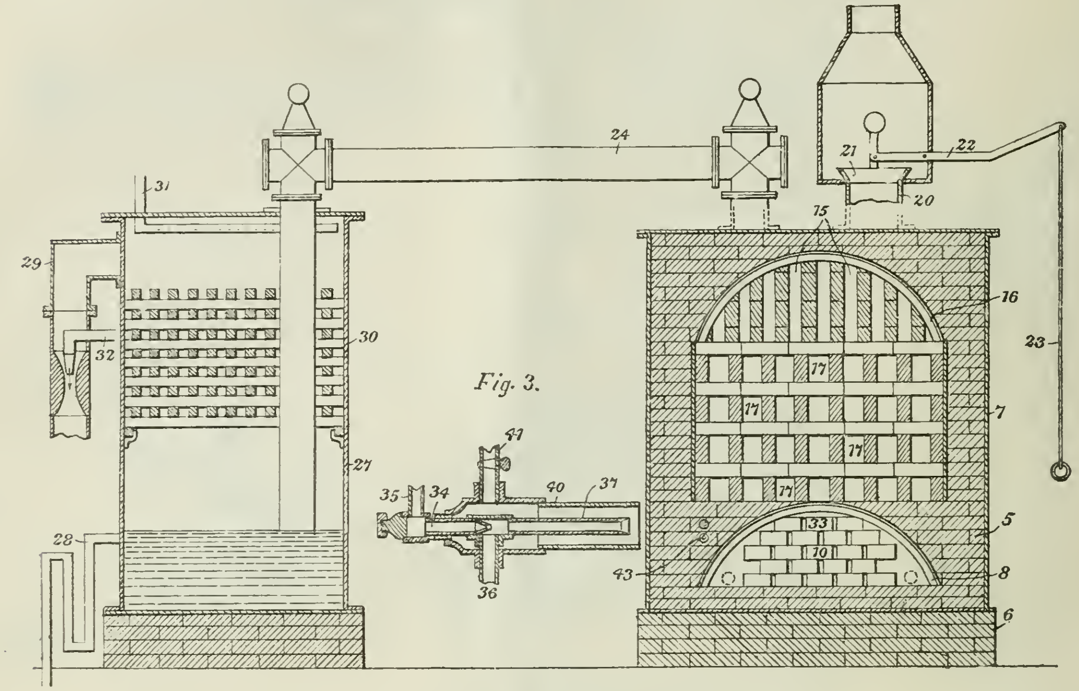
This invention relates more particularly to the manufacture of gas from oil and steam.

Fig. 1 shows a cross section through the apparatus, and its accessory scrubber and exhauster: Fig. 2, a longitudinal section through the generator; and Fig. 3, a section through the injector-burner.

The apparatus consists of three parts. First, the chamber at the bottom formed by the arch 8, and containing the checker-work 10, its front end being fitted with a door giving access to the interior. On each side of this door is an injector-burner 40. At the opposite end to the door the chamber is in connection with the second part of the apparatus, namely, the fixing chamber; this consists of four layers of multiple flues 17, alternately connected at opposite ends by the cross flues 11, 12, 13, and 14, thus forming a number of zigzag flues parallel to each other in a vertical plane. The third part consists of the superheater 15, also composed of a set of multiple flues connected at one end by the flue 14 and at the other by the flue 19. Out of the latter pass the chimney 20, which is fitted with a valve 21, and the gas exit 24, which is also fitted with a valve, and passes to the scrubber; 29 is an exhauster actuated by the steam jet 32.

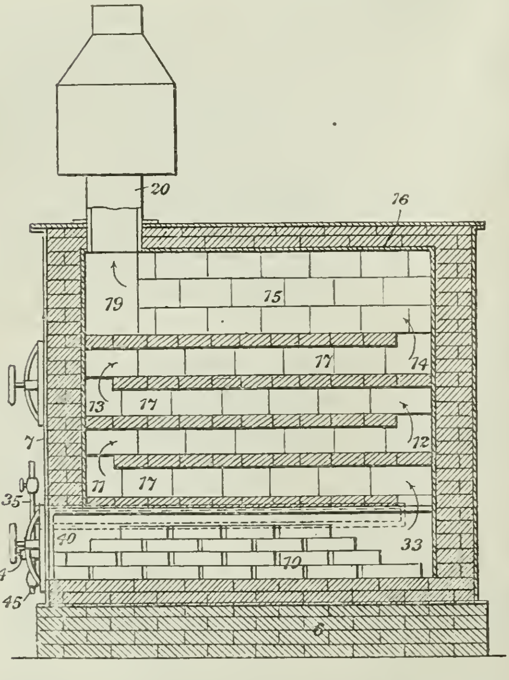
The working of the plant is as follows. The chimney valve being open and the valve in the gas exit shut, a small fire is lighted in the bottom chamber, the injector-burner started (the steam operating this on its way to the injector-burner is highly heated whilst passing through the pipe 43, built into the walls), and the jet of oil-spray and steam ignites, producing an intense heat. The air supply is regulated by opening more or less the door of the chamber. The checker-work 10 becomes highly heated, and the walls of the various flues take up the heat from the products of combustion as they pass up to the chimney 20. When a sufficiently high temperature has been reached, the injector-burner is shut off, the valve 21 and the door of the chamber shut, the valve in the gas exit pipe 24 opened, and the exhauster started. The injector-burner is then re-started, and the mixed jet of oil and steam from it, striking the highly heated checker-work 10, decomposes into gas, which, passing up through the flues 17 and 15, becomes fixed and combined into permanent gas, and then passes through the scrubber. The inventor principally claims "a gas generator, provided at its base with a combustion chamber having a filling of refractory material; a series of superposed sets of horizontal multiple flues communicating with the combustion chambers, the members of each set being arranged side by side, and opening at their ends into a cross-flue, in turn communicating with the proximate ends of the next succeeding set; a superheater composed of a set of multiple flues separated from each other by fire-brick walls of varying heights, surmounted by an arch, and oil and steam supply pipes entering the combustion chamber as described."—R. B. P.

Fig. 1.



Improved Apparatus for the Manufacture of Gas.

Fig. 2.



III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Adipic Ketone from Wood Oils. W. Hentzschel. Annalen, 275 (2 and 3), 318—322.

Claisen in 1875 (Ber. 8, 1258) obtained a ketone-like body, approximately of the composition of adipic ketone, from the latter oils, which pass over on rectifying crude wood spirit. This oily substance boiled at from 129°—131° C.

Pinner in 1882 (Ber. 15, 594) obtained confirmative evidence of the presence of this ketone. Both these investigators considered this body identical with that first prepared by Kane (Pogg. Ann. 44, 494) by the destructive distillation of acetates, and which appeared to boil at 120° C., and to possess the formula $C_{10}H_{16}O$. The same identity was considered to hold good as regards the substance also obtained by Heintz by the dry distillation of two parts of lead acetate with one of quicklime, and termed "*Dumasin*." To it was ascribed the formula $C_6H_{10}O$ (Pogg. Ann. 68, 277). Fittig in 1859 (Annalen, 110, 21) also isolated the so-called "*Dumasin*" from the portions of crude acetone which distil between 120° and 125° C., and he ascribed to it the formula $C_6H_{10}O$. The author has isolated the product, hitherto and in the hands of previous chemists, more or less impure. He found it actually to consist of the adipic ketone mixed with a small quantity of succinyl ketone.

The crude oils contained considerable quantities of pyridine.—W. S.

Newly-discovered Constituents of Wood Oil. E. Looft. Annalen, 275 (2 and 3), 366—382.

Kraemer and Grodzki (Ber. 7, 1492, and 9, 1921) discovered in the lower boiling fractions of wood oil, besides acetone, methyl acetate and the allyl alcohol discovered by Aronheim (Ber. 7, 1381), also ethyl aldehyde, dimethyl-acetal, methyl ethyl ketone, and acetone condensation products. The benzene homologues first isolated by Cahours (Annalen, 76, 286), according to the first-named investigators, are not originally present as such, but have arisen through the action of the concentrated sulphuric acid employed, upon as yet unknown constituents. As already shown (see preceding abstract), the fractions distilling above 100° C. contain adipic ketone or ketopentamethene.

A quantity of the higher boiling oils (*i.e.*, boiling above 100° C.), after separation from adipic ketone, effected by repeated treatment with sodium bisulphite and filtration from the crystalline bisulphite compound formed, was now taken and carefully fractionated nearly 100 times.

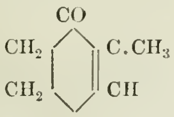
Fractions were obtained as follows :—

Fractions. Distilling Points.	Course of Fractionation.	Constituents Discovered.
100°—140° C.	Gradually diminishing quantity.	.. ..
114°—116° C.	Increasing quantity...	.. ..
116°—117° C.	Large fraction of very constant boiling point.	Contains chiefly pyridine, methylated pyridines, and probably an unsaturated alcohol.
117°—120° C.	Smaller fraction	.. ..
120°—129° C.	Increased fraction	.. ..
129°—131° C.	A principal fraction...	Chiefly consists of iso-amyl alcohol.
131°—140° C.	First decreasing, then again increasing.	.. ..
140°—141° C.	A principal fraction...	.. ..

Continued fractional distillation gave a small quantity between 145° C. and 152° C., the chief quantity coming over at 158° C., and containing a ketone-like substance, refusing, strange to say, to allow of any separation by means of the bisulphite reaction.

It was successfully isolated by treatment of the oil boiling at 158° C., solution in alcohol along with hydroxylamine hydrochloride, and then slow addition of concentrated sodium carbonate solution. The oxime then separates out. By treatment of the latter with 15 per cent. hydrochloric acid solution, it was decomposed and the ketone recovered.

It was found to be the α-methyl-β-ketopentamethenylene—



Continuing the results of the higher fractionation ; above 160° C. and up to 300°, very little passed over. At about 300° C. a considerable quantity distilled over, but was not further examined.

The sodium salt of the sulphonic acid of a still unknown and apparently complex body of ketone-like character, was prepared from the crude ketone from the fraction boiling between 160°—180° C. This is to be examined, and further researches to be made, when a larger quantity of raw material is obtained.—W. S.

The Coefficients of Expansion of the Higher Distillates and Residues of Petroleum. Holde. Mitth. Königl. Tech. Versuchs. 1893, 45—68.

The chief conclusions drawn from this voluminous paper and its lengthy tables are the following :—

The heavy viscous products of distillation or residues from crude petroleum of different origins, possessing a specific gravity of at least 0·908, do not show any marked difference in their expansions between + 20° C. and 78° C. Their coefficient of expansion varies from 0·00070 to 0·00072. Those oils holding solid paraffin suspended at temperatures below + 20° C. (as German oils) have a higher coefficient of expansion between 12° C. and 20° C., viz., 0·00075 to 0·00081, owing to the melting of the solid particles.

The heavy liquid products of distillation of specific gravities below 0·905 at + 15° C. possess a higher coefficient of expansion between 20° C. and 78° C., viz., 0·00072 to 0·00076. The American and Scotch oils belong to this class.

As to *the completely fluid lubricating oils*, their coefficients of expansion rise gradually in proportion to the increase of temperature.

The coefficients of expansion of the oils of various origin do not show, therefore, such differences as to point to different chemical composition.—J. L.

The Oil-Shale Industry in France and in Scotland. G. Chesneau. Annales des Mines, 3, 1893, 617 ; Proc. Inst. Civil Eng. 1893 [4], 53—57.

The author was commissioned by the Minister of Commerce to study, in France and abroad, the condition of the mineral oil industry ; and, in February 1892, he investigated the manufacture of shale-oil in France and in England, making special inquiry how it was that an industry, so precarious in his own country, had made considerable advance in England without the advantage of protective duties.

In this report of his investigations, the author deals first with the oil industry of Autun and of Buxières-les-Mines (in Allier), where the principal and only important deposits of bituminous shales in France occur, remarking in passing that, of 210,000 tons of shale produced in that country during the year 1890, the basins of Autun and Buxières contributed respectively 156,000 and 51,000 tons. After a brief geological account of these two deposits, the methods of distilling the shales and of rectifying the crude oils are described. The products of the distillation of 35·316 cubic feet (1 cubic metre) of crushed shale, weighing from 1 to 1¼ tons, are stated to be as follows :—

Crude oil, density 0·890 to 0·902	9·90 to 12·76 gallons.
Ammoniacal liquor.................	11·00 „ 13·20 „
Gas................................	847·584 cubic feet,

the Autun shales yielding less than those of Buxières.

The machinery and methods employed at the refining works at Plamores (Buxières) and of those of the Société Lyonnaise at Saint-Léger (Autun) are described in some detail, the author concluding this section with a consideration of the cost of production and the profits accruing. Assuming that the cost of 22 gallons (1 hectolitre) of crude oil is 8*s.*, that the cost of refining this quantity, together with general expenses, amounts to 2*s.* 5*d.*, and taking the mean selling prices of the different commercial oils as a basis of calculation, he finds that there is a net profit to the refiners of 2*s.* 8¼*d.* on the 22 gallons of crude oil, or, per gallon, about 1½*d.*; while, taking the lowest selling prices, the profit amounts to only ½*d.* per gallon of crude oil.

The author then passes on to the Scottish industry, which produces annually, in round numbers, 52,000,000 gallons of crude oil from 2,000,000 tons of shale. The deposits occur in the counties of Mid and West Lothian, and consist of beds of boghead—now nearly exhausted—and of bituminous shales, the latter occurring in four seams, of which, however, only one is usually exploited in each shaft. These bituminous shales are much richer in oil than those of Autun, yielding on an average 27 gallons of oil per ton, as against only 11 gallons obtained from the French shales. Further, the French crude oil contains only from 2 to 3 per cent. of paraffin, while that of Scotland yields 12 per cent.; besides which the distillation of Scottish shale furnishes a considerable quantity of ammonia, which, transformed into sulphate, constitutes two-thirds of the value of the commercial products of the shale.

Notwithstanding the richness of these shales, the competition of American petroleum and paraffin, not burdened with import duties, has nearly ruined the Scottish industry, which, after enjoying remarkable prosperity between 1875 and 1885, has since rapidly declined. It has only succeeded in its struggle with American produce by continual perfecting of its methods of treatment, notably with a view to increasing the output of sulphate of ammonia—a product which has practically saved the Scottish oil and paraffin industry from collapse.

The author shows, in a striking way, how the Scottish shale industry has suffered from American and Russian imports, by comparing to-day's selling prices with those of 20 years ago:—A gallon of lamp oil, which was then worth, on an average, 1*s*. 5*d*., now realises only 5¼*d*.; refined paraffin and crude paraffin, which was then worth 10*d*. and 5*d*. per lb. respectively, are now sold for as little as 5*d*. and 2¼*d*.; heavy oil and sulphate of ammonia, which were sold for 20*l*. per ton, are now worth 5*l*. and 10*l*. per ton respectively. All the prices have thus fallen one-half, and some as much as two-thirds. By incessant improvements the cost of production has been reduced to such a point that the gallon of oil which 20 years ago cost 12·63*d*. to produce now costs only 4·44*d*. This figure is, nevertheless, higher than the selling price; and it is only the increased production of paraffin and sulphate of ammonia that has allowed the Scottish industry to exist.

The author describes the methods of mining the Scottish shales and of distilling them for crude oil, noting, under the latter head, that the average produce amounts to 27 gallons of crude oil per ton of shale, while the cost of distillation (not including general expenses) averages 2*s*. 9*d*. per ton, which, added to the cost of the shale, namely, 5*s*. 6*d*., makes the cost of production of 27 gallons of crude oil 8*s*. 3*d*., or of one gallon, 3·66*d*. The methods of rectifying the crude oil, of separating the paraffin, and of producing sulphate of ammonia are then described, the author showing that the cost of the complete treatment of a ton of shale amounts to 12*s*. 7*d*., the average selling price of the products to 13*s*. 7¼*d*. per ton of shale, leaving a profit of 1*s*. 0¼*d*. per ton to the refiners.

Comparing the French and Scottish industries, the author shows that, in regard to mining methods, the comparison is entirely favourable to France, the cost of winning shale in Scotland being 5*s*. 6*d*. per ton, and in France only from 2*s*. 9½*d*. to 3*s*. 2½*d*. (according to its density) per ton, the latter being a very moderate cost, which can hardly be reduced. The author sees nothing in the Scottish rectification processes worthy of imitation by his countrymen, except in the matter of the employment of superheated steam, which is always advantageous in the fractional distillation of oils not very rich in illuminating properties. The method is also used in the Russian refineries of crude petroleum. It is quite another thing with the processes of shale distillation for crude oil, which are absolutely characteristic of the Scottish industry. In the Scottish method of treatment superheated steam is injected in large quantity into the mass of shale, which is gradually heated up from a low temperature at the introduction of the charge at the top of the retort to a white-red heat at the bottom of the fire-brick chamber, a temperature unattainable in the French retorts. Messrs. Chosson and Tournaire have already shown that the presence of water in shales, up to a certain point, favours the formation of oils; and, without wishing to make it appear that French shales would in Scottish distilleries give a yield comparable with that of English shales—which are far richer in bituminous matter—the author thinks that it is reasonable to conclude, from the experiments of these gentlemen, and from the results obtained in Scotland, that a progressive distillation finishing at a very high temperature would considerably increase the yield of the shales of Buxières and Autun. The author has himself endeavoured to determine the part played by steam by distilling Buxières shales in sandstone retorts of a litre capacity, first, without, and, secondly, with the injection of superheated steam, obtaining in the latter way 50 per cent. more crude oil than in the former, the density of the oil in the first case being 0·973 (at 14° C.), and, in the second, 0·955. Nothing more can be inferred from these experiments than the general effect of the introduction of steam; for the distillation of French shales in Scottish furnaces would alone indicate whether the increase of yield would justify the very costly alterations which the adoption of the system would involve, alterations which, if the residue could no longer be utilised, as at present, for heating the retorts, would necessitate the use of a special fuel in the gas generators, the consumption in which might, however, be reduced, as in Scotland, by utilising the combustible gases at present hardly anywhere made use of in the French shale industry. Other determining considerations would be the probable increase in the yield of ammonia, and the content of paraffin, which would allow of the extraction of those substances; also a certain improvement in the quality of the crude oil, which is less odorous when the distillation of the shale is effected in presence of steam.

The author, in conclusion, suggests that the French shale-oils, which are rather highly sulphuretted, might with advantage be freed from sulphur by the oxide of copper method used in America in the treatment of Lima oils.

PATENT.

An Improved Composition for Flooring or Covering Iron Bridges, Arches, Tanks, and other Structures. H. Lockwood, Manchester. Eng. Pat. 21,064, November 19, 1892.

THE invention consists in substituting burnt oxide of iron (obtained in the sulphuric acid manufacture from the "spent" oxide used in the purification of coal-gas) for the sand, lime, flue dust, &c. ordinarily mixed with crude tar oil for making asphalte floors to resist water. A good mixture is two parts by weight of the burnt oxide and three parts by weight of anthracene oil, sp. gr. 1·10.—V. C.

IV.—COLOURING MATTERS AND DYES.

Analysis of Aniline Oils. H. Reinhardt. Chem. Zeit. 1893, **17**, 413.

See under XXIII., *page* 954.

Analysis of Alkylanilines. W. Vaubel. Chem. Zeit. 1893, **17**, 465.

See under XXIII, *page* 954.

Hydroxyl Derivatives of Alizarin Blue. Graebe and R. Philips. Chem. Zeit. 1893, **17**, 2.

ALIZARIN blue is a dihydroxy derivative of a quinone which is obtained by oxidising anthraquinoline. On heating the blue with sulphuric acid, products containing more than two hydroxyl groups are obtained; of these, two—alizarin green and alizarin indigo—have been put on the market by the Badische Anilin und Soda Fabrik. The indigo consists principally of the pentahydroxy derivative, whilst the green colour is a mixture of the tri- and tetra-hydroxy derivatives of anthraquinolinequinone with their sulphonic acids. The authors have succeeded in separating these substances and have thus obtained them in a pure state. With the exception of the monohydroxy derivative, which is red, all the hydroxyanthraquinolinequinones are blue and their colour is the darker the more hydroxyl groups the molecule contains. They are all soluble in alkalis.—W. J. P.

PATENTS.

A Method and Apparatus for Drying Colour Paste and other Strongly Aqueous Materials. E. Passburg, Moscow, Russia. Eng. Pat. 6326, April 12, 1884.

See under I., *page* 913.

Improvements in the Manufacture of Blue Mordant-Dyeing Colouring Matters. J. Y. Johnson, London. From the "Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 13,029, July 15, 1892.

This is an extension of Eng. Pats. 19,588 and 19,589 of 1891 (this Journal, 1893, 257 and 258), which relate to the production of colouring matters by the action of fuming sulphuric acid and subsequently of strong sulphuric acid on dinitro-anthraquinones. The modifications described in the present specification are in the first place the production of partially reduced nitro-anthraquinones and the treatment of these with fuming sulphuric acid, and secondly, the employment of acids or other reagents in place of the strong sulphuric acid used in the second stage in the above-mentioned patents, in order to eliminate sulphonic acid groups. In order to obtain the partially reduced nitro-anthraquinones, one molecular proportion of the dinitro compound is treated with a quantity of a suitable reducing agent corresponding to from three to six atoms of hydrogen. The following dinitro-anthraquinones may be employed:—1·4′-dinitro-anthraquinone, the crude mixture obtained by strongly nitrating anthraquinone, or the various components of this mixture. The reducing agents used are stannous chloride in acid or alkaline solution, and ammonium or sodium sulphide. These partially reduced products are then subjected to the action of fuming sulphuric acid in place of the dinitro-anthraquinones themselves, as described in the earlier patents. The reduction may also take place in the sulphuric acid melt itself by adding suitable reducing agents, such as zinc, tin, iron, carbon, or sulphur. The following examples of the various methods are given. About 10 kilos. of 1·4′-dinitro-anthraquinone are mixed with an equal weight of crystallised sodium sulphide ($Na_2S + 7H_2O$) in 200 litres of water and the mixture is boiled for about two hours. When all the sodium sulphide has been oxidised the mixture is filtered and the residue washed and dried, and the partially reduced nitro-anthraquinone so obtained is subjected to the same treatment as in the principal patent for obtaining colouring matters from dinitro-anthraquinones. The method for reducing the compound in the sulphuric acid melt is as follows:—About 10 kilos. of 1·4′-dinitro-anthraquinone, 1·5 kilos. of sulphur, and 50 to 100 kilos. of fuming sulphuric acid containing from 12 to 40 per cent. of anhydride, are mixed and heated to 100° to 130° C. for several hours. The melt subsequently is heated with ordinary sulphuric acid, with or without the isolation of the soluble colouring matter, and the reduction products formed in the melt are immediately converted into colouring matters, which appear to be identical with those obtained according to the preceding patents, and the melt is worked up in the same way. Both the yield and quality of the colouring matter are said to be superior, and hence the cost of production is reduced by this process. With reference to the removal of the sulphonic acid group from the products obtained in the first stage described in the principal patents, which are soluble colouring matters, the method employed is to heat the substances with an acid under pressure, an example of which is given. About 10 kilos. of the substance are heated with 10 to 20 times the weight of concentrated hydrochloric acid, containing 32 per cent. of HCl, to about 200° C. After cooling, dilute with water, filter, and wash the colouring matter obtained. Other saponifying agents may be used, such as aqueous phosphoric acid (about 87 per cent. of H_3PO_4), water alone at a high temperature, or dilute sulphuric acid containing about 62 per cent. of H_2SO_4. When using the last-named reagent it is not necessary to heat under pressure.—T. A. L.

An Improved Method of and Apparatus for Oxidising Indigo Liquor. H. S. Elworthy, Stratford, Essex. Eng. Pat. 18,762, October 19, 1892.

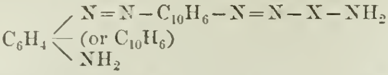
The apparatus consists of a drum terminating in a cone and attached to a vertical shaft which can be rotated at a high speed. The periphery of the drum is perforated, whilst the conical portion is closed with the exception of two holes, which are the apertures of two tubes arranged spirally, the other ends opening into the drum. When the apparatus is rotated in the indigo vat, which is so arranged that the level of the liquor comes up to about the top of the cone, the centrifugal force drives the liquor through the pipes into the drum, from which it escapes back again into the tank in the form of fine spray through the perforated sides. The same effect is produced by rotating spiral tubes partially immersed in the liquor and provided with a rose or other suitable jet at their upper ends. The object of the enclosing conical envelope described above is to reduce friction. The specification contains a drawing showing the apparatus in section and elevation.—T. A. L.

The Manufacture or Production of New Colouring Matters. H. E. Newton, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 19,557, October 31, 1892.

The colouring matters are nitroso derivatives of the azo-compounds obtained by combining equimolecular proportions of a diazotised amidocarboxylic acid and resorcinol. The following amidocarboxylic acids can be employed:— *o*-, *m*-, and *p*-amidobenzoic acids, *o*- and *p*-amidosalicylic acids, amidocresolcarboxylic acid, amido-*p*-hydroxy-benzoic acid, amido-phthalic acid, and amido-anisic acid. These substances are diazotised in the usual manner, and combined with resorcinol in an alkaline solution, and are then converted into their nitroso derivatives:—2·75 kilos. of the dyestuff obtained by the combination of equimolecular proportions of resorcinol and diazotised *p*-amido-salicylic acid are dissolved in water, together with 0·4 kilo. of caustic soda. A solution of 0·7 kilo. of sodium nitrite in 3·5 litres of water is then added, the mixture cooled to about 0° C., and acidulated with hydrochloric acid. After about 12 hours the sparingly soluble nitroso dyestuff is filtered off and washed. It forms a brown paste and produces reddish-brown shades on chrome-mordanted wool. The dyestuff acids are almost insoluble in water, whilst the alkaline salts form red to brownish solutions. Other methods for producing these nitroso-azo colouring matters may be employed, and the compounds produced are both azo- and nitroso-dyestuffs. They will dye mordanted or unmordanted wool, and mordanted cotton, and are specially valuable for printing, as they give fast and clear shades, which vary from yellowish-brown to brownish-red with chromium mordants, and olive to olive-brown with iron mordants. The dyestuffs are said to withstand light and fulling.—T. A. L.

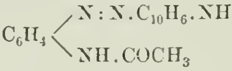
The Manufacture or Production of New Azo Colouring Matters. H. E. Newton, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 19,743, November 2, 1892.

This specification of 38 pages, comprising 15 claims, is an extension of Eng. Pat. 16,484 of 1887 (this Journal, 1888, 619), which described the preparation of direct dyeing cotton colouring matters by combining the diazo compounds of acetyl-*p*-phenylene diamine or of acetyl-naphthylene diamine with α-naphthylamine, diazotising the amido-azo compounds thus formed, and combining them with phenols and their sulphonic or carboxylic acids, saponifying the products thus obtained, and after diazotising them, combining them with amines, diamines, phenols, and their derivatives. In the present specification one of the series of colouring matters claimed is obtained by omitting the final step described above, and by substituting for the α-naphthylamine either one of its derivatives or a suitable amine which, after combination, will yield a true amido-azo compound capable of rediazotisation, such as *p*-xylidine, *o*- and *m*-amido-*p*-cresol ether, amidonaphthols, amidonaphthol ethers, amidonaphthol and amidonaphthol ether sulphonic acids, amidonaphthoxyacetic acids, and their sulphonic acids, and the β and δ α-naphthylamine sulphonic acids of Clève. These compounds, for brevity, are termed "middle components." The colouring matters produced dye unmordanted cotton bluish- to greenish-black shades, and have the general formula—



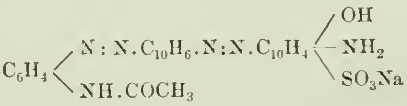
$$C_6H_4\left\langle\begin{array}{l} N=N-C_{10}H_6-N=N-X-NH_2 \\ (\text{or } C_{10}H_6) \\ NH_2 \end{array}\right.$$

In place of the acetyl derivatives of *p*-phenylene and naphthylene diamines, the corresponding nitro compounds may be employed. In this case the compounds require reduction by means of sodium sulphide in place of saponification. In compounds of the above general formula either one or both of the amido groups may be diazotised and combined either with the same or with different amines, phenols, amido-phenols, amido-phenol ethers, and their sulphonic and carboxylic acids. These compounds are briefly termed "last components." The following example illustrates the production of these colouring matters. A solution containing 1·5 kilos. of acetyl-*p*-phenylene diamine and 4·5 kilos. of hydrochloric acid (21° B.) in 20 litres of water is cooled and diazotised by adding a concentrated solution of 0·7 kilo. of sodium nitrite. This diazo solution is run into 1·43 kilos. of α-naphthylamine dissolved in water and hydrochloric acid, and sodium acetate is added to complete the reaction. The resulting compound has the formula—



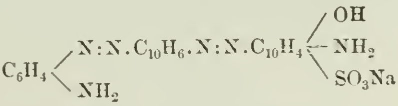
$$C_6H_4\left\langle\begin{array}{l} N:N.C_{10}H_6.NH_2 \\ NH.COCH_3 \end{array}\right.$$

The product is filtered off, washed, and mixed with 0·7 kilo. of sodium nitrite and 20 litres of water, and made acid with hydrochloric acid. In about 24 hours the solution of the diazo compound is run into an aqueous solution of 2·61 kilos. of amido-naphthol sodium sulphonate G, and kept alkaline with sodium carbonate. After the combination is complete the compound, which is represented by the following formula, is filtered off :—



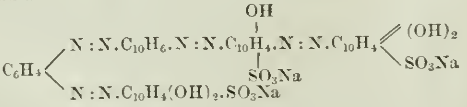
$$C_6H_4\left\langle\begin{array}{l} N:N.C_{10}H_6.N:N.C_{10}H_4\left\langle\begin{array}{l} OH \\ NH_2 \\ SO_3Na \end{array}\right. \\ NH.COCH_3 \end{array}\right.$$

In order to saponify it, it is boiled with 30 litres of water and 6 kilos. of soda lye of 35° B., and is then salted out, filter-pressed, and dried, and has the formula—



$$C_6H_4\left\langle\begin{array}{l} N:N.C_{10}H_6.N:N.C_{10}H_4\left\langle\begin{array}{l} OH \\ NH_2 \\ SO_3Na \end{array}\right. \\ NH_2 \end{array}\right.$$

This colouring matter dyes greenish-black shades on unmordanted cotton from an alkaline bath. It can be further diazotised and combined as follows :—5·34 kilos. of the dyestuff are mixed with 1·4 kilos. of sodium nitrite and 50 litres of water, made acid with hydrochloric acid, and after standing several hours the solution is poured into 5·24 kilos. of sodium 1·8-dihydroxynaphthalene α-sulphonate and 10 kilos. of sodium acetate dissolved in water. The temperature is then raised to 60° C., and after having been made alkaline, the dyestuff, which has the following formula—



$$C_6H_4\left\langle\begin{array}{l} N:N.C_{10}H_6.N:N.\underset{\displaystyle SO_3Na}{\overset{\displaystyle OH}{C_{10}H_4}}.N:N.C_{10}H_4\left\langle\begin{array}{l} (OH)_2 \\ SO_3Na \end{array}\right. \\ N:N.C_{10}H_4(OH)_2.SO_3Na \end{array}\right.$$

is salted out, filter-pressed, and dried, and gives greenish-black shades on unmordanted cotton. Other "last components" may be employed in place of the 1·8-dihydroxynaphthalene sulphonic acid, and the shades obtained from an alkaline soap-bath vary from a bluish-black to a pure black. Another series of dyestuffs is obtained by combining the diazo compounds of the acetyl-*p*-phenylene or naphthylene diamines, or of the *p*-nitraniline or 1·4-nitro-naphthylamine with one molecular proportion of a "middle component," then saponifying the acetyl or reducing the nitro group, rediazotising the diamido-azo compound so formed, and combining this tetrazo compound with two molecular proportions of the "last components," which may be either similar or different. If in place of one of these last components a middle component be substituted, the product so formed is capable of further diazotisation and combination with either a middle or last component, and if both last components be replaced by middle components a further series of colouring matters is produced.—T. A. L.

A New Manufacture of Red Colouring Matter. O. Imray, London. From the "Farbwerke vormals Meister, Lucius and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 19,820, November 3, 1892.

The direct nitration of rhodamine has not given good results, but a nitro derivative of a rhodamine has been obtained by heating together rhodamine base and *m*-dinitro-chloro-benzene in an alcoholic solution. If rhodamine hydrochloride be used the addition of an alkali is necessary. The substance is known as "nitro-rosamine," and is produced by boiling together 44 kilos. of rhodamine base (tetraethyl- or tetra-methyl-*m*-amido-phenolphthaleïn), 20 kilos. of dinitro-chloro-benzene, and 100 kilos. of alcohol of 95 per cent., in a copper vessel under a reflux condenser. The alcohol is distilled off and the residue dried at a low temperature. In order to purify it, it is repeatedly extracted with very dilute hydrochloric acid and precipitated with salt from the solution. It forms a red powder sparingly soluble in boiling water, easily soluble in alcohol and 50 per cent. acetic acid. It dyes wool a yellower and tannined cotton a bluer shade, and has a greater affinity for vegetable fibres, than rhodamine.—T. A. L.

Improvements in the Manufacture of Azo Colouring Matters. Brooke, Simpson and Spiller, Limited, and A. G. Green, Hackney Wick. Eng. Pat. 19,891, November 4, 1892.

These colouring matters, which dye wool a brilliant scarlet from an acid bath, and are remarkable for their extreme fastness to milling and scouring, are obtained by combining the tetrazo-compounds of either azoxy-aniline (melting point 145° C.), azoxy-*o*-toluidine (melting point 168° C.), azoxy-*o*-toluidine (melting point 148° C.), azoxy-*p*-toluidine (melting point 148° C.), azoxy-*m*-xylidine (melting point 143° C.), azo-aniline, azo-*o*-toluidine (melting point 203° C.), or azo-*p*-toluidine (melting point 159° C.), with one molecular proportion of α-naphthol-*p*-sulphonic acid and one molecular proportion of β-naphthol. The details are as follows :—A solution of 14 lb. of sodium nitrite in 20 galls. of water is gradually added to an iced solution of 25·5 lb. of azoxy-*o*-toluidine (melting point 168° C.) dissolved in 100 galls. of water and 4·5 galls. of hydrochloric acid of 31 per cent. HCl. This tetrazo solution is then added to a solution of 25 lb. of sodium α-naphthol-*p*-sulphonate and 20 lb. of crystallised sodium acetate in 100 galls. of water. A solution of 14·5 lb. of β-naphthol and 10 lb. of caustic soda in 30 galls. of water is then run in, and when the combination is complete the colour is filtered off, and dried or used in the form of paste. It dyes wool a brilliant scarlet from a boiling acid bath. The shade obtained from azo-*o*-toluidine (melting point 203° C.), is about the same as the scarlet described, whilst azoxy-*m*-xylidine (melting point 143° C.) gives a bluer scarlet and the remaining compounds yellower shades.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From A. Leonhardt and Co., Mühlheim-on-the-Maine, Germany. Eng. Pat. 21,154, November 21, 1892.

This is an extension of Eng. Pat. 1390 of 1892 (this Journal, 1893, 35), in which colouring matters are described derived from nitrosodimethyl-*m*-amidocresol and naphthylamine or aromatic diamines. It has now been discovered that nitrosodiethyl-*m*-amidocresol may be employed in place of the dimethyl derivative; secondly, that the nitroso derivatives may be replaced by corresponding azo compounds; and thirdly, that the azo derivatives of dimethyl- or diethyl-*m*-amido-phenol also yield blue basic dyestuffs when condensed with certain aromatic diamines. In order to prepare the nitroso compound, 7 kilos. of diethyl-*m*-amidocresol are dissolved in 200 litres of water and a solution of 3 kilos. of sodium nitrite is gradually added. The mixture is stirred occasionally and allowed to stand for several days. The mononitroso-diethyl-*m*-amido-cresol separates almost completely as a red crystalline precipitate and the rest can be salted out. It is soluble in dilute acids and caustic soda, and when crystallised from petroleum ether melts at 77° C. For the production of a colouring matter, 8 kilos. of nitrosodiethyl-*m*-amidocresol are heated with 4 kilos. of α-naphthylamine and 40 litres of spirit under a reflux condenser until the formation of the colouring matter is complete. The dyestuff crystallises out on cooling and is filtered off, pressed, and dried. It dissolves easily in water. In place of the nitroso derivatives, the azo compounds of dimethyl- and diethyl-*m*-amidocresol may be employed. These are obtained by combining a diazotised aromatic amine with an aqueous alkaline solution of the sodium salt of the dimethyl- or diethyl-*m*-amido cresol. The product of the reaction, after acidulating with hydrochloric acid, gives the hydrochloride of the azo dyestuff. In order to effect the condensation with an aromatic amine the two components are dissolved or suspended in a suitable medium in presence of a mineral acid and heated for some time, the reaction taking longer than in the case of the nitroso derivatives; 15 kilos. of benzene-azo-dimethyl-*m*-amido cresol hydrochloride, 6 kilos. of α-naphthylamine, 4 kilos. of 30 per cent. hydrochloric acid, and 40 litres of spirit are heated under an inverted condenser for several hours. The mixture ultimately becomes blue, and on cooling down deposits the dyestuff. The following aromatic amines can be employed for either of the two foregoing processes:—α-naphthylamine, ethyl-α-napthylamine, *m*-amido-diethylaniline, *m*-amido-dimethyl-*p*-toluidine, benzyl-*m*-amido-dimethyl-*p*-toluidine, *p*-phenylene diamine and tetramethyl-*m*-phenylene diamine. Blue colouring matters are also obtained by applying the process just described to the azo colours produced by the action of diazo compounds on dimethyl- or diethyl-*m*-amido phenols. For instance, 15 kilos. of benzene-azo-dimethyl-*m*-amidophenol, 5 kilos. of *m*-amido-dimethyl-*p*-toluidine, 5 litres of hydrochloric acid of 30 per cent., and 50 litres of spirit are heated until the liquid has become blue. The colouring matter crystallises out partly on cooling, the remainder being precipitated by adding zinc chloride and salt.—T. A. L.

Manufacture of Blue Colouring Matters from Ortho-dinitro-anthraquinone. O. Imray, London. From "The Farbwerke vormals Meister, Lucius and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 21,167, November 21, 1892.

Blue colouring matters have been produced by heating dinitro-anthraquinone with fuming sulphuric acid containing 40 per cent. of anhydride (Ger. Pat. 6525 and Eng. Pat. 2177 of 1878). By employing acid of 70 per cent. the reaction takes place in the cold, and the yield is better than by the old process. 10 kilos. of *o*-dinitro-anthraquinone are dissolved in 100 kilos. of fuming sulphuric acid containing 70 per cent. of anhydride, and the mixture is allowed to stand at the ordinary temperature for several days, or until a test shows that no increase in the amount of colouring matter is taking place. The melt is then poured into ice water, filtered, and washed with hot water until no longer acid. The colouring matter dyes blue on a chrome mordant, fast to fulling and light.—T. A. L.

Improvements in the Production of Blue Colouring Matters from Amido-nitro-anthraquinone. O. Imray. From "The Farbwerke vormals Meister, Lucius and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 21,168, November 21, 1892.

By heating *o*-dinitro-anthraquinone with ammonia under pressure it is converted into amido-nitro-anthraquinone, which crystallises in small reddish-brown crystals. It differs from diamido-anthraquinone by dissolving in 70 per cent. anhydride with a reddish-violet colour, whereas diamido-anthraquinone dissolves with a blue colour and the solubilities in sulphuric acid are also different, the latter being the more soluble compound. Colouring matters are obtained from the substance by the action of fuming sulphuric acid, the method of procedure being similar to that described in the preceding patent. The colouring matters obtained dye blue shades on chrome mordants fast to fulling.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

The Production and Uses of Kapok Fibre. J. Soc. Arts, 1893, 1030.

In Indo China, and in the Indian archipelago, the name of "kapok" is given to the setaceous fibre which envelops the seed of the *Bombax pentandrum* and of the *Eriodendron anfractuosum*, a tree which grows to a height of from 90 to 100 ft. Its capsular fruit resembles a small pear, with a tough shell containing seeds about the size of a small pea, of a brownish colour, which are enveloped in a fibrous substance. It is said that the tree commences to yield its fruit and its textile matter from the third year. It thrives in any soil, but it prefers altitudes of about 6,000 ft., and is very sensitive to cold. The countries supplying the best kapok are the islands of the Indian archipelago, Java, Bombay, Sumatra, and the Peninsula of Malacca. In the island of Ceylon the kapok is not of so good a quality, it being generally more powdery and less elastic. The kapok fibres are shrunken and twisted like those of cotton, and, when exposed to the action of fire, emit an odour similar to that of vegetable matter. It appears to have been first introduced into the London market in 1851, having been brought there from the Netherlands, but it attracted little attention. In Australia, however, it soon received favourable notice, and quantities of it were obtained from Ceylon. In Australia kapok has for some time past been used in the decorative industries, and in 1884 1,000 bales were imported. In 1886 this quantity had increased to 8,600 bales, chiefly obtained from Java. This island in the Indian Ocean produces the finest description of kapok, as the quantity obtained there is the cleanest, the least compressed, and consequently the most elastic. That of the East Indies, less elastic, is often stained by the oil produced by the breaking of the seed. Recently, however, this difficulty has been obviated by the use of ginning machines. Kapok is used in preference to cotton for wadding and for cushions. Stuffs are made with it in imitation of beaver, and it is used for making hats, for mixing with hare and rabbit skins, and for making up into turbans, cloaks, &c. Experiments have also been made with it for use in dressing wounds. Kapok may also be used in preparing fulminating power, after treatment by nitric acid. This kapok, after treatment by nitric acid, mixed with alcohol, yields the reduced fibre which, variously coloured, furnishes a solution of vegetable silk, which solidifies in water, and may be spun and then mixed with silk from silkworms. The tree which yields this kapok, and which is called *randon* in Java, is planted on the high roads, so that its straight trunk may be used as a telegraph pole. The wood is light, and can be used for making boats and for the framework for fishing nets. From the bark exudes a description of gutta-percha, and from the trunk of the tree a species of gum is obtained, soluble in water, of a disagreeable taste, and which is used by the natives as a medicine for intestinal complaints, such as dysentery and diarrhœa. From the seeds an oil is obtained by pressure, which is more appreciated than cotton-seed oil, and which is equally useful in lubricating machinery. The thread measures from 135 to 150 millimetres in length, and this same fibre, treated with alcohol and dried, loses 12 per cent. of its weight.

PATENTS.

An Improved Composition for Producing a Silky Finish on all Classes of Textile Fabrics. A. Millveigh, Dromore, Ireland. Eng. Pat. 19,939, November 5, 1892.

The patented composition is prepared by boiling flax seed and Iceland moss, and mixing the same together in the proportion of one quart of the boiled preparation of flax seed to one pint of the solution of Iceland moss, to which mixture is added one ounce of vegetable wax and half an ounce of spermaceti " dissolved " in boiling water. This composition is put into size composed of flour or other farina for dressing yarns or thread for weaving, in about the proportion of 20 or 30 wine glasses of the composition to 10 gallons of sizing. It lays the downy or divergent fibres and imparts strength to the yarn, facilitates weaving, and produces a silky finish on the woven cloth.—E. G. P. T.

Improvements in Machinery for Breaking or Treating Flax and similar Textile Materials. R. Davidson, Ballymena, Ireland. Eng. Pat. 20,258, November 10, 1892.

The object of the invention is to substitute for the ordinary scutching process, as applied to flax, &c., the action of improved machinery designed to secure the desired result without the great waste of fibre which takes place in the scutching operation. A purely mechanical patent, in which the claim is for " pairs of rollers arranged to move the materials, combined with plates made with slots through which the materials are passed, the said plates being made to reciprocate, each plate moving oppositely to the plate next it."—E. G. P. T.

Improvements in the Cleansing, Treating, or Washing of Wool and like Animal Fibres, and in Apparatus employed therein. A. Ambler, S. Ambler, and F. Ambler, Wilsden, Yorkshire. Eng. Pat. 20,839, November 17, 1892.

The invention has reference to improvements in a machine described in Patents 13,626, 1889, and 20,267, 1890. According to the present invention, the ends of the conduits supplying the fibre and the cleansing liquid are controlled by means of a door or doors secured and regulated by suitable screw and locking means, so that as desired the door or doors may be opened and the conduit washed and emptied and thoroughly cleansed. The construction of the nozzle or delivery end of conduit is also improved by the insertion of a perforated plate near the top of the incline with a box or receptacle beneath, and with pipes connected thereto, so as to be adjustable, in order that much or little water, as desired, may be allowed to flow over the bridge down an inclined plate, which is cut in slits, or provided with suitable interstices, and curved to suit any diameter of roller employed.—E. G. P. T.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

PATENT.

Improvements in or applicable to Mechanism or Apparatus for Dyeing, Bleaching, and otherwise Treating Cotton and other Fibrous Materials in the Raw or Manufactured or Partly Manufactured State. G. Young, Winton, and W. Crippin, Patricroft. Eng. Pat. 8766, May 9, 1892.

An extension of Eng. Pats. 1157 of 1890, and 4928 of 1891 (this Journal, 1891, 922, and 1892, 742), having for its principal object the adjunction to the apparatus therein described of arrangements for enabling the liquids or gases employed in the dyeing of yarn in cops, to be drawn, not in one direction only, as has hitherto been the case in such apparatus, but in an opposite direction also.

One arrangement for achieving this consists of a reversible, cylindrical vessel, closed at its ends by perforated plates, the perforations in one of them serving as receptacles for the cop-skewers, and those in the other, which is secured against the tips of the skewers, for the entrance or escape (according to the position of the vessel in the treating chamber) of the dye solutions into or out of the vessel. This vessel is to be employed in connection with the cop-dyeing apparatus described in the patents referred to, in which the dye solutions are drawn in one way only, namely, up into the treating chamber and thence downwards through the cops to be dyed. The reversal of the course of the dye solutions through the cops is accomplished by the aid of the cop-holding vessel, when the dyeing is being performed, by inverting its position in the treating chamber (the vessel having flanges at both ends to form tight junctions with the elastic ring at the bottom of the chamber).

The object is also attained by modifying the construction of a portion of the dyeing apparatus, so that the solutions drawn into the large receiver, which forms part of it, are prevented from flowing directly into the vat, except when required to do so, and by arranging the valves to allow the solutions to be forced back through the cops.

In a third arrangement, two receivers, or one large receiver divided into two compartments, are connected with the treating chamber, one by a pipe or passage with the cavity above the table-plate, and the other similarly with the space below the table-plate in the treating chamber. By means of a slide-valve the dye solution is caused to pass through the cops on the table-plate into one compartment of the double receiver, which is exhausted for its admission; then the valves are reversed, air is admitted into the compartment into which the dye solution has thus been drawn, and the other compartment is simultaneously exhausted, the solution being so forced back through the cops into the exhausted compartment. These operations are repeated as often as is required for the dyeing of the cops, and, if necessary, air or steam or a mixture of the two is passed through the cops, finally or alternatively with the dye solution.

A second part of the invention relates to an improved combination of apparatus forming a multiplex machine, in which several treating chambers are connected with one large receiver and one or more vats. Suitable valves are provided to enable the dye solutions to pass either from the exterior to the interior of the cops under treatment or alternately in this manner and *vice versâ*, as desired.

For the mechanical details of the above and several other arrangements which are described, and particulars of the claims, the original specification, which is illustrated with seven sheets of drawings, must be consulted.—E. B.

VII.—ACIDS, ALKALIS, AND SALTS.

Preparation of Potassium Cyanide. Pharm. Zeit. 1893, **38**, 292; Chem. Zeit. Rep. 1893, **17**, 113.

Potassium ferrocyanide and potassium bichromate are, separately, finely powdered, and dried in an iron crucible at a gentle heat. They are then mixed in the proportion of 4:3 and the mixture gradually introduced, in small quantities at a time, into a large iron crucible, which is heated by a Bunsen burner to a point just short of red-heat. Oxidation takes place and is indicated by a glowing of the mass introduced. As soon as one portion has ceased to glow, the next is introduced, and so on, the contents of the crucible being stirred with an iron spatula. The temperature must not be allowed to rise high enough to effect the melting of the resulting mass, which should remain porous and spongy. After cooling, the product is powdered and extracted with five times its volume of hot 80 per cent. alcohol. The solution is filtered and on cooling deposits potassium cyanide as a perfectly white crystalline powder. The mother-liquor is used to extract the product a second time, and this proceeding is repeated until no further crystals separate out on cooling. The crystalline powder is then washed several times with small quantities of ether.—J. G. W.

The Commercial Preparation of Alumina. A. Ditte. Comptes rend. **116**, 509—510.

The author draws attention to the fact that the changes that take place during the commercial preparation of alumina may be explained by means of the results of his former experiments (this Journal, 1893, 675). The mineral (bauxite) is treated with caustic soda and the aluminate thus produced mixed with a small quantity of crystallised alumina, such as is obtained when a current of carbon dioxide is passed through a cold solution of an aluminate; the mixture is then agitated, when the precipitation of hydrated alumina, in a state which is easily washed, takes place at the ordinary temperature. After a few hours stirring only a small proportion of the alumina remains dissolved in the liquid. The effect of adding crystallised alumina—gelatinous alumina has no effect—is to disturb the state of equilibrium in the solution and induce the precipitation to take place. If air is simply passed through the solution, it is only when the carbon dioxide contained in the air has precipitated a small quantity of crystallised alumina that the reaction which conditions the progressive decomposition of the alkaline aluminate takes place regularly. In this method of preparing alumina, impurities, such as silica, phosphoric acid, &c., which often occur in bauxite, remain behind in the mother-liquor; consequently the precipitated alumina is obtained in a very pure state.—J. S.

A New Method for the Extraction of Copper from Roasted Pyrites, and the Simultaneous Production of Chlorine. Action of Gaseous Hydrochloric Acid on Burnt Pyrites. G. Blattner and P. Kestner. Chem. Zeit. 1893, **17**, 466—468.

The copper present in burnt pyrites is partly in the form of sulphate, which can be extracted by water, partly as oxide, which can be dissolved out by dilute hydrochloric or sulphuric acid, and partly in combination with sulphur and requiring nitric acid for its solution. The relative proportions of these three combinations vary with the nature of the pyrites, and are still more dependent upon the manner of roasting.

The authors find that nearly the whole of the copper can be rendered soluble by heating burnt pyrites to dull redness (470°—500°) in a current of hydrochloric acid gas mixed with air. The copper becomes converted into chloride, and a great part of the excess of hydrogen chloride is converted into free chlorine, which can be utilised for the manufacture of bleaching powder, chlorates, &c. The product is extracted with acidulated water and the copper precipitated by metallic iron. The amount of chlorine obtainable is somewhat uncertain, but, working on the large scale and with roasted pyrites containing 1·5 to 7 per cent. of copper, the authors hope to effect a decomposition of 50—60 per cent. of the hydrochloric acid. The most satisfactory proportion of air and hydrochloric acid is 4 to 7 vols. of the former to 1 vol. of the latter.

When hydrochloric acid gas is caused to act upon roasted pyrites at the ordinary temperature and in the presence of moisture, ferric chloride is produced, and A. and P. Buisine recommend this as a cheap method of obtaining ferric chloride either in solution or in the solid form. The reaction may also be made use of for the absorption of hydrochloric acid fumes in various branches of industry, and for the separation of this gas from chlorine.—A. K. M.

PATENTS.

New or Improved Process for the Production of Crystals or Crystalline Masses. J. Morris, D.Sc., Glasgow. Eng. Pat. 18,496, October 15, 1892.

The invention relates mainly to the production of the crystals or stones found in nature, and known as spinels, and "more particularly alumina-magnesia spinels." But individual oxides may also crystallise as such. The process consists, essentially, in heating an intimate mixture of the oxides, which, or a combination of which, it is desired to obtain in the crystalline form, with carbon, in a current of carbon dioxide gas. To obtain spinels, solution of aluminium and magnesium chlorides is mixed with carbon, preferably a mixture of coarsely-powdered wood charcoal and lamp-black, and is dried up, hydrochloric acid escaping. Undecomposed magnesium chloride may be washed out, and the mass may be heated in a current of steam, to complete the decomposition. The evaporation may be repeated once or oftener. The mass is formed into balls or bricks and dried, and should contain one part of oxides to about one and a quarter parts of carbon. The balls may be perforated and enclosed in cages of nickel or other wire, when they are gently heated in a current of steam, and may then be heated further in a current of "some neutral gas," preliminary to the main ignition in carbon dioxide gas. The balls are then heated to full redness in long retorts or vessels, similar to gas retorts, for from 50 to 500 hours, a current of carbon dioxide gas being maintained, which gas may be heated before it enters the retorts. The progress of the process is known by the proportion of carbon monoxide found in the issuing gases; when this proportion becomes low, the ignition may be stopped.

Colour-giving compounds, as of chromium, iron, or cobalt, may be added at any suitable stage of the process. The crystals formed may be separated in any suitable way from the unchanged oxides and residual carbon.—E. S.

Improvements in Obtaining Ammonia, Chlorine, and Hydrochloric Acid from Ammonium Chloride. L. Mond, Northwich. Eng. Pat. 19,812, November 3, 1892.

The processes, coming under the above title, described in Eng. Pats. 66, 1049, and 3238 of 1886 (this Journal, 1887, 140, 216, 217, 289, and 440); also 10,955 of 1887 (this Journal, 1888, 626 and 627), and 2575 of 1889 (this Journal, 1890, 291), are referred to, according to which ammonium chloride is decomposed by certain oxides or salts to obtain fixed chlorides or oxychlorides, and ammonia, followed by the treatment with a hot inert gas, and then with air, of such chlorides or oxychlorides at a higher temperature, to obtain chlorine, and recovery of the original oxides or salts. The ammonia obtained as described is liable to retain ammonium chloride, from which, under the present improvements, it is freed by passage through a short pipe, covered by non-conducting material, from the generating apparatus, into a washer wherein it is sprayed with hot milk of lime, or with a hot unsaturated solution of ammonium chloride. The hot inert gas used in the preliminary heating of the chloridised oxides or salts is similarly washed, either with hot milk of lime or by ammonium chloride solution containing free ammonia, to remove both ammonium chloride and hydrochloric acid. The inert gas is then scrubbed with cold water, and is filtered through cotton or glass wool, or like material, to free it from finely-divided ammonium chloride. The inert gas may thus be repeatedly used. The chlorine gas obtained in the processes is washed with a strong solution of calcium chloride, to absorb hydrochloric acid, in stone towers, packed with flints or the like. On subsequently heating the acid solution of calcium chloride, nearly dry hydrochloric acid is recovered, which may be directly used in the manufacture of chlorine; and the calcium chloride is likewise recovered. —E. S.

Improvements in the Manufacture of Bleaching Powder and like Compounds, and in Apparatus therefor. W. J. Fraser and L. McG. Fraser, London. Eng. Pat. 20,055, November 7, 1892.

A vertical chamber or tower, having an inclined bottom, with discharging door, and a gas-tight feeding door, is supplied with lime, which is raised and continuously distributed in the chamber by an elevator (worked from the outside by a band and pulley) carrying a series of buckets. These buckets, in descending, empty their charges on to fixed, perforated, inclined planes or baffle-plates. There is a hinged chute for the discharge of the finished powder, which is inclined upwards out of the way during the chlorination, but is operated by a lever outside so as to receive the powder when ready, and shoot it into a communicating chamber. There is also a condenser or cooling apparatus fixed outside the tower, enclosed in a water trough, pipes being provided for the passage of the gas. —E. S.

Improvements in the Manufacture of Sulphurous Acid and its Compounds—Sulphites and Bisulphites of Lime, Soda, and the like. M. P. Hatschek, Balham, Surrey. Eng. Pat. 20,269, November 10, 1892.

Sulphur is burned in a tray contained within a stove having a swing door, perforated for admission of air, and a similarly perforated sliding plate, whereby the entrance of air may be nicely regulated. The stove is heated by, for instance, a Bunsen's burner below. A pipe conveys the sulphur dioxide to a Woolffe's bottle charged with sulphuric acid, whence it passes to a vessel having baffle-plates containing asbestos or other porous material, and then through a pump or aspirator to a receiver containing cold water, into which the gas passes through a number of small holes or slots in the pipe. The receiver may be connected to two or more covered vessels to prevent loss of gas. Lime, soda, potash, magnesia, and the like may be introduced to the sulphurous acid solution, to obtain the corresponding sulphites or bisulphites, as may be desired. —E. S.

Improvements in Apparatus for the Manufacture of Chlorine. P. De Wilde, A. Reychler, Brussels, Belgium, and F. Hurter, Widnes, Lancaster. Eng. Pat. 20,284, November 10, 1892.

In the manufacture of chlorine by the process described in Eng. Pat. 17,659, 1891 (this Journal, 1892, 907), according to which currents of air and hydrochloric acid are passed through a decomposing material, it is now directed that the vessels in which the reactions take place should be divided in the direction of their height into compartments by perforated slabs of refractory material, or iron gratings, for example, forming shelves on which the decomposing material is spread. The air and acid gas are admitted into the free space at the top, and the gases issue through a passage in the lower part of the vessel. Doors are provided, coated with clay, capable of being hermetically closed, at the spaces between the shelves, by means of which, when a series of vessels is in use, the material can be renewed without stopping the working. A single decomposing vessel may be used when the acid gas and the air are passed in together; but if the previously heated gas and air are introduced separately, it is desirable to have the vessels in series, and to pass the gas and air into alternate vessels. —E. S.

Improvements in the Manufacture of Sulphide of Sodium or of Sulphide of Potassium from their respective Sulphates. F. H. Gossage, Widnes, and J. Williamson, Widnes, Lancaster. Eng. Pat. 20,921, November 18, 1892.

Alkali waste, or calcium sulphide, is added to the mixture of sodium or potassium sulphate and carbonaceous matter from which the sulphide is to be formed. This addition is made to prevent injurious action of the sulphides upon the furnace lining. The proportion of alkali waste preferred is from 35 to 40 parts to 100 parts of the sulphate taken. After furnacing, the sulphide mixture is withdrawn into open vessels, in which it is cooled before lixiviation without danger of oxidation. Crystals of sodium or potassium sulphide, as the case may be, are obtained on concentrating the liquors of lixiviation, and from solution of such crystals the corresponding bicarbonate may be obtained by treatment with carbon dioxide or otherwise.—E. S.

A Process for the Utilization of Liquors containing Sulphate of Alumina or Ferric Sulphate. L. Tralls, Dux, Bohemia, and E. Burmeister, Hamburg, Germany. Eng. Pat. 1138, January 18, 1893.

Mother-liquors containing aluminium sulphate and ferric sulphate, and especially such as result from the alum manufacture, or come from the refuse of shale works, are made into manure by treating them with ammoniacal products, such as gas liquor, or with nitrogenous matters capable of yielding ammonia; and in some cases also with calcareous or chlorinated substances, quicklime, lime ashes, lime or soda mud, and phosphates being specified. Such additions are made as long as carbon dioxide is evolved, or until a neutral reaction is reached. Sometimes the mixture may be filtered, and the liquid concentrated to obtain a product rich in ammonium salts. Or the mixture may be dried up. In some cases, sulphuric acid may be added to the neutralised product, which is then treated with further portions of ammoniacal matters to enrich it further.—E. S.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

The Diathermancy of Certain Glasses of Known Composition. R. Zsigmondy. Annalen der Physik und Chem. 1893, **49**, 535; Proc. Inst. Civil Eng. 1893 [4], 88.

The behaviour with regard to radiant heat of alumina and ferrous oxide, when dissolved in the substance of a glass, is exactly analogous to that of aqueous solutions of these compounds. While the presence of an abnormal proportion of alumina has little influence on the diathermancy of a glass, a very small percentage of ferrous oxide produces a marked increase in its power of absorbing heat rays. The author gives details of experiments with eight samples of glass of various kinds, free from iron. These, in plates from 7·5 to 8 millimetres thick (0·3 to 0·32 inch), transmitted from 58·4 to 63·14 per cent. of the heat from an Argand burner. On the other hand, a soda-alumina glass with 8 per cent. of alumina, coloured pale bluish-green by a slight trace of iron, allowed only 20·97 per cent. of the radiant heat to pass. Another specimen of lime-soda crown glass, containing about 1 per cent. of ferrous oxide, transmitted 0·72 per cent. This sample was blue-green in colour. A plate of green glass with about 2 per cent. of iron stopped the heat rays entirely. The author believes that this discovery may be utilised in providing transparent screens to arrest radiant heat.

He also suggests the possibility of determining from the diathermancy of any given glass whether the iron it contains is in the ferrous or the ferric condition, the presence of a small quantity of iron having a much greater effect than a considerable variation in any of the other constituents.

PATENTS.

Improvements in or relating to the Cutting of Glass and Apparatus therefor. L. Havaux, St. Ghislain, Belgium. Eng. Pat. 6544, March 28, 1893.

This is an improvement upon an invention described in Eng. Pat. 17,691, October 1, 1892. The cutter is a circular metal plate or strip of German silver or other badly conducting metal supported by metal standards, which serve as conductors. The clamps for holding the cutter are adjustable at various heights on the standards. The article to be cut is carried upon a table, of which the height can also be adjusted, and to which a rotatory motion can be imparted by hand, whereby the operation of cutting is facilitated. The cutter is only held at four points by nuts, instead of being compressed between two flat fire-proof rings, as in a previous invention (Eng. Pat. 17,691, October 4, 1892).—V. C.

A Process for the Production of Coloured Pictures, Writing, and the like on Glass, Porcelain, or Enamel. W. Knapp, Hamburg. Eng. Pat. 13,838, July 17, 1893.

A rubber pad having the picture or writing in relief is moistened with solution containing 2 parts by weight of 40 per cent. silicate of sodium or potassium, and 1 part by weight of 7 per cent. caustic soda. The stamp is pressed on the surface to be treated, or, in the case of glass bottles, the object is rolled upon the surface of the stamp. The moistened surface is then covered with the colour powder, which is rubbed in by means of pads. A temperature of 40°—50° Reamur is sufficient for drying and fixing. Washing in cold or boiling water or boiling in acids has no effect upon the picture.—V. C.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Experiments on the Action of Magnesia in Portland Cement. L. Erdmenger. Thon-Industrie Zeit. 1893; Proc. Inst. Civil Eng. 1893 [4], 7.

The raw material for these experiments was a dolomitic limestone, which was sifted through a sieve of 1,600 meshes per square centimetre (10,322 meshes per square inch) before use. Two series of experiments were made; in one the magnesia replaced part of the lime present in Portland cement, in the other the usual quantity of lime was retained and magnesia added in various proportions. From previous investigations the author is of opinion that magnesia cannot be considered as an equivalent for lime in Portland cement, and cannot therefore replace any part of that substance which is present in a normal cement.

A number of cements were made, in which the proportion of magnesia varied from 0·8 to 23·3 per cent. On the whole the specific gravity increased with the proportion of magnesia, although the increase was scarcely perceptible when the percentage of magnesia was very small.

A number of rods 100 millimetres (3·937 inches) in length and 5 square centimetres (0·775 square inch) in section were made of the different samples of cement. Immersed in water, the whole of the test-pieces expanded, especially those made with neat cement; with three parts of sand the expansion was not so great. The observations were continued for a period of 90 weeks, when those cements with the highest proportions of magnesia showed signs of disintegration.

Exposed to the air, all samples contracted, and none of them showed decomposition of a serious nature. With the increase in the proportion of magnesia, beyond a certain point there was a diminution in the amount of contraction, and the author considers that this might ultimately result in expansion, and in the destruction of the cement after a number of years. It is also considered that the changes would have been more considerable had the test-pieces been exposed to the atmosphere instead of being kept under cover.

The author is of opinion that when cements containing much magnesia are mixed with a large proportion of sand, the effect of this impurity may be so toned down that disintegration of the masonry or concrete need not necessarily ensue.

In order to ascertain rapidly whether the magnesia in a cement is present in sufficient quantity to prove injurious, the author recommends his high-pressure steam-test. In carrying this out the briquettes are allowed to harden for three days at the ordinary temperature, and are then exposed for about six hours to steam at pressures varying from 3 to 20 atmospheres. The author considers that this test, which has now been in use for 15 years, gives, when properly carried out, the means of forming a complete and rapid judgment on a cement containing magnesia. On the other hand, it has been stated that even the best cements fail to stand this test.

X.—METALLURGY.

Scaffolding in the Blast-Furnace. W. Van Vloten. Stahl und Eisen, 1892, No. 3.

With the adoption of hot-blast and of furnaces with wide hearths, serious interruptions of work from scaffolding have become more frequent than they formerly were. The writer gives the results of his own experience and states certain conclusions.

When a scaffold is beginning to form the blast experiences but little resistance, but the top-flame becomes clearer than usual, freer from dust, bluish or reddish, and transparent. A short interruption of the blast is often sufficient to bring down the scaffold, but new ones are often formed after short intervals, resistance to the passage of the gases grows stronger and stronger, the quantity of air blown in grows rapidly less, the slag flows feebly and much of it is blown out as dust, while the top-flame becomes very weak, bluish, smokeless, and transparent. If now the old remedy of blowing in cold air be adopted, it often happens that the obstruction lessens, the slag begins to flow more freely, and after a little time the scaffold breaks and the charge descends.

In some cases, however, this remedy fails; the resistance to the passage of air becomes very great, so that if the blast be stopped the gases stream out with violence through the tuyères, no more slag flows, and the top-flame entirely disappears. Even now a remedy may often be found if an opening be made in the furnace-wall so that cold air can be blown into the charge, to make its way out again through the slag-spout or one of the tuyères. In this case much coke is often blown out, a great cavity arises beneath the arch formed by the scaffold, portions of its lower side fall down, and finally it is so weakened that some of the blast finds a way through, the top-flame again appears, the charge sinks, and the trouble is over. And in some cases this break up of the vault may be effected merely by the use of an exceptionally strong blast.

The writer makes the following general remarks upon scaffolding:—

1. It usually originates while the general working of the furnace is good; with a badly-working furnace the charge is generally sufficiently open to allow of the air passing freely.
2. A cold blast is in general the best means of removing the scaffold.
3. Incipient scaffolding is indicated by a clear, transparent top-flame, while irregular working is indicated by a white or smoky flame.
4. As a rule scaffolding commences with a slower sinking of the charge; this is followed by an absolute stoppage,

which may be remedied by stopping the blast for a short time; and this again by a third stage, in which such a stoppage has no effect.

5. It frequently begins on the employment of bad coke, soft and wet ore, and a very hot blast. Narrow furnaces with almost vertical walls and furnaces with very wide hearths seem particularly liable to this trouble.

6. Very heavy tapping, producing a large cavity in the hearth, often leads to scaffolding.

The author states that the scaffolds in the furnaces with which he has had to do generally lie very deep in the shaft, and never above the upper part of the boshes. The upper side of the obstruction is sometimes indicated by little flames which make their way through cracks in the furnace walls.

The writer then goes on to discuss the immediate cause of scaffolding. He asks how it is that with a furnace six metres wide above the boshes and three in the hearth it is possible that an arch can be formed from the loose, mixed materials present, which is capable of bearing for hours together the heavy burden resting upon it, and even to resist all the means which are taken to destroy it. And further, how is it that, when the arch has fallen, and the hearth is filled with masses of apparently cold material, the furnace so rapidly passes into good working order again? And why does such an arch generally appear after regular rather than irregular working? And why does a cold blast generally destroy it? His conclusion is, that the obstruction is actually caused by an accumulation of finely-divided carbon, partly consisting of coke-dust blown up from the crucible and entangled, as in the meshes of a filter, and so rendering the top-flame dust-free, but principally by deposits resulting from the dissociation of carbonic oxide by means of the hot-blast, and aided by a swelling of the ore resulting from superficial reduction. This deposit is more or less rapidly burnt away when a cold blast is substituted, and when at length the scaffold breaks, the fallen material, being mostly carbon, though cold, is soon consumed, and the furnace resumes its normal working condition.

The apparent explosions which occur on the collapse of a scaffold, and by which the gas-leading apparatus at the mouth is often damaged, are not due to any accumulations of explosive gases within the furnace, but merely to the violent displacements of already compressed gases occasioned by the fall, or to gases sucked in at the moment of the collapse.

Furnace accretions facilitate scaffolding, both by narrowing the working area and by supplying rough surfaces of abutment for the arch.

In conclusion, it is recommended that the tuyère nozzles should be made to project further into the furnace than has been hitherto practised.—J. H. C.

Combustion in the Blast-Furnace Hearth. W. Van Vloten
Stahl und Eisen, 1893, No. 1.

The process of combustion before the tuyères of a blast-furnace is not sufficiently understood. No one knows how far the oxygen of the blast penetrates into the furnace before it enters into full combination; whether the carbon of the fuel is converted at once into carbonic acid or whether carbonic oxide is first formed; and equally little is known of the precise influences which the character of the fuel and the temperature of the blast exert in the combination.

It is, no doubt, of great importance that the furnace-man should know exactly what does take place. He knows, indeed, that the number, situation, and size of the tuyères, as well as the size of the hearth, influence the results, but he only knows it empirically, and he can only guess as to the direct result which may be expected to follow any particular change. Many furnace-men believe, for instance, that the use of a strong blast leads to a useless combustion of fuel outside the crucible of the furnace, but this has not been actually either proved or disproved. With a view of getting direct light on this subject the writer devised a method of drawing off gases from the furnace by means of a cooled pipe, as shown in Fig. 1. Here *a* is a copper tube of 4 mm. internal diameter, through which the gas streams out. This passes through a $\frac{3}{4}$-inch gas pipe and is secured with hard solder into the side of an outer pipe $1\frac{3}{4}$ inch diameter. Cold water is supplied through the $\frac{3}{4}$-inch tube, which surrounds the little copper tube and thence passes into the outer pipe. This latter, which is 2,200 mm. long, is provided with a strong flange and cap as shown, so that it can be driven into the furnace by blows from a wooden mallet.

Fig. 2.

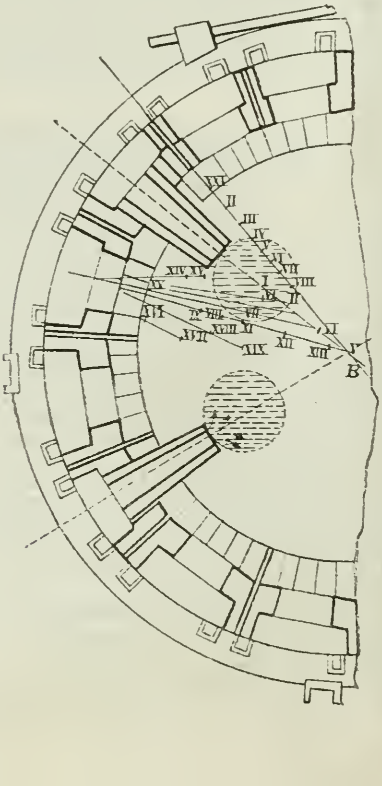
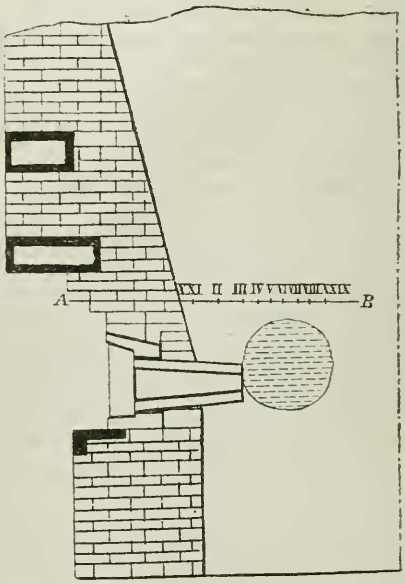
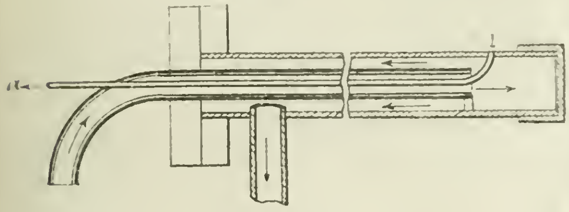


Fig. 3.



The gases drawn off were analysed to determine $O.CO_2$, CO, and H by means of the Thörner gas apparatus. The hearth of the furnace in which these tests were made is shown in plan and section in Figs. 2 and 3, which are drawn, in the original, to a scale of $\frac{1}{30}$th.

Fig. 1.



The furnace is 20 metres high, the hearth being 3 metres in diameter, the boshes increasing upwards to 6 metres. The tuyère zone is surrounded with a ring of cast-bronze water-boxes, which greatly facilitated the tests.

Most of the tests were made under normal conditions on white Thomas-iron, of which the furnace produced about 130 tons daily. With each 1,000 kilos. of raw iron there was supplied, on an average, 920 to 940 kilos. of coke, containing from 9·5 to 10 per cent. of ash, 600 kilos. of puddle-slag and forge scale, 1,720 kilos. of ore, and 620 kilos. of flux. There are five tuyères, each having a diameter of 120 mm., and working under a pressure of 5 lb., at a temperature of 650° to 750°. A few tests were made while working on grey Thomas-iron containing 2 per cent. of silicon, whereby the production was reduced to something over 100 tons per day, with a slightly raised coke consumption. The mixture, wind-pressure and temperature remained the same, but the five nozzles then had only 110 mm. internal diameter. Besides these there were also a few tests made while working on steel-iron containing 5 per cent. of manganese.

The analytical results are given in the following table, in which the Roman figures correspond with those given in Figs. 2 and 3 to indicate the places from which the samples were taken.

Date.	Place of taking Sample.	Ref. No.	Kind of Iron produced.	Volumes of					Vols. O to 1000 N	Remarks.
				O	CO_2	CO	H	Loss = N		
			SAMPLES TAKEN AT THE TUYÈRE LEVEL.							
14/5	I.	1	Thomas-iron	9¾	8¼	..	4	78	231	
21/11	I.	2	„	13	6	..	¾	80½	236	
18/5	II.	3	„	1½	15	1½	1¾	80¼	216	
24/10	II.	4	*Steel-iron	..	..	32½	1¾	65¾	243	Shortly before scaffolding.
19/11	II.	5	Thomas-iron	..	7¾	19	¾	72½	238	
22/11	II.	6	„	..	3¼	25½	1	70¾	212	Rapid working, much pressure.
23/11	II.	7	„	..	11¾	9¼	½	78½	209	
23/5	III.	8	„	..	2	28½	4	65½	248	
29/7	III.	9	Grey Thomas-iron	..	2½	28¼	2¼	67	248	
25/6	IV.	10	Thomas-iron	..	2¼	30¼	3	64½	263	
21/6	V.	11	„	..	..	37	3	60	308	Middle of the hearth.
18/11	V.	12	„	..	½	38	2	59½	328	„ „
18/5	VI.	13	„	7¾	10¼	..	2	80	225	
19/11	VI.	14	„	3	14¼	1½	¾	80½	224	
22/11	VI.	15	„	..	11¾	10	1	77¼	217	Rapid working, much pressure.
23/11	VI.	16	„	..	13½	6	¼	80¼	205	
23/5	VII.	17	„	6	12⅓	..	2	79⅔	230	
29/7	VII.	18	Grey Thomas-iron	4	12¾	..	1⅓	82	204	
25/6	VIII.	19	Thomas-iron	3½	13	1	1¾	80¾	211	
25/5	IX.	20	„	..	4	25	3¼	67¾	244	
21/6	X.	21	„	..	8	17¼	2	72¾	229	
25/5	XI.	22	„	..	15½	4	2	78½	223	
17/10	XI.	23	Steel-iron	..	6½	19	2	72½	221	
17/10	XII.	24	„	..	9	16½	2	72½	238	
27/7	XIII.	25	Grey Thomas-iron	..	..	39¾	3	57¼	347	Slow working.
18/6	XIV.	26	Thomas-iron	..	..	34½	1¾	63¾	270	
18/6	XV.	27	„	..	1¼	31½	1¾	65½	260	
24/6	XVI.	28	„	..	..	36½	2½	61	299	
24/6	XVII.	29	„	..	..	34½	2½	63	274	
16/6	XVIII.	30	„	..	..	33½	2	64½	250	
16/6	XIX.	31	„	..	..	33¾	1¾	64½	252	Between two tuyères.
24/10	XX.	32	Steel-iron	..	..	40	1¾	5 ¼	343	Shortly before scaffolding.
18/11	XX.	33	Thomas-iron	..	..	45¼	2	52¾	421	

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* The original word used was "*Stahleisen*," which probably corresponds with our "*Bessemer pig*," made from red ore, with low silicon.

Date.	Place of taking Sample.	Ref. No.	Kind of Iron produced.	Volumes of					Vols. O to 1000 N	Remarks.
				O	CO_2	CO	H	Loss = N		
SAMPLES TAKEN BELOW THE TUYÈRE LEVEL.										
16/7	II.	34	Thomas-iron	..	4	24¼	?	?	?	340 mm. under point II.
20/7	XI.	35	Grey Thomas-iron	..	½	33¾	3	62¾	277	400 „ „ XI.
19/7	XII.	36	„	..	..	33	2	65	254	340 „ „ XII.
SAMPLES TAKEN ON THE LINE A B (FIG. 3), 630 MM. ABOVE TUYÈRE LEVEL.										
1/12	XXI.	37	Thomas-iron	..	..	31¼	¾	65	263	
27/10	XXII.	38	„	..	3	27¼	2	67¾	245	
10/11	XXIII.	39	„	..	4	24½	2½	69	236	
7/12	XXIV.	40	„	..	6	19½	¾	73¾	213	
10/11	XXV.	41	„	..	5½	23	2½	69	246	
20/10	XXVI.	42	„	..	11	11¾	2	75¼	224	
1/12	XXVI.	43	„	..	7¼	17½	½	74¾	214	
5/11	XXVII.	44	„	..	3¾	27	2¾	66½	260	
7/12	XXVIII.	45	„	..	1	30	1	68	235	
5/11	XXIX.	46	„	..	½	33	2	64½	271	

The analyses show clearly that a very active combustion takes place, but that it is very local. When the blast entered at the rate of about 250 m. per second, the outside limit of the free oxygen was found to be only 600 mm. in front of the tuyères and 630 mm. above their centre. The spaces in which, under normal conditions, free oxygen was found are shaded with horizontal lines in Figs. 2 and 3. In many cases the space must be much smaller than is there shown. There is nothing to show that overheating ever begins through the combustion of carbon in the upper regions of the furnace.

Furthermore, the analyses show that the oxygen of the blast when working at a high temperature is at once converted into carbonic acid before any carbonic oxide is formed. These gases are, indeed, occasionally found together (see Table Nos. 3, 14, 19), but even then the carbonic oxide is small in quantity, and its presence is probably due to slight variations in the pressure from the "throbbing" of the blast-engine.

Free H is found in all the tests, as well where free O is found as in the waste gases. Hence it would seem that any moisture entering the furnace is decomposed and the liberated H, like the nitrogen of the air-blast, streams up passively through the charge.

The proportion of O to N is interesting. In the ingoing blast there are 1,000 vols. N to 265 of O; in most of the tests one finds less oxygen than this, some having been consumed in oxidising the silicon, manganese, phosphorus, &c. of the raw iron. There must therefore be in the hearth an oxidation-zone where O and CO_2 predominate, and a reduction-zone where CO predominates, the extent of the first depending upon the intensity of the combustion and the quantity of blast; hot-blast and slow working both tend to lessen the oxidation-zone.

Part of the raw iron in front of the tuyères is exposed to oxidation, as is shown by the separation of decarbonised iron from the ingots, in the form of thin plates, one of which, 4 mm. thick, gave on an analysis—

	Per Cent.
Carbon	0·04
Silicon	0·10
Manganese	0·41
Phosphorus..........................	0·99

Iron at a very high temperature readily absorbs carbon, which subsequently separates as graphite. When, however, there is much silicon present the carbon does not so readily separate.

The author, modifying some of the opinions expressed in a former paper (Das Hängen der Gichten in den Hochöfen. Stahl und Eisen, 1892), draws certain conclusions from these experiments, as follows:—

The greater part of the furnace cavity, and particularly in the region of the crucible, is filled with coke, which is unalterable by heat unless oxygen be present. Consequently the charge does not subside equally, but only in a series of funnels situated directly in front of the tuyères, and which join, when the working is normal, at a moderate height above the tuyère. These considerations throw a new light upon the origin of "scaffolding." Instead of one vault over the whole of the furnace, we must conceive a series of smaller vaults over the separate funnels, which become narrowed with each increase in the intensity of the combustion owing to irregular working or to inferior charge-material, and at the same time their junctions rise higher and higher.

An arch which is chiefly composed of carbon cannot be destroyed by heat alone, while the possibility of oxidation is lessened as the blast becomes more and more obstructed. It can only be broken by a cold blast, or by a *very* strong wind pressure, or by blowing out. This last method sometimes leaves a vault extending over the whole furnace area, but it is a result and not the cause of irregular working.

When the samples Nos. 4 and 32 were taken the furnace was going very slowly but quite regularly; half an hour later the charge set fast in the furnace and remained so for several hours, so that the conditions which produced scaffolding so soon after, must have been already existent. Although the sample No. 4 was taken only a little in front of No. 3, where much carbonic acid existed and a little oxygen, it was found to contain 32½ per cent. of carbonic oxide, but neither carbonic acid nor oxygen. Evidently this gas had no oxidising power. The "funnel" before the tuyère was unusually narrow, and it is not to be wondered at that shortly after the charge stuck fast.

The author concludes that furnaces with wide hearths are most subject to scaffolding, and also that when it has occurred it is generally better to close one or more of the tuyères rather than to lessen the wind pressure.—J. H. C.

Plated Sheet Metal. G. Buchner. Chem Zeit. 1893, **17**, 1—2.

Silver-plating is usually supposed to afford complete protection to the plated metal; this, the author has observed in the case of silver-plated copper, is not always the case. An examination of silver-plated copper which has been soldered in order to prepare drinking vessels from it, reveals the presence on the metal of numbers of black spots of copper oxide as large as pins' heads, whilst vinegar has an appreciable action on the plate either before or after heating for the purpose of soldering. Under the magnifying glass red spots of naked copper are seen on the unheated copper sheet; the plating of copper consequently does not afford a continuous coating of silver, but leaves portions of the copper unprotected. These uncoated patches then become visible as black specks on heating the metal. Vessels of plated copper should therefore not be used for containing food or drink unless they will stand 24 hours' contact with vinegar without being attacked.—W. J. P.

The Manufacture of Basic Steel at Witkowitz. P. Kupelwieser. Iron and Steel Institute, Autumn Meeting, 1893.

The problem that the author had to contend with, was how to convert into steel or ingot iron of good quality a pig-iron containing too much phosphorus for the Bessemer process, and too little for the basic Bessemer process without the use of scrap. The procedure is as follows:—

Pig-iron containing about 1 per cent. of silicon, is run from the blast furnace into a ladle and transferred to the Bessemer converter, where it is blown until it is desiliconised. The metal containing some manganese and carbon and the phosphorus, is then introduced into the ladle, taken to and run into a basic-lined Siemens-Martin furnace, where, in conjunction with two-thirds of its weight of cold pig, its conversion into steel is completed.

The advantages of this method of procedure are many. In the first place the cost is much less than for the conversion in the Siemens-Martin furnace from the commencement, and is equal to about that of the basic Bessemer process when carried out on a large scale. The running in of the molten metal saves time, fuel, and wages, and the metal, being previously desiliconised, does not attack the basic lining of the Siemens-Martin furnace, whilst a smaller quantity of lime is necessary to keep the slag basic.

—A. W.

The Modifications of Carbon in Iron. A. Ledebur. Iron and Steel Institute, Autumn Meeting, 1893.

This paper is a short summary of what has already been done in researches on the above subject. The author divides the carbon in iron into four modifications, viz., graphitic, temper, carbide, and hardening. The temper-carbon resembles graphite, and if present in appreciable quantity is visible to the eye on the fractured surface of the iron in the form of small black spots, which frequently join together to form spots of larger size, causing the surface of the metal to possess a kind of sprinkled appearance. Like graphite it is not attacked by boiling acids. It has therefore been frequently confused with graphite, and at present there are no means of separately determining both these modifications when they occur together. It is unlike graphite in being amorphous, and it is the first to disappear when the metal is heated under oxidising conditions, such as with iron ore to form malleable castings. Any percentage of manganese in the iron renders its formation more difficult. Its name is chosen because this form of carbon is mainly produced during the prolonged heating of white pig-iron during the tempering process. The formation, and the well-known influences which govern it, of the other modifications of carbon are also reviewed.—A. W.

New Method of Casting Steel Ingots in Sweden. Board of Trade Journal, November 1893, 579.

At the Nykroppa Iron Works, in Sweden, a method of consolidating steel ingots, by subjecting the freshly filled mould to pressure developed by centrifugal action, has been introduced by the manager, Mr. L. Sebenius, according to *Stahl und Eisen.* The apparatus consists of an upright shaft in the centre of a cylindrical casting pit, carrying a frame of four arms, to each of which is articulated a platform supporting four ingot moulds. While the shaft is at rest the moulds are upright, and are filled in the usual way, but when it is set in rapid rotation they fly up into the horizontal position, and a pressure in the direction of the length of the ingot is developed equal to 30 times that due to the column of liquid metal in the mould, which drives the gases out and produces a perfectly solid casting. Uniformity of composition is also induced, as on account of the rapid cooling liquation is prevented. The process, which has now been in use about two years, has been applied to both the Bessemer converter and to the open-hearth furnace. The ingots are free from external defects, and the loss by defective ends has been diminished 40 per cent., the metal being so compact as to bear rolling to finished sizes without the use of the cogging-mill. The cost of the apparatus is about 2,000 dollars for a three-ton, and 4,000 dollars for a 10-ton charge.

The circumference described by the bottom of the moulds, when spun up into the horizontal position, is about 67 feet, corresponding with the working speed adopted of 125 revolutions, to a velocity of nearly 10,000 feet per minute. The pressure on the mould, taken at 30 times the depth of the ingots, will be about 150 feet of iron, or from 500 to 600 lb. per square inch. In the form of the apparatus intended for smaller ingots the moulds are arranged on an inclined position and radially to a central fixed vertical feeding tube upon a turntable, which is set in rotation after filling, or the latter operation may be performed while the table is actually in motion.

There is a later modification of the apparatus, in which the rotating table, being smaller in diameter than that previously adopted, can be driven at a higher speed up to 200 revolutions per minute. There are eight pivoted moulds, each divided by internal walls, so as to give nine small ingots suitable for wire billets or thin sheets. By means of a central annular funnel lined with refractory material, and provided with eight feeding spouts, or one for each group of moulds, the whole number of 72 ingots is cast by a single pouring from the ladle, which contains from four to six tons of steel.

PATENTS.

Improvements in and connected with the Reduction of Antimony Ores, Alloys, and Salts, and Purification of the Metal obtained therefrom. J. B. Alzugaray, London. Eng. Pat. 15,713, September 1, 1892.

The ores and substances to be treated are fused in closed vessels of clay, plumbago, enamelled iron, or other suitable material, while a current of hydrogen, coal-gas, petroleum gas, or other reducing gas is made to pass through the fused mass.

The reduced antimony is collected in iron moulds or other convenient receptacles. In order to purify or refine the metal, and to separate precious metals therefrom, it is used as an anode in an electrolytic bath, the cathode of the same being a plate of lead or other good conductor. The electrolyte employed is a solution of one or more chlorides or other salts of antimony dissolved in an alkaline-, alkaline-earthy, or metallic chloride, or in an acetate or tartrate, and acidified when necessary.

The pure metal collected on the cathode is melted and run into moulds. The impurities are collected in the anode, from which the precious metals are subsequently separated.

—J. H. C.

Improvements in or relating to the Manufacture of Iron and Steel. G. F. Thomson, Newport, Essex. Eng. Pat. 16,408, September 13, 1892.

These consist in the application of aluminium or aluminium alloy, with or without lime or other basic material, during the decarbonising stage in the puddling, Siemens' basic, and Siemens' acid processes, for the purpose of utilising cheap or inferior classes of pig-iron.

Any of the materials known as "physic," such, for instance, as ferro-manganese, salt, chloride of calcium, or fluorspar, may be added in conjunction with the aluminium, or before or after it, as desired. From 4 to 14 ounces of aluminium per charge of 500 lb. of pig-iron will usually suffice.—J. H. C.

Improvements in Apparatus for Concentrating Gold Ores and the like. R. H. Gray, Acton. From F. W. Gray and W. Marsh, of Orrgaum, India. Eng. Pat. 16,592, September 16, 1892.

The inventor uses a kind of conical hydraulic separator with adjustable outlet, and an inlet for water under pressure. The material to be concentrated is mixed with water and fed into the separator in the ordinary way.—J. H. C.

Improvements in the Extraction of Bismuth, especially applicable to the Treatment of the Flue-Dust of Copper Works. J. W. Kynaston, Liverpool. Eng. Pat. 17,694, October 4, 1892.

The flue-dust is digested with moderately diluted hydrochloric acid, not in excess; the solution obtained is mixed with chloride of calcium so as to eliminate most of the sulphuric acid present, and, after filtration, the bismuth is precipitated with carbonate of lime or other alkaline earth. The impure carbonate of bismuth so obtained may be readily reduced to metallic bismuth by fusion with a flux composed of ordinary salt-cake mixed with one-third of its weight of powdered coal.—J. H. C.

Improvements in the Manufacture of Cuprous Oxide. C. H. W. Hoepfner, Giessen, Germany. Eng. Pat. 18,900, October 21, 1892.

Ground ores and smelting products containing copper sulphide are treated with a hot solution of copper chloride and calcium chloride, by which means the copper in the ore passes into solution as cuprous chloride, that already in solution being at the same time reduced to cuprous chloride. The clear solution is divided into two portions; the first is purified from iron, bismuth, arsenic, antimony, silver, and other metals in a well-known manner, and then caustic lime or soda is added, by which means cuprous oxide in a state of great purity is obtained. The other half of the solution is treated with sulphurous acid and air or oxygen, or with chlorine, by which means its copper is converted into cupric chloride, to be used again, as at first, in the lixiviation of ores, &c.—J. H. C.

A Process for the Elimination of Sulphur and Phosphorus from Molten Iron or Steel. H. J. Phillips, Leytonstone. Eng. Pat. 19,727, November 2, 1892.

This is effected by forcing through the molten iron or steel, by means of a blast of air, one or more desulphurising or dephosphorising agents, such as lime, oxide of manganese, limestone, chalk, magnesia, chloride of calcium, chloride of manganese, dolomite, carbonate of barium (witherite), carbonate of magnesia, fluoride of calcium (fluorspar), barium dioxide, sodium chloride (common salt). The agents used form light compounds, which are partly ejected by the blast, and partly remain on the surface of the metal. The process is more particularly applicable during or near the completion of the decarburisation in the Bessemer converter, and the chemicals may be conveniently blown in by the use of an apparatus devised by the inventor.—J. H. C.

An Improved Lining for Blast and other Furnaces. B. Richards. Eng. Pat. 20,978, November 18, 1892.

The lining is made of asbestos, "to prevent the metal penetrating the bottom and brickwork of the furnace." The asbestos is sewn together with strings of the same, and covered with a layer of sand 7 in. thick.—J. H. C.

An Improved Method of Preparing Solder, principally for Soldering Aluminium. R. Haddan, London. From F. Singer, Breslau, Germany. Eng. Pat. 21,162, November 21, 1892.

To the molten tin or alloy of tin and lead, an oxidising or cleansing substance, such as nitrate of potash, of soda, of ammonia, or of lead, chloride of soda or of lead, sulphate of lead, chlorate of potash, or hydrate of soda, is added. The scum is removed, and the operation repeated several times prior to casting the solder into rods.—J. H. C.

An Improved Method of Converting Metallic Copper into Copper Oxide. J. C. Richardson, London. Eng. Pat. 4114, February 24, 1893.

The metallic copper, in a state of division, is immersed in caustic soda or potash solution. After the copper scrap has become saturated it is thrown out on a straining floor of brick or other porous material. As the moisture passes away the air finds its way among the divided copper, which becomes considerably heated and, presently, oxidised.
—J. H. C.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

PATENTS.

Improved Method of and Means for supplying Electricity to the Carbon Electrodes employed in the Electrolysis of fused Electrolytes. H. H. Frei, Hirzel, Switzerland. Eng. Pat. 16,300, September 12, 1892.

Contact with the carbon electrode is effected by means of large masses of metal connected with the lower portion of the electrode and cooled by atmospheric action, or by means of a current of cold water or air, the size of the masses of metal being such as to ensure their not being either appreciably heated by the passage through them of the current employed, or melted by the heat of the electrolyte.
—C. R. A. W.

An Improvement in Carbon Electrodes. H. T. Barnett, London. Eng. Pat. 17,099, September 24, 1892.

The object of the invention is to combine in an electrode for use in an electric battery or in an electrolysing arrangement, carbon in filamentary form with a carbonaceous or metallic conducting support, to which the said filaments are connected mechanically and electrically, and from which they are outstanding.—G. H. R.

An Improved Process for Treating Cups, Separating Partitions, or Diaphragms used in Electric Batteries or Electrolytic Apparatus. A. J. Lehman, New York, U.S.A. Eng. Pat. 17,653, October 4, 1892.

The object of this invention is to treat cups, diaphragms, partitions, and the like, so that they will not be porous to the physical transfusion of liquids, while they remain in such a condition that chemical action can pass through them. The inventor places the cup or partition to be treated in a saturated solution of barium chloride (hot or cold), and leaves it over night in it. While still wet he puts it in sulphuric acid of 10° B., or a saturated solution of any soluble sulphate. The precipitated barium sulphate is an amorphous gelatinous one, and does not contain any combined water; therefore a cup thus treated retains the precipitate in a permanent condition, which is also a good electrolyte. The inventor also uses a saturated solution of barium chloride, or of calcium chloride followed by immersion in a saturated solution of oxalic acid; or he uses as the first solution (either hot or cold) a saturated solution of the proto-sulphate of iron, and as the precipitating solution a saturated solution of the red prussiate of potash; or a saturated solution of tungstate of soda for the first, and any mineral acid, preferably nitric of ordinary strength, for the second.—G. H. R.

Improvements relating to the construction of Electrodes for Electrolytic Purposes. J. C. Richardson, London. Eng. Pat. 19,953, November 5, 1892.

The inventor describes a method by which gas-retort carbon may be used for electrodes in preference to prepared carbon. Pieces are chosen as nearly similar in size as possible, and trimmed roughly with a hammer if necessary. They are then notched or pierced to receive a metal attachment, which is applied by casting in such a way that the shrinkage of the metal, which is preferably lead, tends to bind it tightly on the carbon. There are four illustrations showing different modes of attaching the metal to the carbon.

—G. H. R.

Improvements in Electrolytical Apparatus. A. J. Boult, High Holborn. From O. Knöfler and F. Gebauer, Charlottenburg, Germany. Eng. Pat. 20,214, November 9, 1892.

The apparatus described is intended for the technical electrolysis of solutions of all kinds, but more especially aqueous solutions of metallic chlorides for the purpose of obtaining bleaching solutions for paper-making, high-tension currents being employed such as are ordinarily used for lighting purposes. Conveniently a dynamo is employed, used for electrolysis during the daytime and for the electric lighting of the factory at night. The electrodes are flat plates, separated by insulated intermediate frames, put together after the fashion of a filtering press, so as to form a series of shallow chambers, each electrode acting as cathode on one side and as anode on the other. The first and last plates are connected with the terminals, so that the whole arrangement forms a compact series of decomposing cells traversed in succession by the current, and consequently yielding a total amount of electrolysis proportionate to the number of cells. The frames serving as containing vessels and the alternate electrodes are made watertight by india-rubber or asbestos washers, the whole being screwed up by a screw spindle; in another form of apparatus the arrangment is like that of the plates in a Cruikshank's primary battery, the frames forming one connected whole with the case or box, and the electrodes being partitions in the trough thus formed. In either case each cell is provided with an inlet tube for admitting fresh fluid to be electrolysed, and an outlet; the liquid treated may thus be made to flow in succession through the whole series of cells if required, or each cell may be fed separately from a supply main and discharged in similar fashion. The frames may be constructed of non-conducting material, such as hard rubber, celluloid, glass, clay, &c., or may be made of metal coated with such substances; the electrodes may be plates of sheet metal (such as platinum) or of carbon, manganese (brownstone), peroxide of lead, &c. When platinum is used, sheets not exceeding one millimetre in thickness may be employed; owing to the nature of the construction much stronger currents can be advantageously passed than when similar plates are used as electrodes in the usual way; thus 10 or more ampères may be passed per grm. of platinum in the form of sheet exposing 100 square centimetres of surface. For electrodes of large size a number of comparatively small plates may be employed, set in a frame of non-conducting material, like panes in a window; since no contacts are requisite, excepting at the terminal plates, much expense in repairing and maintaining contacts throughout the series is avoided. In cases where diaphragms are requisite, these may be included between the frames in exactly the same way as the electrodes; they may conveniently be constructed of comparatively small plates of clay or other porous material, set window-pane fashion in a frame of non-conducting material.—C. R. A. W.

Improvements in Electric Smelting of Aluminous and other Refractory Ores or Compounds. T. L. Willson, Leaksville, U.S.A. Eng. Pat. 21,696, November 28, 1892.

Alumina, preferably precipitated and thoroughly dried, is stirred into hot pitch, coal-tar, paraffin, or heavy hydrocarbon oil, and heated until the mass is practically a dry black powder; 22 lb. of alumina will thus absorb a gallon of tar. The carbon-impregnated alumina thus obtained is fed into an electric furnace, where it is reduced with much greater facility than in the ordinary methods of employing alumina in similar fashion, granulated copper being added from time to time, preferably in alternation with the impregnated alumina. When precipitated alumina is not employed, but more compact material, this should be ground to an impalpable powder before admixture with the tar, &c., so as to bring about extremely intimate contact between the metallic oxide and the carbonaceous reducing material. In similar fashion other difficultly reducible metals or ores may be smelted.—C. R. A. W.

Improvements in the Reduction or Treatment of Refractory Metallic Compounds by Electric Smelting. T. L. Willson, Leaksville, U.S.A. Eng. Pat. 21,701, November 28, 1892.

Electric furnaces are of two kinds, viz., incandescent furnaces, where the current passes through a mass of broken carbon; and arc furnaces, where the current passes across an arc between two separated electrodes. In the former, the poles are placed horizontally; in the latter, usually vertically; the alumina or other refractory ore becomes fused, and a pool is formed at the bottom of the crucible, any base metal (*e.g.* copper) introduced lying as a fused layer beneath the melted ore. The molten matter in such cases is very apt to spatter or spout or foam at frequent irregular intervals, and the boiling up of the mass thus brought about short-circuits the arc and lowers the resistance of the furnace, thereby seriously affecting the operation of the dynamo. This boiling-up and short-circuiting may be prevented in arc furnaces by commingling with the alumina or other metallic compound to be reduced, finely-subdivided or pulverised carbon; the violent fluctuations in the resistance of the arc that would otherwise occur are consequently avoided and injurious strains of the machinery obviated. This is brought about in virtue of the non-formation of a bath of fused alumina, the finely-divided carbon preventing the alumina from coalescing together as its particles melt, so that it does not run down as a liquid mass. The best arrangement is where the electrodes are vertical, the crucible constituting one and a carbon pencil thrust into it forming the other; the latter is raised or lowered as required by means of an adjusting screw or otherwise. Other arrangements, however, are admissible, though believed to be inferior.—C. R. A. W.

An Improvement in Secondary Voltaic Batteries. H. Imray, London. From La Société Anonyme pour le Travail Electrique des Metaux, Paris, France. Eng. Pat. 1948, January 28, 1893.

This invention relates to a method of supporting the plates of secondary batteries by suspending them in the cell by shoulders, which rest on fillets of wood or other insulating material extending along each side of the cell, so that the plates are free to expand and contract, while their parallelism is maintained by grooves, in which they loosely fit. Contact is made by an arm projecting upwards and laterally from each plate, and which is tightened by nuts on a conducting bolt.—G. H. R.

Improvements in Apparatus for the Electrolytic Decomposition of Solutions of Chloride of Sodium and Potassium. J. C. Richardson, London. Eng. Pat. 5694, March 16, 1893.

The solution to be electrolysed is placed in a tank of slate or other suitable non-conducting material, with a covered compartment for the anode, the cathode being placed underneath and forming part of (or being contained within) an inverted trough, the ends of which extend beyond the depending sides of the anode. The upper surface of this trough nearest the anode is covered with insulating material, so that the evolution of gas at the cathode can only take place *within* the trough; this may be arranged horizontally, or preferably on a slope, so that the gas may escape at the upper end, clear of the anode compartment.—C. R. A. W

Improvements in Secondary Batteries. A. J. Boult, London. From H. Woodward, Toronto, U.S.A. Eng. Pat. 12,291, June 22, 1893.

The battery consists of a cell containing the electrolyte and a number of perforated lead cylinders, in each of which is placed a spiral-shaped piece of lead forming the core, and around which are packed shot-like pieces of lead, their shape allowing the liquid entering through the perforated cylinder to pass freely through the mass. Both ends of each cylinder are closed with rubber plugs; the stem of each core projects through its respective plug. Each cylinder forms an electrode, but instead of arranging them in pairs, one large electrode is made and its stem connected to either the positive or the negative pole. The other electrodes are arranged round the central one, and their stems are connected together by a band. To avoid the risk of short-circuiting by particles dislodged from the plates and falling to the bottom of the tank, the electrode is raised on blocks of glass or rubber to prevent the possibility of the particles forming an electrical contact between the opposite poles of the battery.—G. H. R.

Improvements in the Construction of Plates for Secondary Batteries. J. Pitkin, London. Eng. Pat. 13,081, July 4, 1893.

This patent is an improvement on Eng. Pat. 4384, 1890, granted to J. Pitkin and Capt. Holden, in which the troughs are gripped in a mould, lead bars having been cast on their end so as to form a frame with the troughs, from which the spacing pieces are afterwards knocked out. According to the present invention, the troughs, after being arranged in position, are clamped together so that the solid ends are in contact one over the other, while the hollow partitions of the troughs, which contain the active material, are spaced as in a finished plate. The ends of the troughs are then fused by a blow-pipe flame, or by other means, so that they are melted together to form bars extending from top to bottom of the plate on either edge thereof.—G. H. R.

Improvements in Galvanic Elements. C. W. A. Hertel, Berlin, Germany. Eng. Pat. 14,315, July 25, 1893.

The cell is composed as follows:—A glass containing vessel in which is placed a carbon cylinder, which is closed by a plate of copper, the rim of which is formed with strips prolonged upwards, one of which serves for making contact. The space between the copper strips and the carbon cylinder is filled with a mixture composed of fragments of retort carbon, copper oxide, and suboxide of copper, and the bottom of the glass containing vessel is also covered with a layer of fragments of retort carbon. Into the above-mentioned carbon cylinder a second carbon cylinder formed with a bottom is placed. The outside diameter of this cylinder being smaller than the inside diameter of the former, an annular space is left between them. The zinc electrode is suspended on a glass rod in the inner cylinder in such a way that between its bottom end and the carbon cylinder a space is left. The annular space between the containing vessel and the outer carbon cylinder, which is filled with a mixture of granular retort carbon and oxide of copper with suboxide of copper, is charged with the exciting liquid, consisting of a solution of caustic potash (preferably in the proportion of 1 lb. caustic potash to $1\frac{1}{2}$ lb. water); and the inner cylinder, after the insertion of the zinc electrode, and the annular space between the cylinders are likewise filled with the same solution.—G. H. R.

Improvements in and connected with Electric Furnaces. A. F. W. Kreinsen, Schleswig Holstein. Eng. Pat. 14,516, July 28, 1893.

In order to prevent the detaching of portions of the graphite or carbon crucible used in electric furnaces, and their intermixture with the fused metal, producing dirty and unsound castings and ingots, a lining of chamotte (a mixture of fireclay and burnt pottery, old crucibles, and the like) is arranged inside the primary crucible, an intervening layer of mica, asbestos, or similar material being interposed to allow for the difference in expansion of the two concentric crucibles. The primary crucible is made in two vertical halves to permit of the insertion of the inner lining when the mouth and outlet are constricted, as is desirable to prevent radiation of heat. Two or more crucibles are arranged over a common trough heated by the current like the crucibles, so that their contents may be mixed together and a uniform product obtained. With small-sized crucibles an internal lining of asbestos or mica without chamotte is preferable. Protective mouthpieces are applied, and a specially arranged clip and spring connection for the purpose of making contact with the crucible.—C. R. A. W.

A Method of and Apparatus for Electrolytical Decomposition while using Quicksilver as Cathode. P. Jensen, London. From A. Sinding-Larsen, Christiania, Norway. Eng. Pat. 14,910, August 3, 1893.

In order to prevent the decomposition of the amalgam (formed as the primary result of electrolysis) by contact with the water of the electrolyte, either the quicksilver is kept in circulation between the point where it takes up metal and the point where it again gives it up to the reagent serving to produce the desired combination; or a quicksilver cathode is employed having a free surface towards the electrolyte as well as towards the reagent for production of the alkaline compound in question. The walls, pipes, or spaces which form separating or connecting links between the decomposing space and the solution space, and are in contact with the quicksilver, are provided with a covering of amalgam for the purpose of causing the adhesion of the quicksilver to the walls, and thus hindering the passage of the liquid from one space to the other between the quicksilver and the walls. In order to remove the gas globules formed upon the anode from its active side, the anode or anodes are kept in rotation.—C. R. A. W.

Improvements in and connected with Galvanic Batteries. S. Marcus, Vienna, Austria. Eng. Pat. 15,257, August 10, 1893.

According to this invention the battery is regenerated by means of an electrode of helical or propeller-like form (provided with ribs), which in rotating stirs up depolarising substances contained in the exciting liquid. The depolarising materials, which consist of pulverised salts (such as bichromate of potash, soda, &c.), are formed into bands or cords by mixing them with a flexible adhesive agent (such as mucilage, glue, gelatin, dextrin, &c.) to which glycerin has been added. The rotation of the electrode may be effected by clockwork, an electric motor, or any suitable method.—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Apricot-, Cherry-, Plum-, and Peach-Oils, and their Employment as Adulterants of Almond-Oil. C. Micko. Zeits. österr. Apoth.-Ver. 1893, **31**, 175.

The above oils are liquid at the ordinary temperature, are pale yellow, and in taste and odour are scarcely distinguishable from genuine almond-oil. With the object of finding distinguishing characteristics, the author has determined their specific gravities, the free acid ("Acid number," "Säurezahl"), the saponification equivalents,* and the iodine absorption; further the saponification equivalents, the iodine absorptions, the melting-points, and the mean molecular weights of their fatty acids. The following are the results:—

	—	Apricot.	Cherry.	Plum.	Peach.
Kernel oils.	Specific gravity	0·92108	0·92850	0·91949	0·92147
	Free acid	0·64	1·11	0·55	0·52
	Saponification equivalent	193·11	193·36	191·55	191·11
	Iodine absorption	108·07	114·30	100·20	99·71
Insoluble fatty acids	Saponification equivalent	194·04	189·04	200·47	200·87
	Iodine absorption	102·64	104·33	104·21	101·93
	Melting-point	13·4°—18·0°	16·0°—20·6°	12·4°—18·1°	10·0°—18·9°
	Mean molecular weight	288·60	296·23	279·34	278·78

When mixed with nitric acid (sp. gr. 1·4), apricot- and plum-kernel oils assume an orange colour; peach-kernel oil becomes first yellowish-brown and afterwards dirty orange; cherry-kernel oil becomes dark reddish-brown.

With Bieber's reagent (a mixture of equal parts of concentrated sulphuric acid, crude nitric acid, and water), apricot-oil gives a peach-red, cherry-oil a brown, and plum-oil a pink coloration, whilst peach-oil gave no colour after half an hour, and only assumed a brown coloration after an hour.—A. K. M.

Jatropha Curcas and the Oil which it contains. J. J. Arnaudon and Ubaldini. Monit. scient. 1893, 447—449.

The seeds of *Jatropha curcas* are enclosed in an envelope or capsule divided into three compartments; their weight varies from 0·5 to 0·7 grm. They are composed mainly of two portions, the kernel and the husk, 100 parts containing 58·46 parts kernel and 41·50 parts husk.

On extraction with cold ether, the kernels yielded 37·1 and the seeds (with envelope) 29 per cent. of a syrupy, nearly colourless oil; this has a density of 0·915, becomes yellow on exposure to air, and deposits globules of a fatty substance. It has a nauseous and slightly acrid odour. It is soluble in cold alcohol, but when treated repeatedly with small quantities of this solvent, a residue is left consisting of a solid fatty substance which required a much larger proportion of alcohol for its solution. The oil obtained from the alcoholic solution, and from which the solid fat had been separated, was more fluid and more readily soluble in alcohol than the original oil, and from this result, taken in conjunction with the results of saponification, the authors conclude that the oil of Jatropha differs from castor-oil only in the proportion of the fatty substance which it contains.

The portion of the kernel insoluble in ether was found to contain albumin, caseïn, glucose, and ligneous matter.

The decoction of the husk of the seed imparted a greyish colour to unmordanted silk. With iron mordants, a chestnut-brown colour was obtained, and an umber shade with salts of copper. The colouring matter is yielded by the inner portion of the husk.—A. K. M.

Contributions to the Chemistry of Fish Oils and Dégras. W. Fahrion. Chem. Zeit. 1893, **17**, 521.

See under XIV., *page* 938.

Dégras. B. Weiss. Der Gerber. 1893, **19**, 137.

See under XIV., *page* 937.

Dégras. W. Fahrion. Chem. Zeit. 1893, **17**, 524.

See under XIV., *page* 937.

Adulteration of Margarine with Sunflower Oil. A. Jolles and E. Wild. Chem. Zeit. 1893, 879.

The authors met with a sample of margarine which was undoubtedly sophisticated by the admixture of a vegetable oil. The margarine gave a positive reaction with Becchi's test for cotton oil, but a negative result for the latter oil when tested for by the nitric acid reaction (1·3 sp. gr.). This (in conjunction with a high iodine absorption) pointed to the presence of another oil; olive oil, rape oil, and also linseed oil, in the authors' opinion, being excluded on account of their high prices, they thought that sunflower oil might be the adulterant used. To differentiate sunflower oil from cotton oil the authors found the nitric acid test the only reliable one. Whilst cotton oil becomes brown on shaking with nitric acid, sunflower oil does not undergo any change on the same treatment; this is a distinct difference, which is also notable in mixtures of margarine with 10 per cent. of cotton or sunflower oils. Experiment proved the correctness of the conjecture of the authors that sunflower oil had been used for adulteration.

—J. L.

Contributions to the Knowledge of Train Oils. W. Fahrion. Chem. Zeit. 1893, 684—686.

This paper is a continuation of one abstracted in this Journal, 1893, 607.

The author has again examined various train oils for solid fatty acids and finds that they contain small quantities of palmitic acid, with which a little stearic acid is mixed. This is explained by the fact that most train oils are allowed to stand for some time before being brought into the market, whereby the solid glycerides are separated out. Amongst the liquid (unsaturated) acids of sardine oil (which is free from oleïc, linoleic, linolenic, and isolenic acids; see page 938) the author had previously found the new unsaturated acid, *jecoric acid*, $C_{18}H_{30}O_2$. He has now examined a sample of cod liver oil and of Japanese train oil for jecoric acid, but could not detect it with certainty, the ultimate analysis of the isolated product leading to the formula $C_{18}H_{34}O_2$. The determination of the iodine and acid values gives, according to the author, uncertain results in this case, polymerisation easily taking place in the course of the examination. Hydroxy acids, however, the presence of which in train oils had been asserted by Weiss, are not present in fresh train oils. Both samples of train oils examined last were treated as in the currying process, and the hydroxy acids formed by the accompanying oxidation process determined. They had increased from 0·6 and 0·7 per cent. to 14·5 and 23·0 per cent. respectively. The hydroxy acids owing their formation, according to the author, exclusively to the jecoric acid, the proportion of the other unsaturated fatty acids in the remaining not oxidised acids, must have been increased. An examination of the latter in this respect did not give a definite result, and the only conclusion that can be drawn is, that the presence of physetoleïc acid in train oil has not been proved. The author succeeded, however, in an indirect way, in proving the occurrence of an acid, $C_{17}H_{32}O_2$, by isolating from the oxidation products of Japanese train oil an acid of the formula $C_{17}H_{34}O_4$, which must be considered, according to Hazura's views, a dihydroxylated acid, derived from an acid $C_{17}H_{32}O_2$. The author names this new dihydroxyheptadecylic acid (nacreous laminæ, melting point 114°—116°, insoluble in cold, very sparingly soluble in hot water, with difficulty soluble in ether, easily soluble in warm alcohol) dihydroxyasellic acid, so that the hypothetical unsaturated acid $C_{17}H_{32}O_2$ must be named asellic acid.—J. L.

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* The term "saponification equivalent" is used by the author to signify the number of milligrammes of caustic potash (KHO) required to saponify 1 grm. of oil.

The Determination of the Flashing Points of Lubricating Oils. A. Martens. Mitth. Königl. Tech. Versuchs. 1893, 37—45.

This is a lengthy official report caused by discordant results having been obtained by different observers in the determination of the flash points made according to the rules laid down by the "Versuchsanstalten." The discrepancies are mainly due to variations in the proximity of the small flame to the surface of the oil, to currents of air, to differences in the manner and speed of heating up the oil, and to the personal equation of the observer.—J. L.

Patent Bread-Oil. Hefelmann. Pharm. Central-H., New Series, 1893, **14**, 405; Chem. Zeit. Rep. 1893, 205.

Bread-oil is used by the baker for smearing the oven plates. The so-called "patent bread-oil" was stated to be an American palm oil. It has an orange-red colour, a greenish fluorescence, a neutral taste, a specific gravity of 0·905, a saponification number of 4·2, an acid number of 0·32, and an iodine absorption of 13·9. It yields no acroleïn when heated on platinum foil, and thus, taking into account the other properties cited, it must consist practically of a pure mineral oil.—A. G. B.

PATENTS.

Improvements in the Steam Treatment of Oils and Fats for Purifying or Distilling Purposes. A. G. Petty, London. Eng. Pat. 16,954, September 22, 1892.

The treatment described relates to the steaming, at a low temperature and pressure, of oils and fats for improving their odour or flavour, whereby, it is stated, the deterioration caused by ordinary methods of steaming is avoided. For cotton-seed oil the temperature should not exceed 110° F., for butter and other animal fats it may reach 130° F., while for castor-oil, cocoa-nut oil, &c., as high a temperature as 212° F. may be employed, although a lower is preferable. Multiple-effect heaters may be used.—B. B.

An Improved Soap. J. Kennedy, Preston. Eng. Pat. 21,414, November 24, 1892.

100 parts of milk, skim-milk, or butter-milk are heated by open or closed steam to 110°—130° F., and treated with about 5 per cent. of carbonate of potash or soda, or a mixture of the two and sufficient borax "to dissolve up the potash or alkali." About 25 per cent. of the above mixture is added to soap after the latter is cast from the pan, the temperature of both being about 110°—130° F. Either hard or soft soap may be used. "It is" claimed "that sulphate of soda or other like potash or alkali may be employed in like proportion."—B. B.

Improvements in the Process of Cleaning and Extracting Oil and Grease from Cotton-waste and other Fibrous Materials. J. D. Barnett, London. Eng. Pat. 21,817, November 29, 1892.

The patent relates to improvements on Eng. Pat. 1652 of 1890 (this Journal, 1891, 134). The use of petroleum was claimed in the former patent, and the present patent consists essentially in the substitution of silicate of soda therefor. Two and a quarter hundredweight of silicate of soda are added to each ton of dirty waste, and the mixture is heated with steam under pressure in a closed vessel provided with an agitator. The time of treatment is about eight hours. The waste is then washed and dried, and the oil and grease may be recovered and used.—B. B.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

PATENTS.

A Method and Apparatus for Drying Colour Paste and other Strongly Aqueous Materials. E. Passburg, Moscow, Russia. Eng. Pat. 6326, April 12, 1884.

See under I., *page* 913.

Improvements in Treating or Preparing Gutta-percha and Rubber for various Purposes. A. Hutchison, Cowlairs. Eng. Pat. 17,739, October 5, 1892.

This invention consists in the combination of gutta-percha or india-rubber with lanolin or more or less purified wool cholesterin, at a temperature of about 212° F.—C. O. W.

The Utilisation of a Certain Waste Oxide of Iron in the Manufacture of Paints and Pigments, and for other Purposes. T. Harris, Runcorn, and H. C. Sacré, Manchester. Eng. Pat. 20,547, November 14, 1892.

The ferric hydrate obtained in the purification of chloride of zinc is washed with water, dried, and then calcined in a furnace. Red oxide of iron is obtained, which may be used as a pigment for paints.—C. O. W.

Improvements in the Manufacture of White Lead and Coloured Pigments. R. Matthews, London, and J. Road, Essex. Eng. Pat. 20,891, November 17, 1892.

Lead oxide or litharge is ground in water until it is converted into a hydroxide. To every 20 ounces of this hydroxide one gallon of water, containing one ounce of acetic acid (40° B.) and one ounce of glycerin, is added. The whole is agitated at intervals for about 48 hours and is then treated with carbonic acid. The carbonate of lead so obtained is then washed and dried. If it is desired to obtain coloured pigments, colouring agents, such as, for instance, yellow prussiate and ferric chloride, are added to the above lead preparation.—C. O. W.

Improvements in the Manufacture of Water Colours. J. Horadam, Düsseldorf. Eng. Pat. 21,639, November 26, 1292.

This invention consists in preparing water colours without ox gall, and mixing with the particular colour taurocholic acid or its salts (free from glycocholic acid), or taurin, or the salts of taurocholic acid.—C. O. W.

Improvements in or relating to Rubber Fabric. J. F. Palmer, Riverside, Ill., America. Eng. Pat. 4926, March 7, 1893.

The purpose of this invention is to produce a rubber fabric which will stretch freely in one direction only, and to arrange the fibres in the fabric in such a way as to prevent their cutting each other on bending, folding, or twisting the fabric. This result is obtained by embedding in a sheet of rubber, parallel fibrous threads, which are so arranged as to be out of contact with each other. This fabric, when vulcanised, will not stretch longitudinally, but will freely stretch transversely. If a fabric is desired which shall stretch in neither direction, two plies of fabric are so arranged one upon the other, that the threads of one are at right angles to the threads of the other.—C. O. W.

Improvements in or relating to Rubber Tubing applicable for Wheel Tyres. J. F. Palmer, Riverside, Ill., America. Eng. Pat. 4926a, March 7, 1893.

Fabrics prepared according to the preceding patent are cut into narrow strips and wound spirally upon the rubber tubes to be covered, first in one, and then in the opposite direction, and then vulcanise all together. In this manner the longitudinal distension of the tubes is lessened and the transverse distension lessened. A tube may also be made from the fabric by cutting out of it a strip at right angles to the line of threads, the meeting edges of the fabric being sealed in any convenient way.—C. O. W.

Process and Means for Obtaining Colour Leaf which can be used in the same way as Gold Leaf for Blocking and like Purposes. H. Ernst, Berlin. Eng. Pat. 5216, March 10, 1893.

A mixture of about 70 per cent. of 2 per cent. of collodium solution and 30 per cent. of oil colour, is poured on to a polished surface and the thin leaves which form are loosened when perfectly dry.—C. O. W.

Improvements in the Manufacture of Preservative Driers and Drying Compounds for Varnishes, Oils, and the like. T. G. Hojar, New York. Eng. Pat. 13,450, July 11, 1893.

This drier is obtained by mixing a solution of 151 parts of manganese sulphate, or of 126 parts of manganese chloride, with 74 parts of slaked lime.—C. O. W.

A New or Improved Method or Process of Manufacture of India Rubber, especially applicable for the Tyres of Wheels for Cycles and other Vehicles. Z. Arboucau, Paris. Eng. Pat. 14,224, July 22, 1893.

This invention refers to the manufacture of tyres from india-rubber, consisting of a number of air cells or chambers separated by partitions, the cells being filled with air or gas. In carrying out the invention unvulcanised india-rubber tubes of suitable section are compressed at different places, whereby a succession of cells is obtained, and by cutting a number of cells result, closed at both ends and incapable after vulcanisation of being flattened, by reason of the air contained in them. Tubes divided into cells, or cut into separate cells are massed together in moulds, and vulcanised together.—C. O. W.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

Dégras. B. Weiss. Der Gerber, 1893, **19**, 137—138.

In this criticism of Fahrion's recent paper on the subject (preceding abstract), the author points out that Fahrion has no right to assume the identity of the oxidation products of [*]sardine-oil with those of the fish oils employed in the chamois leather manufacture and therefore in the production of dégras, which are almost invariably liver oils or the blubber oils of sea-mammals, whilst sardine-oil is not a liver oil. On this latter account the name jecoric acid (Latin, *jecur*) is ill-chosen for the acids obtained by Fahrion from sardine-oil. The analyses, and conclusions drawn therefrom, in Fahrion's paper are somewhat severely handled, and the author concludes that there are not sufficient grounds for the statement that a dégras equal in value to that obtained in the chamois leather process can be produced by oxidising fish oil in the manner suggested, nor for regarding the dégras-former as a mixture of hydroxyjecoric acids and their anhydrides, mixed with impurities of nitrogenous matter.—A. G. B.

Dégras. W. Fahrion. Chem. Zeit. 1893, **17**, 524—525.
Compare preceding abstract.

A considerable amount of information concerning dégras and the "dégras-former," will be found already given in this Journal, 1892, 639, and 1891, 557. Suspecting that the "degras-former" would prove to be identical with a mixture of hydroxyjecoric acids and their anhydrides, the author extracted a German dégras by means of water and ether, and thus it was freed from nitrogenous constituents and fatty matters other than those constituting the dégras-former, the insolubility of which in ether has been established by Simand (this Journal, 1891, 557). The viscid red oil thus obtained partially solidified on cooling, and gave the following analytical numbers :—

Sodium number............	55·1	
Acid number...............	79·5	
Unsaponifiable matter	3·6	per cent.
Fatty acids.	73·0	„
Total hydroxy acids........	16·9	„
Solid hydroxy acids	7·6	„

The water-extracted dégras contains volatile substances: the hydroxy fatty acids separated from these were obtained in the form of brown clots, and by means of barium chloride were separated into a solid hydroxy acid I, in the form of a brown amorphous powder, a solid hydroxy acid II, as a brown plastic mass, and a non-solidifying hydroxy acid. The iodine numbers of these products were 59·0, 49·3, and 62·0 respectively, and the percentages of carbon and hydrogen were as follows :—

——	C.	H.
Liquid hydroxy acids............	72·19	10·35
Solid hydroxy acids I............	63·43	7·55
Solid hydroxy acids II...........	62·03	7·55

The hydroxy acids were also separated from a French dégras. The water- and nitrogen-free *moëllon* proved to be a thick, dark red oil, and gave the following figures :—

Iodine number............	59·9	
Acid number...............	71·7	
Unsaponifiable matter.....	1·6	per cent.
Fatty acids..................	74·2	„
Total hydroxy acids	13·2	„
Solid hydroxy acids	6·6	

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[*] According to Villon, "*Traité pratique de la Fabrication des Cuirs et Peaux,*" sardine-oil is frequently used in France in chamoising.

The hydroxy acids were similar in appearance and behaviour to those already described; the liquid acid gave the iodine number 72·4, and contained 72·17 per cent. of carbon and 10·31 per cent. of hydrogen.

The conclusion which the author draws from these experiments is that the dégras expressed from stocked and piled chamois leather is a partially oxidised fish oil, mixed with more or less nitrogenous matter derived from the skin. Simand's dégras-former is a mixture of hydroxyjecoric acids and their anhydrides, containing nitrogenous substances as impurities.

The demand for a larger output of dégras than that at present yielded by the chamois leather trade suggests the manufacture of it as a primary product, finished chamois leather being saturated with fish oil, exposed to the air until the same has been partially oxidised and pressed. The author considers that this dégras should be a purer product inasmuch as it should be less contaminated with cholesterol and nitrogenous matter from the skin; nor should a higher value be attached to the true by-product.

An artificial dégras prepared in this way from sardine oil was a thick red oil, and gave the following figures, compared with those of the original oil:—

——	Sardine Oil.	Dégras.
Iodine number	193·2	75·4
Acid number	20·6	29·6
Unsaponifiable matter	0·6	1·0
Fatty acids	94·5	65·8
Total hydroxy acids	0·7	23·0
Solid hydroxy acids	0·2	7·3

Jean's method (this Journal, 1891, 557) for estimating water in dégras by mixing it with sand and drying at 120° is inadmissible, for the hydroxy acids are both volatile and alterable at this temperature. The author considers that his method (this Journal, 1891, 557; also 1892, 639) remains the best.—A. G. B.

Contributions to the Chemistry of Fish Oils.

W. Fahrion. Chem. Zeit. 1893, **17**, 521—524.

It is generally supposed that the fatty acid characteristic of fish oils is physetoleic acid, discovered by Hofstaedter, in walrus oil (Annalen. **91**, 177), which is a fluid wax. If present in true fish oils, however, it must be accompanied by one or more unsaturated fatty acids, because the iodine absorption of fish oils lies generally between 130 and 160, while the calculated figure for the glyceride of physetoleic acid is 94·9. The author's experiments were made on a sample of sardine oil which had already served for a previous investigation (see preceding abstracts) and was chosen on account of the readiness with which it underwent oxidation. In the fresh state this oil was reddish-yellow in colour and had only a slight smell. It gave the following analytical figures:—

Sp. gr.	0·933
Iodine number	193·2
Acid „	20·6
Ash	Trace
Unsaponifiable matter	0·6 per cent.
Insoluble fatty acids (Hehner's number)	94·5 „
Total hydroxy fatty acids	0·7 „
Solid hydroxy fatty acids	0·2 „

The method for the determination of the insoluble unoxidised fatty acids and total hydroxy fatty acids was that described in the abstract already quoted. The estimation of the solid hydroxy fatty acids was effected in the same way as for the total hydroxy fatty acids, but with the use of ether instead of petroleum ether (Zeits. ang. Chem. 1891, 634). The liquid fatty acids from this oil were prepared by the extraction of the barium salts with ether, and the removal of the hydroxy fatty acids formed during the process of preparation was performed by treatment with petroleum ether. The product was a bright yellow perfectly fluid oil, not readily solidified, while physetoleic acid prepared by Hofstaedter is stated to have a melting point of 30° C. The analysis of these fatty acids gave the following results:—

——	Found.	Calculated for $C_{18}H_{30}O_2$
C	78·21 per cent. 77·85 „	77·70 per cent.
H	11·36 „ 11·20 „	10·79 „
Iodine number	229·4	273·0
Acid „	189·4	201·4
Saponification number	201·0—202·5	201·4
Ba in barium salt	19·91 per cent. 19·86 „	19·83 per cent.
Ca in calcium salt	6·55 „ 6·71 „	6·73 „
Mg in magnesium salt	4·25 „	4·15 „

These values (except the percentages of carbon and hydrogen) are selected from numerous results, which the author considers influenced by the constant tendency of the free fatty acid to polymerise (see preceding abstract). On the basis of the figures obtained by combustion he concludes that the oil is essentially composed of a fatty acid having the formula $C_{18}H_{30}O_2$, to which he gives the name *jecoric acid*, isomeric with linolenic and isolinolenic acid. The large variations in the iodine absorption of fish oils may be attributed to the presence of different percentages of this acid.

Further investigation of the sardine oil showed that the only solid fatty acid present was palmitic acid, whereby it is distinguished from most fish oils which also contain stearic acid. Using Allen's modification of Varrentrapp's method for the determination of palmitic acid, 17·6 per cent. of a highly-coloured product was obtained, a quantity which on recrystallisation fell to 11·3 per cent. A fair concordance was obtained by Mulder's method of refrigerating an alcoholic solution of the total fatty acids, which gave 9·8 per cent. of palmitic acid, a result which is necessarily low from the nature of the method. By limited oxidation of the fatty acids by potassium permanganate in alkaline solution 13·6 per cent. of approximately pure palmitic acid was obtained, corresponding to 14·3 per cent. of tripalmitic. From these results the composition of sardine oil is reckoned to be 14·3 per cent. of tripalmitin and 85·7 per cent. of trijecorin, giving an ultimate composition of C 78·08 per cent., H 10·78 per cent., O 11·56 per cent., as against C 77·58 per cent., H 11·34 per cent., O 11·08 per cent. found by combustion.

According to the dicta of Hazura, jecoric acid should yield hexahydroxystearic acid, $C_{18}H_{36}O_8$, on oxidation with potassium permanganate in alkaline solution. This product was however not obtained, only volatile fatty acids and carbonic acid being produced.

An attempt to prepare definite oxidation products by treatment of the oil with nitric acid failed, owing to the formation of nitro-derivatives. On exposing the oil to the air in a flat porcelain dish for three weeks, a sticky mass was obtained, nearly insoluble in ether and petroleum ether, but soluble in alcohol, which gave the following figures on analysis:—

	Per Cent.
Iodine number	61·3
Acid number	53·1
Unoxidised fatty acids	47·1
Total hydroxy acids	25·2
Solid hydroxy acids	13·9

The oil never yields a solid mass like that given by typical drying oils, but, at most, becomes resinous. By oxidising the oil with hot air, various products were obtained, the chief of which were identified by the author as hydroxyjecoric acid, $C_{18}H_{30}O_3$, and dihydroxyjecoric acid, $C_{18}H_{30}O_4$, both substances soluble in ether and easily oxidised further, the whole process of oxidation being analogous to that which occurs with linolenic and isolinolenic acid when linseed oil is allowed to dry.—B. B.

Examination of Glue. R. Kissling. Chem. Zeit. 1893, **17**, 726.

See under XXIII., *page* 952.

Gambier. U.S. Consular Rep. No. 149, February 1893, 201—202.

Gambier is obtained from the leaves and twigs of the *Uncaria gambia* plant (Nat. Ord. *Rubiaceæ*) which occurs wild and is cultivated in the Straits Settlements, Jahore, Java, and Sumatra. The manufacture is very primitive. A plantation is generally cropped after about 18 months, the cropping being repeated as much as four times a year. The leaves, &c. are boiled until a syrup is obtained, the extract poured off, cooled and stirred until it commences to solidify, it is then cut into cubes and air-dried, or dried in smoke. A plantation lasts about 10 years and is abandoned in 15 years at the latest. It is pale brown or yellow, and has an even, earthy fracture; the quality varies much and adulteration is practised. It seems to have been used in India for dyeing at a very remote period, and was introduced into Europe at the beginning of this century; it is now extensively used in dyeing, and is a valuable medicine. It is rapidly coming into use for tanning purposes. Owing to the cheapness of its production it will probably in time take the place of hemlock bark. The importation from the Straits Settlements and Japan into Great Britain is 20,000 tons per annum. The amount shipped through Singapore to the United States for the year 1891 was 113,730 piculs (1 picul = 133⅓ lb.) or about one-ninth of the total export. With improved management the production of gambier is certain to develop largely before long.—N. H. J. M.

Tannin and other Principles of Carob (*Cæsalpinia Melanocarpa*). J. J. Arnaudon. Monit. Scient. [4], **7**, 107—108.

The name carob as used in commerce includes the fruits of several leguminous plants; the true carob seems to be *Cæsalpinia melanocarpa*, and is produced by the tree known as "guaïacan" in Central America. This is a large tree varying from 8 to 15 metres high and 0·4 to 1·0 metre in diameter. The wood is dry and dark brown, and its sp. gr. = 1·27 to 1·44.

The mealy matter of the dried pods is soluble to the extent of more than one-half in alcohol, yielding a solution containing a kind of tannin, carob-tannic acid, a resinous gum, a yellow colouring matter, and a special sugar mixed with ordinary sugar. Carob dissolves almost entirely in boiling water, forming a pale yellow solution which gives the following reactions with various reagents :—

Sulphuric, hydrochloric, and oxalic acids : turbidly.

Potash, soda, and ammonia : brown colour and slight precipitate.

Lime and baryta : brown colour and white precipitate which changes to brown.

Alum and tin bichloride : yellowish-brown precipitate.

Aluminium acetate : abundant yellow precipitate.

Lead acetate : abundant greenish-yellow precipitate, and a clear supernatant liquid.

Copper acetate : abundant reddish-brown precipitate and greenish flocculent matter.

Iron salts in excess : the liquid blackens and a blue-black precipitate is formed.

Iron salts in smaller amount : dark grey colour.

Potassium bichromate : yellowish-brown colour and ochre-like sediment.

Gelatin and quinine sulphate : abundant yellowish-brown precipitates.

Rosaniline salts : precipitate.

When wool, silk, and cotton are passed through the carob derivative, exposed to air, and, after 24 hours mordanted with iron chloride and pyrolignite, and gradually heated for two hours to 90° they become black; an exposure of 30 years had no effect on the dye. If the materials, after being boiled in the carob-bath, are immersed in a solution of potassium bichromate, they acquire a dark greenish-brown colour.

Comparative experiments were made in tanning sheep skin with carob and with Sicilian sumac and holm oak. Carob proved to be better than the same quantity of sumac; but the tanning is more coloured (reddish-yellow). The liquid in which the skins have been tanned has a distinct spirituous odour and an aroma like that of apples. The filtered liquid, when distilled, yielded an alcohol of an ethereal odour. Carob contains a starchy substance and a fermentable sugar analogous to mannitol.—N. H. J. M.

The Production and Uses of Kapok Fibre (*Kapok Oil*). J. Soc. Arts, 1893, 1030.

See under V., *page* 923.

PATENT.

Improved Process of and Apparatus for Tanning and cleaning Hides and Skins. T. Cowburn, Vienna, Austria. Eng. Pat. 21,551, November 25, 1892.

This consists in rocking the hides or skins with the tanning liquid, in a closed box, in such a manner that the hides or skins are dashed to and fro, and lie alternately on the hair side and flesh side, while being submerged in the liquid. For this purpose a closed box supported by an axis situated below the level of the liquid is employed. The rocking motion being supplied by means of a crank lever or other suitable mechanism.—J. C. C.

XV.—MANURES, Etc.

PATENTS.

Improvements in Machines or Apparatus for Grinding or Reducing Phosphates, Bones, or other Substances. J. N. Askham, Sheffield. Eng. Pat. 15,924, September 5, 1892.

See under I., *page* 913.

An Improved Dressing for Hop Plants applicable to other Plants. H. S. Beaumont and F. Haigh, Huddersfield. Eng. Pat. 22,691, December 10, 1892.

The improved dressing proposed consists of an aqueous decoction of quassi bark, mixed with an aqueous solution of copper sulphate, gum arabic and tobacco juice.—J. G. W.

XVI.—SUGAR, STARCH, GUM, Etc.

Researches on the Sugar of the Agave Americana. G. Michaud and J. F. Tristan. Amer. Chem. J. **14**, 548—550.

A crystalline sugar was obtained from the juice of the *agave americana.* Its composition is represented by the formula $C_{12}H_{22}O_{11}$, its aqueous solution is optically inactive and has a cupric reducing power about $\frac{5}{8}$ that of glucose.

It forms a compound with lime from which the sugar is easily recovered; oxidised with nitric acid it yields no mucic acid; when inverted with hydrochloric acid it yields a sugar or mixture of sugars having a rotatory power $[\alpha]_y = -14{\cdot}5$, and the same cupric reducing power as glucose. The authors propose to call the sugar *agarose.* —A. L. S.

The Action of Ferric Oxide and Ferric Hydrate on Cane Sugar. Schachtrupp and Spunt. Zeits. für Rübenzuck. Ind. **30**, 215. Pharm. Centralhalle, 1893, **11**, 148.

Ferric oxide has an invertive action on cane sugar but the hydrate has none. Ferric oxide is not directly soluble in cane sugar solution, but only after inversion has taken place, when an iron saccharate is formed. This invertive action does not take place in alkaline solutions, but in neutral solutions it is possible to effect a complete inversion of the cane sugar. The amount of iron dissolved as saccharate is directly proportional to the amount of invert sugar formed, which is again dependent on the concentration of the sugar solution and on the quantity of ferric oxide employed.—J. G. W.

The decomposition of Galactose by means of Calcium Hydrate. H. Sanda. Zeits. für Rübenzuck. Ind. **31**, 27—35.

When galactose, in aqueous solution, is acted on by calcium oxide at ordinary temperatures metasaccharin is formed and in much greater quantity than when milk sugar is submitted to the same treatment. To prepare metasaccharin, the author recommends heating the strong alkaline solution, which remains at the conclusion of the reaction at ordinary temperatures, to the boiling point for some hours and then crystallising the metasaccharin out in the form of its calcium salt. In addition to metasaccharin another and hitherto unknown saccharin *parasaccharin*, is formed. It is itself uncrystallisable, but yields a finely crystalline barium salt $((C_6H_{11}O_6)_2\,Ba.4H_2O)$, which bears a striking resemblance to the barium salt of metasaccharic acid, so much so that the two will crystallise together. On the other hand, the calcium and phenylhydrazin compounds of parasaccharic acid do not resemble the analogous compounds of metasaccharic acid in crystalline form.

Dextrose does not yield parasaccharin when treated in the same way.

Parasaccharin yields α-ethylbutyrolactone on reduction with fuming hydriodic acid and so contains a carbon-chain, in addition to those existing in the already known saccharin. On oxidation with silver oxide it yields, besides other bodies, glycollic acid, but no acetic acid.

Metasaccharin is, in a weak sulphuric acid solution, reduced to a sugar which forms a non-crystallisable and abnormal osazone.—J. G. W.

PATENTS.

Improvements in or Relating to Adhesive Pastes for use in Posting Bills, Hanging Wall Papers, and other Purposes. W. Bell, Birkenhead, M. A. Scott, Birkenhead, T. H. Fox, St. Helens, and A. E. Richardson, Bootle. Eng. Pat. 16,581, September 16, 1892.

The patentees claim the production of an adhesive paste consisting mainly or entirely of flour, together with caustic soda, boiled flour paste, and water or other suitable solvent. The following receipt may be cited for the preparation of a paste suitable for posting bills, the patentees do not, however, confine themselves to fixed proportions:—3 lb. of flour and $5\frac{1}{2}$ quarts of water are beaten together, and the resulting batter mixed with a solution of $\frac{1}{2}$ lb. of caustic soda in $5\frac{1}{2}$ quarts of cold water, and 22 quarts of cold water are stirred into the mixture. To 2—3 parts of this mixture one part of boiled flour-paste or starch-paste is added.—A. R. L.

Improvements in the Treatment of Starch-containing Substances for Use in Brewing, Distilling, the Manufacture of Glucose, and in similar Operations. S. Pratt, Lower Tooting. Eng. Pat. 3302, February 14, 1893.

The process claimed is for the production of a "highly-liquid starch-containing solution." Raw grain (336 lb.) and ground malt (17—68 lb.) are added to about 330 gallons of water at a temperature of 140° F., the mixture gradually raised to a temperature of 180° F., and finally treated with steam at a pressure of 100—175 lb. per square inch.—A. R. L.

An Improved Apparatus and Process for Purifying Sugar Saccharine, and the like, also applicable to Oils, Alcohol, and other Liquids which need Purifying. W. H. Wayland, Marylebone. Eng. Pat. 8367, April 25, 1893.

A suitable quantity of "magnetic porous or spongy iron or iron in combination with carbon" is placed in the lower part of a cistern constructed preferably of glass, and furnished with an outlet pipe. The substance to be purified is then poured into the cistern and the latter closed hermetically. Oxygen, ozone, or atmospheric air is now forced into the cistern by means of tubes lying on the bottom or along the lower part of the cistern, which tubes are perforated so as to allow the oxygen to thoroughly impregnate the iron, and to pass through it and through the substance to be purified.—A. R. L.

Improvements in Continuous Subsiding or Settling Apparatus for Sugar-cane Juice. W. Smith, Glasgow. From H. Kidd, Sydney, New South Wales. Eng. Pat. 15,300, August 11, 1893.

This invention relates to a subsiding or settling apparatus for cane-juice, consisting of a vessel furnished with an overflow outlet at the top for the juice, and, at some distance below this outlet, radiating hollow arms receiving the entering juice from a hollow centre-piece and distributing it through perforations on their under sides. —A. R. L.

Improvements in Apparatus for Treating Shredded or Comminuted Sugar Canes Preparatory to Crushing. W. Smith, Glasgow. From H. Kidd, Sydney, New South Wales. Eng. Pat. 15,304, August 11, 1893.

The apparatus consists of an inclined trough into the lower end of which the shredded or comminuted cane is delivered from the shredding apparatus. The shredded cane is conveyed on an endless chain conveyor, to which rakes are attached at intervals, to the crushing mill, and is, during its transit, subjected to the action of steam. —A. R. L.

XVII.—BREWING, WINES, SPIRITS, Etc.

The Estimation of the Intensity of Colour of Wort and Beer. F. Cerny. Zeit. ges. Brauw. 1893, **16**, 39; Chem. Zeit. Rep. 1893, **17**, 151.

C. J. Lintner's recently described method (see this Journal, 1892, **11**, 1037—1038), requires two standard solutions, one for pale and the other for dark beers and black malts.

These solutions are not comparable with one another, which is a disadvantage, and especially when the liquid under examination approaches both the standards in tint. Iron ammonium alum solution also has the disadvantage that its colour intensity is not proportional to its concentration.

The author prepares a colorimetric material from malt in the following way :—A pale malt-wort is evaporated to a syrup, and a small portion of it slightly caramelised and then returned to the main portion. The syrup is mixed with a saturated solution of ammonium sulphate, and the mixture thoroughly shaken up with absolute alcohol. After settling, the reddish-brown alcoholic solution is filtered off from the thick syrup, which falls to the bottom. This solution contains the greater part of the colouring matter of the malt and, when diluted with 75 per cent. alcohol, closely approximates in all degrees of concentration to the colour of malt-extracts and beers. The colour-intensity of this alcoholic solution is determined with Lintner's No. 1 solution, and the colour-intensity of black malts and the darkest beers can then be determined with its aid and expressed in terms of Lintner's No. 1 solution, or in terms of the standard colorimetric scale which the author describes.—J. G. W.

The Use of Antinonnin in the Brewery. L. Aubry. Zeits. ges. Brauw. 1893, **16**, 141 ; Chem. Zeit. Rep. 1893, **17**, 139.

Antinonnin occurs in commerce as a mixture of the potassium compound of orthodinitrocresol, soap, and glycerol. The author recommends its use in very dilute solution for disinfecting and preservative purposes. He states that if yeast be treated with solutions containing up to 5 per cent. of antinonnin, all bacteria existing in it will be destroyed without the vitality of the yeast being affected. A solution containing from 0·1 to 0·2 per cent. is recommended for washing wood-work, sprinkling cellar walls, &c. as a protection against fungoid and bacterial growths. It cannot be used for surfaces with which wort or beer comes in direct contact, on account of its poisonous nature.

—J. G. W.

The Diagnosis of Wines as based on their Chemical Analysis. J. Nessler. Chem. Zeit. 1893, **17**, 577.

An adverse criticism of the new German regulations regarding the adulteration of wine, which proclaim that the addition of sugar solution shall not be sufficiently great to make (*a*) the total extractive matter lower than 1·5 per cent., or the extractive matter, after deduction of the non-volatile acids, lower than 1·1 per cent., or, after further deduction of the free acids, lower than 1 per cent., and (*b*), the mineral constituents lower than 0·14 per cent. The author contends that these analytical limits would not prevent many adulterated wines from being passed as genuine.—J. G. W.

Iodine as an Indicator in the Estimation of the Acidity of Coloured Plant Extracts, Worts, Beers, &c. H. Petersen. Zeits. ges. Brauw. 1893, **16**, 243 ; Chem. Zeit. Rep. 1893, 204.

See under XXIII., *page* 952.

The Determination of Isomaltose. A. Bau. Chem. Zeit. 1893, **17**, 499.

It is well known that when beer wort is fermented with pure cultures of Saaz yeast and ordinary yeast (*e.g.*, Frohberg yeast) different degrees of attenuation are obtained. The difference in the specific gravities of the resulting products is attributed by the author to isomaltose which he assumes to be fermentable by ordinary yeast but not by Saaz yeast. In support of this view, he describes experiments in which he isolated isomaltosazone from beer prepared with Saaz yeast. Whilst this beer contained 1·10 per cent. of a substance fermentable by ordinary yeast but not by Saaz yeast, the amount of osazone obtained was equivalent to 0·1392 per cent. isomaltose. The discrepancy is explained by the poor yield of osazone usually obtainable.

—A. K. M.

Influence of Alkalis in Steaming Starchy Raw Materials. F. Stiasny. Zeits. Spiritusind. 1893, **16**, 190 ; Chem. Zeit. Rep. 1893, 210.

Experiments were made with a view of ascertaining whether alkalis would aid the opening up of starchy materials. Different meals were steamed at 1·8—2·8 atmospheres, with addition of 0·3—2·5 per cent. (on 100 parts of starch) of Na_2O in the form of caustic soda. Afterwards the alkali was neutralised with hydrochloric acid and the meal left acid to the extent of 0·1 per cent., this acidity being found favourable to diastatic action.

The following conclusions are drawn :—(1.) Contrary to recent pronouncements, maize grist is beneficially influenced when steamed in presence of dilute alkali, being opened up at a lower temperature ; the resulting mash is uniform, attenuated, and a clear yellow colour. (2.) The starch grains which have been steamed in presence of alkali are easily and fully inverted by diastase after the alkali has been neutralised with hydrochloric acid. (3.) The fermentation proceeds smoothly, nearly the whole process occurring at a saccharometer indication of 0·1—0·0. The acidity of the fermented mash corresponds with 0·36 per cent. of lactic acid, which may be deemed favourable. (4.) The fermentation shows a lusty and pure yeast development under the microscope ; the colour is clear yellow. (5.) The alcohol yield is 34·25—34·75 litres per cent. per 100 kilos. of raw material.

A further recommendation for the method is that maize which has been opened up with caustic soda yields, after neutralisation and saccharification, a considerable quantity of maize oil, which is finding an extending application.

—A. G. B.

PATENTS.

Improvements in Brewing Stout and Porter. J. Rose, Nettleton, Lincolnshire. Eng. Pat. 17,329, October 29, 1890. (This Journal, 1890, 719.)

This patent is now amended so as to include only the use of malted barley and oats.—A. L. S.

Improvements in Means or Apparatus for Maturing and Improving Fermented Alcoholic Liquids, applicable also for Oxidising Oleaginous and other Liquids. W. S. Martin, Paris. Eng. Pat. 22,413, December 22, 1891. (This Journal, 1893, 54.)

The patent is now amended by directing that the current of oxygen should impinge at right angles to the direction of the liquid.—A. L. S.

A New or Improved Process or Manufacture of Non-injurious Beverages from Liquids containing Alcohol. W. Rohowsky, Hoch Kretscham, near Nassiedel, Silesia, Germany. Eng. Pat. 16,563, September 16, 1892.

The liquids are treated with oxygen, peroxide of hydrogen, or ozone. The peroxide of hydrogen is added in the proportion of 1·5 per cent. of the absolute alcohol, and the ozone in solutions containing $\frac{1}{10}$ this quantity. A greater amount is used for the cruder kinds of spirits. After the addition of one of these oxidising agents, the mixture is well shaken and allowed to stand. The clear solution is decanted off, and should be consumed soon.—A. L. S.

Improvements in the Mode of Clarifying and Reviving Ale, Beer, and other Liquids. A. T. Harris, Harrow, Middlesex. Eng. Pat. 18,370, October 13, 1892.

The apparatus consists of an atmospheric gas burner, enclosed in a copper tube, and furnished with an adequate air supply. The apparatus containing the burning gas is introduced into a cask through the bung-hole, and the slight warming produces a bright and sparkling appearance in the liquor.—A. L. S.

Improved Construction of Dephlegmators or Apparatus for Condensing and Separating Aqueous Constituents and Impurities from Alcoholic Vapours. A. Jenik, Skalat, Galicia, Austria. Eng. Pat. 20,773, November 16, 1892.

The dephlegmator or other apparatus for producing pure spirit, free from fusel oil and aldehyde, is characterised by two helical passages, the one arranged above the other. Through one of these the condensing water passes downwards, and through the other the alcoholic vapour passes upwards. The latter is divided into two portions by a series of step-like plates. The condensed water and impurities collect in the smaller portion and flow away.
A. L. S.

An Improved Dressing for Hop Plants, applicable to other Plants. H. S. Beaumont and F. Haigh, Huddersfield. Eng. Pat. 22,691, December 10, 1892.

See under XV., *page* 939.

Improvements in Apparatus for Drying Brewers' Grains and the like. J. Y. Johnson, Glasgow. From C. H. Koyl, New York. Eng. Pat. 7838, April 18, 1893.

The grain is passed through the kiln or drying chamber on a series of endless bands arranged one above the other, the wet grains being thrown in on to the topmost band and being discharged at the bottom. At one end of the kiln is placed the furnace, and the hot air is drawn through the kiln by fans placed at the opposite end thereof. The fans are so arranged that more suction is exerted at the lower exits than at the higher, as hot air, having a natural tendency to rise, would otherwise chiefly pass along the higher parts of the kiln.—A. L. S.

Apparatus for Sterilising Beer, Wine, and other Liquids under Pressure. J. B. Tröndle, Halle-on-Saale, Germany. Eng. Pat. 14,967, August 4, 1893.

The proposed apparatus consists of a closed vessel furnished with safety-valves, stop-cocks, &c., in which the liquids may be sterilised by heating under pressure.
—A. L. S.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(*A.*)—CHEMISTRY OF FOODS.

Improvements in Bread. M. Weibull. Chem. Zeit. 1893, **17**, 501—502.

The inferior quality of the rye-bread of last year was due in part to a want of gluten and in part to the gluten having undergone a change which had a deleterious effect on the baking of the bread. There are two ways of making good bread from such flour, namely, either to add some wheat-flour, which contains a greater proportion of gluten, and the constituents of which are more favourable, or to employ some substance which precipitates the soluble constituents of the gluten. Alum and copper sulphate have this effect, but their employment is of course to be condemned, and the author recommends the use of ordinary salt, which produces the same effect. To obtain good bread from 1891 rye, it was necessary to employ at least 1 per cent. of salt.

Another way to improve the quality of rye-bread is to use skimmed-milk in the place of water. This is seen in the following table, which shows the composition of the bread made with water and with milk, also of the rye-flour and milk employed :—

—	Milk.	Rye-Flour.	Milk-Bread.	Water-Bread.
Water	91·35	9·88	38·82	38·33
Fat	0·18	1·33	0·67	0·48
Digestible proteīn	3·32	8·00	7·06	5·99
Indigestible proteīn	..	0·13	0·27	0·32
Sugar	4·40	..	4·37	1·99
Dextrin and gum	..	..	7·46	8·04
Other carbohydrates (starch).	..	80·16	39·96	43·74
Cellulose	..	0·69	0·56	0·53
Ash	0·75	0·85	0·83	0·58
Phosphoric acid contained in ash.	0·25	0·21	0·29	0·18

It will be seen that all the important nourishing constituents are increased by the employment of milk, especially the digestible proteīn and the sugar; the ash also contains a greater quantity of phosphoric acid. The proportion of nitrogenous to non-nitrogenous nutrient substances is also more favourable in the milk-bread than in the water-bread and in the rye-flour.—A. K. M.

PATENTS.

New or Improved Manufacture of a Substance or Composition suitable for Use as a Substitute for Cocoa. J. Berlit, Cassel, Germany. Eng. Pat. 18,064, October 10, 1892.

Oats are bruised or rough-ground, roasted, and reduced to flour between rollers or edge-runners. The product is made into a paste with water, which is then removed by evaporation in a vacuum pan, and the resulting dried mass again ground, after which treatment it is mixed with cocoa from which the oil has been removed.—B. B.

Improvements in Apparatus for Purifying Water. R. M. Deeley and L. Archbutt, Derby. Eng. Pat. 19,830, November 3, 1892.

This is a modification of a previous patent, Eng. Pat. 1791, 1889, whereby reagents intended for mixing with the water for purposes of purification are now introduced into the body of the tank by means of a blower and perforated pipes instead of being placed in the "well and trajector" previously used. By the prescribed use of certain three-way plug cocks, valves, and pipes, air can either be blown into the tanks, carrying with it a current of water in which the chemicals have previously been dissolved, or air alone can be injected, for forcibly mixing the ingredients and stirring up the mud deposited, or the surplus deposit can be withdrawn and removed as may be desired.—B.

Improvements in the Treatment of Bananas and Plantains for Production of Meal and Flour therefrom. L. E. Asser, The Hague, and L. A. H. Hartogh, Amsterdam, Holland. Eng. Pat. 21,038, November 18, 1892.

The fruit to be preserved is picked while green, steamed in a closed vessel, peeled, pulped, and dried, when it can be ground and packed.—B. B.

An Improved Process of Preserving Dried Vegetables. G. Dupont-Dennis, Nantes, France. Eng. Pat. 21,623, November 26, 1892.

Dried vegetables, such as haricot beans, are placed in a vessel of wire cloth and steeped in water at 30° C., the temperature being gradually raised to 50° C. After steeping for 2½ hours the haricots are withdrawn and plunged into a saturated solution of salt at 50° C. They are then transferred to vessels with perforated false bottoms, the beans being enveloped in a wet cloth. A small quantity of water is placed below the false bottom, and the vessels are covered, clamped into a pile, and exposed to a temperature of 100° C. to 102° C. in a steam bath for 2½ hours. The haricots are allowed to cool, dried at a low temperature, and are then ready for storage.—B. B.

An Improved Process for Sterilising Liquids and Apparatus to be used therefor. G. Popp and J. H. Becker, London. Eng. Pat. 5957, March 20, 1893.

The vessels containing the liquid to be sterilised are provided with stoppers consisting of an india-rubber cork with a central grooved plug, which can be rotated so that communication can be made and broken between the interior of the vessel and a lateral hole in the stopper giving access to the outer air. The upper ends of the plugs are square in section and fit into square holes in cross levers carried on coupling rods, which can be actuated from outside the sterilising chamber. During sterilisation the plugs are so turned that there is communication between the interior of the vessels containing the liquid to be sterilised and the atmosphere of the sterilising chamber, and on the completion of the sterilisation this communication is destroyed by the rotation of the plugs. A modification of the apparatus in which the vessels are arranged radially in the chamber, so that their plugs can be rotated by cog wheels connected with a central pinion, is also described, as well as alternative forms of stopper.—B. B.

An Improved Method of and Apparatus for Pasteurising or Sterilising Milk and other Fluids. F. A. Kleeman, Berlin, Germany. Eng. Pat. 14,252, July 24, 1893.

The apparatus essentially consists of a steriliser in which the liquid under treatment is heated by tubes arranged for the circulation of the steam used to raise it to the desired temperature, and a cooler of similar construction in which the sterilised liquid is reduced to the ordinary temperature. The heater is provided with an agitator, whereas the cooler is not thus fitted. The milk may be freed from foam on its passage to the heater by a foam collector, which consists of a vessel with a floating valve in which the foam rises and escapes, while the milk itself is retained. Another trap allows of the escape of gases from the sterilised milk on its passage from the heater to the cooler. A special transport or store vessel for receiving the milk after sterilisation, without contact with the air, is also patented. Modifications of the apparatus are described.—B. B.

(*B.*)—SANITARY CHEMISTRY.

Further Experiments on the Action of Light on Bacillus Anthracis. H. Marshall Ward. Proc. Roy. Soc. **53**, (321), 23—44.

The practical bearings of the results of the author are given by him as follows:—

The establishment of the fact of the bactericidal and fungicidal action of light, dating from Downes and Blunt until now, enables us to see much more clearly into the causes of several phenomena known to practical agriculturists, foresters, hygienists, &c. It helps to explain for example, why the soil of a forest should not be exposed to the sun; it will also affect our way of regarding bare fallows.

The importance of its bearing on the purification of rivers has already been demonstrated. The reasoning obviously applies to dwellings, towns, &c.

It explains many discrepancies in the cultures of *Schizomycetes* and *Fungi* in our laboratories.

It has also a very important bearing on the spread of plant epidemics in dull weather in the summer. No doubt it has even wider application.

That the sunshine has something to do with the rarity of bacterial diseases in plants now seems quite as probable as the currently accepted view that the acid nature of the latter accounts for the fact.

If that part of the chlorophyll which absorbs the blue-violet is a screen to prevent the destruction of easily oxidisable bodies as they are formed in the chloroplasts, we may reconcile several old experimental discrepancies, *e.g.*, the behaviour of plants under bichromate and cupric oxide screens.—W. S.

Hygienic Investigations on Lead Chromate. K. B. Lehmann. Arch. Hyg. 1893, **16**, 315; Chem. Zeit. Rep. 1893, **17**, 135—6.

Lead chromate has the same physiological action on man and animals that all the other difficultly soluble lead salts have, producing chronic lead-poisoning without any symptoms which can be ascribed to chromic acid. In large doses, even of one gramme, it is without immediate action on dogs, cats, and rabbits. Owing to its poisonous nature, it is highly desirable that its employment as a colour material on an industrial scale should be discouraged.
—J. G. W.

The Basis of the Hygienic Value of Water. Max Gruber. Deutsche Vierteljahrsschr. für öffentl. Gesundheitspfl. 1893, 415: Proc. Inst. Civil Eng. 1893, **4**, 28—30.

It is universally admitted that infected water may be the means of introducing disease-germs into the system, but the author considers that the grounds upon which sanitary authorities base their verdict concerning the harmlessness, or otherwise, of any named water-supply should be clearly defined. A right answer to a question of this kind must not only apply to the present state of any such sample of water, but it should take into consideration also the possibility of future dangers, other than those due to malice, which might arise after a lengthened period of use. This aspect of the problem has not hitherto been made sufficiently clear, for if such had been the case, reliance would not have been placed, as it too frequently is, upon compliance with a few chemical and bacteriological tests, without any inquiry into the probable derivation of the supply. It is imperatively necessary that, before coming to a conclusion, the sanitarian should know the actual source of the water, and the chances of its accidental pollution, and he should ascertain whether, by the exercise of proper precautions in the future, it may be guaranteed an immunity from all suspicion. It is true that in many cases it is extremely easy to arrive at such an opinion, as for instance when the water is procured from rivers, lakes, or open wells, which are all of them exposed to possible pollution and thus cannot be preserved from contamination. Such water should therefore never be employed without special cleansing, even if the chemical and other tests indicate its absolute purity for the time being.

It is a well-known fact also that earth has the power of retaining and destroying many poisonous and injurious compounds, more especially the nitrogenous and organic products of decomposition, and that it acts as a filter in intercepting germs; water, therefore, which has passed through the soil is looked upon favourably for drinking purposes, whether it is procured artificially or issues naturally as a spring. Such water is not, however, at all times free from danger, but it is exposed to evils of two kinds which must be taken into account; for either the soil may for some reason or other not permanently act as a filtering material in the manner expected, and may fail to keep back infectious germs, or the pure water issuing from the sub-soil may become mixed with polluted surface-water, penetrating the upper layers of the soil, which are often filled with impurities, and in either way the otherwise wholesome water may become injurious to health. Water analysis is only of use in directing attention to matters which cannot be detected in other ways by local observation. A knowledge of the chemical composition of the water is of importance, because substances may be dissolved in it which render it nauseous or ill-adapted for various uses; and further, because the dissolved impurities may indicate that such water has passed through layers of soil impregnated with human or animal excreta or the refuse from factories. It is, of course, necessary for the above analysis to procure a sample of the water fresh as it issues from the earth, and the condition of the water as it stands in the well or the spring-basin can have but little interest. In a similar way the bacteriological character of the water may convey useful information.

The fact may be regarded as of trifling importance whether the water contains many or few micro-organisms of one kind or another, and it is well known that water when standing in a well becomes richer in germs the longer it stands. There is not even any strongly-defined connection between the chemical composition of a given sample of water and the rapidity of the numerical increase in the bacteria it may contain.

The bacteriological examination of the water is of value, mainly as furnishing an indication of the action of the soil as a filtering material, and as concerning the yield of the natural filter represented by the sub-soil. This system of analysis, which was at first so highly vaunted, has come to be denied the undoubted value it possesses. The soil, as regards its upper layers, teems with germs of widely differing kinds; the water passing through it must become impregnated with these organisms. If notwithstanding this fact the deep well-water is found to be germ-free, it must be assumed that the lower layers of the soil have acted as a sufficient filter and have intercepted these germs, and it may therefore also be assumed that the soil would be capable of removing any disease germs carried down below its surface. Again, in a contrary sense, it holds good that if a sample of water is found to be rich in germs it may be possible for pathogenic germs to gain admission to it.

After quoting many recent opinions, the author concludes that the bacteriological examination of well-waters, as now conducted, should be given up, because it establishes nothing, and is in many respects misleading. It may be taken for granted that at a depth of from three to four metres the soil is free from germs, and samples of water obtained with the observance of due precautions from deep wells should, he considers, be devoid of germs. The matters of real importance are, as already stated, clear and accurate observations respecting the derivation of the supply and its immunity from any possible pollution by excrementitious substances.

Water Filtration and Cholera. R. Koch. Zeits. für Hygiene, Proc. Inst. Civil Eng. 1893, (4) 31, 393.

It is now universally admitted that water plays a most important part in the conveyance of cholera germs; it is not, as some have asserted, the only vehicle for the spread of the disease, for, as the author has pointed out, it is possible that cholera may be conveyed directly from one individual to the other, but in the case of indirect contagion in epidemics and extensive outbreaks of the disease where several vehicles may be concerned, water is no doubt the principal factor. Attention is directed to one of the most recent cholera epidemics, which, during last year, invaded the three towns of Hamburg, Altona, and Wandsbeck, and which throws a most important light upon this subject. These three towns lie so near together that, for practical purposes, they may be regarded as one; they differ but little in their general external circumstances, but their water supply is distinct. Even the sources of the supply are different, for Wandsbeck obtains filtered water from a lake not exposed in any way to excrementitious pollution; the Hamburg water is derived in an unfiltered condition from the Elbe, at a point above the town, and the water of Altona, which is taken from the Elbe below the town, is filtered before use.

Hamburg, as it is well known, suffered terribly from cholera, Wandsbeck and Altona, except for the existence of certain imported cases, remained wholly exempt from it. At the boundary between Hamburg and Altona the state of things was most remarkable; the disease raged up to the border line and there made a dead halt. In the case of one street, which for some considerable distance formed the boundary, cholera was very prevalent on the Hamburg side of the street, while the Altona side remained free from it.

Here was an experiment carried out upon more than one hundred thousand inhabitants, which, in spite of its enormous scale, compares in the directness of its results with an exact and conclusive laboratory experiment. In two great centres of population all things were alike except the water supply; in the one, drinking unfiltered Elbe water, the cholera raged severely; in the other, using filtered water from the Elbe, the cases were proportionately few; and moreover, the river water supplied to Hamburg was comparatively but little polluted, whereas the Altona water was drawn from a point lower down the stream, where the Elbe had received the entire solid and liquid dejections of a population verging on eight hundred thousand persons. The author shows that all the conditions and results agree with the principles laid down by bacteriologists, and clearly demonstrate that pathogenic germs can be removed by careful sand filtration.

The working of the filter is discussed and the necessity for the deposition of a superficial skin of fine particles of mud and organic matter above the sand in the beds is insisted upon. A filter-bed in good condition should not leave more than one hundred germs per cubic centimetre in the filtrate, however impure the water may have been originally, but the slightest disturbance in the filtering process leads to a great increase in the percentage of bacteria passing through the filter. Most of these germs represent harmless species existing in the sand and gravel, constituting the filter-bed itself, but some few are no doubt derived from the unfiltered water.

During the time of the cholera outbreak referred to, the beds at the Altona waterworks were never worked at a greater speed than 100 millimetres per hour, and to this precaution was due the immunity from disease. In illustration of the evils likely to be caused by imperfect fitration an account is given of the waterworks at the penal establishment of Nietleben, near Halle, where a cholera epidemic recently occurred. Here, owing to too great a speed of working and sundry other causes, the water of the Saale, which in the raw state contained three hundred and two thousand four hundred germs per cubic centimetre, was found, after being filtered, to contain fifty-two thousand four hundred and ten germs, pointing to a defective filtering process. A pollution of the Saale by a tributary stream, joining it only 50 paces above the intake of the Nietleben works, took place, and an outbreak of cholera arose which probably might have been avoided, as it proved in the case of Altona, had the working of the filter-beds been reliable.

It is shown by statistics that the infected water of the Elbe, in which cholera germs had actually been found, imperfectly filtered, as already described, at Altona in the winter of 1892, probably caused a subsequent outbreak of cholera in Altona in the first two months of the present year. The danger of relying upon filtration for the removal of pathogenic germs is therefore insisted upon, and the author lays down a series of rules to ensure the regular and proper working of the beds. He points out also the need of securing, if possible, an unpolluted raw material like the underground water from springs and deep wells.

Investigations into the Action of Peat-dust on Cholera-Bacteria. A. Stutzer and R. Burri. Zeits. für Hygiene, 1893 453; Proc. Inst. Civ. Eng. 1893 [4], 36.

Peat is now largely used as a deodorant in dry closets, and as a stable litter and bedding material for cattle, and it is valued by agriculturists, after it has served these purposes, as a manure. Some questions were recently promulgated by the German Agricultural Society as to whether peat, employed in the above ways, was capable of destroying the germs of infectious diseases, more particularly those of cholera, whether particular varieties of peat were better adapted for this purpose than others, and whether the certainty of its action upon these germs could be increased, and its fatal effect thereon accelerated by the addition of other substances which should at any rate be not injurious and if possible advantageous to plant life. The authors have endeavoured to furnish a reply to these questions as far as cholera germs are concerned.

The bacteria found in fecal matters have in a similar degree to cholera-bacteria the power of flourishing in a strongly alkaline medium, but they differ from the latter in being unacted upon by peat. A series of experiments was made to test the effects of acids and disinfectants upon the bacilli present in fecal matters. Dilute sulphuric acid was found to have a more powerful action in destroying these germs than other substances tested. It was found also by practical trials that the fecal-bacteria could rapidly change the fecal matters when mixed with urine into a very favourable medium for the development of cholera-germs; the only way to prevent this state of things was by rendering the fæces acid; a very small dose of dilute sulphuric acid or hydrochloric acid sufficed to stop the production of carbonate of ammonia. Investigations followed into the behaviour of cholera-bacteria present in fæcal matters, alone and mixed with peat, both fresh and stale, also as to the influence upon the mixture of kainit, plaster of Paris, hydrochloric acid, sulphuric acid, and phosphoric acid. The general conclusion is that it is imperatively necessary when peat is used along with excreta, to mix with the peat such a proportion of dilute acid as shall suffice to destroy not only the cholera-bacteria, but also those bacteria present in the compound, which are able to generate carbonate of ammonia from the urine.

PATENTS.

Improvements in Apparatus for the Treatment of Sewage. W. D. Scott-Moncrieff, London. Eng. Pat. 17,006 September 23, 1892.

The inventor has arrived at the conclusion that the beneficial effect of the filtering apparatus described in his former patent, 14,181 of 1891 (this Journal, 1892, 705), is not due to any mechanical action of the filtering material, but to the facility it affords for bacterial action, and hence has devised a modification of his former apparatus, in which one of the tanks can be "aërated and rested" while the other or others is still in action. Means have, in addition, been introduced for the supply of air to the contents of the tank for the benefit of the aërobic micro-organisms, and also for maintaining a temperature in the filter-bed suitable for the development of these organisms.—J. G. W.

An Improved Method for the Purification of Sewage Waters and Waters from Chemical and other Manufactures. R. Stanley, Ashton-under-Lyne. Eng. Pat. 19,198, October 26, 1892.

A mixture of coal ashes, sulphuric or hydrochloric acids, and a salt of magnesium, is used as a precipitating and deodorising agent.—J. G. W.

Improvements in or relating to Apparatus for Filtering Sewage Sludge, and other Substances. J. B. Alliott and J. M. C. Paton, Nottingham. Eng. Pat. 20,118, November 8, 1892.

See under I., *page* 914.

Improvements in the Method of Purifying Sewage and Trade Effluents. W. Oldfield, Shipley. Eng. Pat. 19,785, November 3, 1892.

A process of precipitation with iron salts, carried on in a series of tanks arranged so that the sewage will flow from one to the other through large and shallow troughs, with the object of exposing the mixed sewage and iron salt to the action of the atmospheric oxygen.—J. G. W.

(C.)—DISINFECTANTS.

An Aqueous Solution of Creosote. P. Carles. Journ. Pharm. Chim. 1893, **27**, 503; Chem. Zeit. Rep. 1893, **17**, 149.

To render creosote soluble in water the author recommends the following mixture:—Beech-wood creosote, 10 parts; tincture of quillaia, 80; and distilled water, 60 parts. The mixture is soluble in cold or warm water in all suitable proportions, the creosote being actually dissolved and not remaining simply in a state of suspension. The dissolving agent is the alcoholic solution of the saponin of the quillaia. The author has demonstrated the applicability of this aqueous solution of creosote for clinical purposes.

—J. G. W.

The Use of Antinonnin in the Brewery. L. Aubry. Zeits. ges. Brauw. 1893, **16**, 141; Chem. Zeit. Rep. 1893, **17**, 139.

See under XVII., *page* 941.

Some Improvements in the Practice of Disinfection. R. Traugott. Zeits. für Hygiene, 1893, 427; Proc. Inst. Civil Eng. 1893 (4), 33—34.

The author suggests the use of a dilute solution of peroxide of hydrogen which Gibier and others have shown to possess a very marked disinfecting action, even when diluted to the extent of 1 part in 50,000. It was found that cholera-bacilli were destroyed in five minutes in a solution containing 1 part of the peroxide of hydrogen in 10,000 parts of water; but the bacilli of typhoid fever needed an exposure of 24 hours to a solution of 1 part in 5,000. It was necessary to ascertain whether these dilute solutions were capable of retaining their strength for some days, and this the author investigated by means of tests which are here indicated. He also tried how far the liquid was poisonous, and he found that even 100 grms. of a 5 per cent. solution could be taken internally without injurious effect. The results of numerous practical trials are here recorded, and also bacteriological tests with anthrax spores and various other bacilli, which are set forth in a table. The author concludes that a 1 per cent. solution of peroxide of hydrogen may replace a 3 per cent. solution of carbolic acid; but at the present time the former is three times the cost of the acid. Even a ½ per cent. solution of the peroxide of hydrogen is fatal to germs, if the exposure is slightly prolonged. The dilute solution of corrosive sublimate is no doubt considerably cheaper, but its use should, if possible, be avoided in consequence of its toxic properties. While these trials were in progress, an opportunity of testing the effect of the peroxide of hydrogen upon the bacilli of diphtheria occurred, and an account is given of the successful character of these experiments.

A second substance of which the author made trial was the trichloride of iodine, to which Riedel had previously drawn attention. This material has an extremely sharp irritating smell, which induces coughing and sneezing; it is readily soluble in water, and is best preserved in the form of a 5 per cent. solution, which keeps well and has a strong but by no means unbearable smell of chlorine and iodine. Even a very dilute solution, as, for instance, one of 1 per mille, preserves its disinfecting power intact for several days, though in course of time a chemical decomposition takes place. This substance is not poisonous, as the author was able to demonstrate by practical observations upon hospital patients. Its effect upon disease-germs was very marked. The bacilli of typhoid fever, cholera, and diphtheria were destroyed by a 1 per cent. solution in one minute, and the two latter species of bacilli succumbed to a 1 per mille solution in the same space of time, the typhoid bacilli needing five minutes' exposure to the more dilute soluton. Practical tests of this solution were likewise made with the dejections of cholera patients with very successful results. The price of the 1 per mille solution is stated to be about one quarter that of a 3 per cent. solution of carbolic acid. A solution of soda was also tried, but the practical effect of this salt appears only to be due to the high temperature at which it is used.

XIX.—PAPER, PASTEBOARD, Etc.

PATENT.

Improvements in Apparatus for Maturing, Seasoning, Drying, or Shrinking Paper for Printing in Colours. J. P. Jennings, Liverpool. Eng. Pat. 19,588, November 1, 1892.

The inventor points out that it is a common experience of lithographic colour printers, after some of the colours have been put on, to find that the earlier impressions have become larger than they were when originally printed. This is due not to the pressure to which the paper has been subjected between the cylinder and the stone, but to the absorption of moisture. Then again, paper "green" from the mill is possessed of a certain amount of elasticity, pulls out in passing between the stone and the cylinder, but springs back as soon as released from pressure, so that the impression on the sheet is shorter or longer than that on the stone. The machine by which the inventor proposes to remedy these defects is composed of a strong framework of wood or iron, and between the uprights at each end are a number of moveable grooved iron or wooden rollers one above another. Over the grooves are passed endless tapes or bands. These are made to travel by means of a belt connected with any motive power, and the motion is transmitted to the entire series of rollers by means of an endless cord or belt. The sheets of paper are placed by hand or otherwise on the uppermost set of cords or tapes, by which they are successively carried forward to the opposite end of the machine, round the first set of rollers, on to the next set of cords and tapes, and so on to the outlet. Paper in web is treated in a similar way. The machine itself is cased so as to exclude dust and damp air, but more especially to secure the full benefit from a current of warm air generated by one or more gas stoves placed on the base of the machine. With paper thus matured a much more accurate register is secured.—E. G. P. T.

An Improvement in Parchment. H. O. Band, Brentford. Eng. Pat. 11,693, June 14, 1893.

In the method now generally adopted, the final process is to scald the skin, after which it is left to dry. According to the present invention, the skin, after having been scalded, is subjected, while still wet, to a bath of lime water or its equivalent. It is then powdered, preferably on both sides, with dry French chalk, the excess of which when dry is brushed off. The skin is afterwards wiped over with a wet sponge, and, when dry, is rubbed over with a piece of flannel. By this treatment the parchment is easier to write upon, and the use of pounce is avoided.—E. G. P. T.

Improvements in and in Connection with Pulp Strainers for Paper Making. T. Torrance, Bitton, and J. H. Hervell, Clifton. Eng. Pat. 13,587, July 13, 1893.

These are improvements on a previous invention, patent No. 23,082, 1892. The objects are: economy in the cost of manufacture of the machine, more even distribution and agitation of the pulp, removal of scum from the pulp before entering the paper-making machine, and the provision of means for preventing the thick or knotty pulp, after passing over the rollers, from mingling with the strained pulp that has passed between the rollers. A mechanical patent requiring for its comprehension a description extending over several pages, and explanatory diagrams.—E. G. P. T.

Improvements in Apparatus for Coating Flexible Fabrics. F. Crane, New Jersey, U.S.A., and J. B. B. Wellington, Harrow. Eng. Pat. 14,274, July 24, 1893.

By this invention flexible fabrics, such as paper or woven fabrics, may be coated in long lengths with fluid materials, dried, and rolled up in the finished state. Primarily, the method is intended for the production of photographic films in long lengths, but it may be used for imitation leather fabrics, and other purposes. The apparatus consists essentially of a large well-closed chamber, say 12 ft. high and of convenient width, provided below with heating coils. At the top of this chamber is a vessel containing the viscous fluid, and terminating at the bottom in a narrow opening of the same width as the flexible fabric to be coated. Secured to the vertical side of this vessel is a scraper or coating knife, which can be raised or lowered as required, and serves to restrain the flow of the fluid, and also to regulate its thickness on the paper. A little below, the web of paper rolled round a spindle is brought, by means of rollers, into contact with the opening and the scraper, and after receiving the necessary amount of fluid it passes over a number of other rollers arranged in snail form and fairly occupying the whole space of the chamber. This arrangement gives time to the fluid to dry or set, and the web is finally wound round another roller situated at the apex of the spiral.—E. G. P. T.

An Improvement in the Manufacture of Waterproof Paper Material. O. Imray, London. From V. Benedix and A. de Bary, Berlin. Eng. Pat. 15,830, August 21, 1893.

Waterproof paper, as employed, for example, in the manufacture of horse shoes, has been, up to the present time, produced either by mixing the paper pulp with the necessary waterproofing substances and then pressing the articles in one operation from the pulp thus prepared, or by first making a number of separate sheets of paper, coating them on one or both sides with glue, and causing them to adhere by pressure. Both processes have disadvantages which the present invention is said to avoid. It consists in forming sheets of paper pulp intimately mixed with waterproofing and binding agents (oils, fats, solutions of resin and gutta-percha, caseïn, marine glue, chrome glue, &c.); in passing such sheets, before the waterproofing and binding agents have set or dried, between two pressure rollers, and coiling them in a spiral manner upon one of the rollers so that the loose layers of paper are pressed singly and in succession upon the layers of paper that have already been pressed and thus been rendered hard, so as to serve as a support, for the purpose of obtaining a thoroughly dense and homogeneous product.—E. G. P. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Sumatra Benzoïn. F. Lüdy. Arch. Pharm. 1893, **231**, 43 and 81.

The author shows that Sumatra benzoïn contains free benzoic acid and styrolene, traces of benzaldehyde and benzene, also about 1 per cent. each of vanillin and phenylpropyl cinnamate, 2—3 per cent. of cinnamic cinnamate (styracin), whilst the main portion of the benzoïn is a mixture of a little benzoresinol cinnamate with a large proportion of resinotannol cinnamate. Free cinnamic acid may also be present in small quantity. When the above mixture is saponified, the two alcohols *benzoresinol*, $C_{16}H_{26}O_2$, and *resinotannol*, $C_{18}H_{20}O_4$, are obtained, the former of which crystallises with difficulty in slender needles, whilst the latter forms a light brown tasteless powder.

The uninjured bark of *Styrax benzoïn* was found to contain none of the constituents of benzoïn, and besides traces of wax, a little phloroglucinol and sugar, it contained no substance in any great quantity except a tannin, which, on drying, is readily converted into benzophlobaphene. The author assumes that since the tannin-like resinotannol forms the chief constituent of benzoïn, the latter is formed from the tannin when the bark is wounded.—A. K. M.

A Rapid Method for Testing Hydrogen Peroxide. F. Mörk. Amer. J. Pharm. 1893, 65, 65.

See under XXIII., *page* 950.

Recommendations of the Pharmacopœia Commission (*Tests of Purity*). Apoth. Zeit. 1893, 8, 349, 360; Chem. Zeit. Rep. 1893, 206. Ferrum reductum; Cocaïne Hydrochloride; Oil of Anise; Oil of Caraway; Oil of Cinnamon.

See under XXIII., *page* 951.

Formalin. H. Lüttke. Pharm. Zeit. 1893, 38, 281; Chem. Zeit. Rep. 1893, 17, 137.

This new disinfectant consists of a 40 per cent. (by volume) solution of formaldehyde in water. It has a specific gravity of 1080—1088, and its reaction should be neutral, or at most slightly acid. The formaldehyde is quantitatively estimated by converting it into hexamethylene-amine with an excess of standard ammonia solution and titrating the remainder with standard sulphuric acid. A deduction must be made to allow for the sulphuric acid taken up by the hexamethylene-amine, which is a mon-acidic base. —J. G. W.

Homo-coniine. F. Jacobi and C. Stoehr. Ber. 26, 949—951.

This base, $C_9H_{19}N$, (α-isobutylpiperidine), is one of the secondary bases of the nine isomeric methyl derivatives of coniine, and is formed when α-isobutylenepyridine, $C_9H_{11}N$, the condensation product of α-methylpyridine and acetone, are treated in alcoholic solution with metallic sodium—

$$C_5H_4.CH.C(CH_3)_2.N + 4H_2 = C_5H_9(NH)CH_2.CH.(CH_3)_2$$

To purify it, the nitro-compound, formed by treating the hydrochloride with sodium nitrite, is reduced in a current of dry hydrochloric acid gas, or advantage may be taken of the slight solubility of the hydriodide in cold water.

Homoconiine is a colourless, limpid liquid, closely resembling coniine in smell and in its solubility in cold and warm water. Its boiling point is 181°—182°, and its sp. gr. 0·858 at 0°. It is easily soluble in alcohol and ether, and volatilises with steam as readily as coniine. It is a powerful diacid base, forming fine crystalline salts with hydrochloric and hydriodic acids, and double salts with platinum and cadmium.—J. G. W.

Tolypyrine. P. Guttmann. Berl. klin. Wochenschr. 1893, 30, 249.

Tolypyrine is *p-Tolyldimethylpyrazolone*, and differs from antipyrine in that it contains a tolyl group in the place of phenyl. It forms colourless crystals, melts at 136°—137°, has a bitter taste, and is soluble in about 10 parts of water. Like antipyrine, it gives an intense red coloration with ferric chloride, and a green coloration with nitrous acid.

Tolypyrine has a marked antipyretic action; four doses of 1 grm. each, administered at intervals of an hour, will lower the temperature of the body by at least 1·5° C., generally by about 2°, and sometimes by as much as 3·5°—3·7°. Four grms. have the same effect as 5—6 grms. of antipyrine. As an antineuralgic and antirheumatic specific, and also as a remedy for headache, tolypyrine has the same action as antipyrine.—A. K. M.

Tolysal. A. Hennig. Deutsch. med. Wochenschr. 1893, No. 8.

Tolysal is the salicylic acid salt of tolypyrine (see last abstract), and bears the same relationship to salipyrine that tolypyrine bears to antipyrine. It forms small, nearly colourless crystals, has a harsh bitter taste, melts at 101°—102°, and dissolves sparingly in water and in ether, readily in alcohol and acetic ether. The author has examined the action of tolysal in various complaints and pronounces it to be a very valuable antirheumatic, antineuralgic, and antipyretic.—A. K. M.

Perfume of Orchids. E. Mesnard. Comptes rend. 116, 526—529.

The author points out the difficulties in classifying perfumes, and draws attention to the fact that the perfume of any given orchid varies to a considerable extent, depending on whether the flower was culled at an early or late stage, whether the observation was made in the morning or the evening, or whether the plant had been exposed to the sun or kept in the shade. The perfume is probably due to oxidation of the essential oil, which is generally contained in the epidermic cells of the internal surface of the petals and sepals, and is most abundant in the morning and evening. Sunlight seems to have the effect of converting the perfume into balsam or resin, whilst matters containing tannin are apt to be formed during the night.—J. S.

The Chemical Composition of the Essence of Niaouli. G. Bertrand. Comptes rend. 116, 1070—1073.

The fresh leaves of niaouli (*Melaleuca viridiflora*, a tree belonging to the order *Myrtaceæ*, which grows abundantly in New Caledonia), when subjected to steam distillation, give about 2·5 per cent. of their weight of a pale yellow essence, which can be separated by fractional distillation into two portions, boiling at 155°—156° C. and 173°—175° C. respectively. The lower boiling fraction was identified as terebentene from its boiling-point, density, specific rotatory power, vapour density, and the formation of the crystalline hydrochloride. The higher boiling fraction is a mixture. On placing it in a freezing mixture eucalyptol crystallised out and was recognised by its physical properties and analysis. The other constituent was not obtained quite pure, but it is a hydrocarbon boiling at 173°—175° C. (probably citrene). From the fraction boiling above 180° C. the substance $C_{10}H_{18}O$ (melting-point 30° C., and boiling-point 218° C.) was obtained. It is probably identical with the terpilenol of Bouchardat and Lafont. Essence of niaouli has thus precisely the same composition as List's terpinol.—J. S.

Camphor in Nagasaki. U.S. Consular Rep. 149, February 1893, 297—398.

The manufacture of camphor is an important industry in the island of Kioo-Sioo, the value of the imports from Nagasaki to the United States during the years 1872—1890 being 16,331·93 dols.; more was exported to the United States in 1890-91. Camphor trees grow abundantly at Satsuma. Camphor oil is mostly exported from Kobé; there are two qualities, the oil as expressed from the camphor and the oil from which the solid camphor has been removed by evaporation. The price of the former is about double that of the latter. Owing to its liability to affect other parts of a cargo, camphor is almost entirely shipped in direct sailing vessels to New York. The increased demand for camphor will, in time, result in a temporary cessation of any considerable exportation, as the trees have to be destroyed to obtain the gum, and although for every tree destroyed a new one is planted, the number of available trees is decreasing.

In 1891, 417,085 piculs of camphor were exported from Nagasaki; the value was 141,874·05 dols. In the same year 365,556 lb. of camphor and 635,297 lb. of camphor oil were manufactured in Kagoshima Ken and exported to Osaka, Kobé, and Nagasaki.—N. H. J. M.

Absorption of Mercuric Chloride in Dilute Solutions by Cotton. L. Vignon. Comptes rend. **116**, 517—519.

The author has already shown (this Journal, 1890, 855) that animal fibres possess both acid and basic properties, whilst vegetable fibres show these only to a very small extent, especially as regards the basic properties. He now describes preliminary experiments, which prove that when bleached cotton is immersed in a 0·001 per cent. solution of mercuric chloride, it absorbs about twice as much mercury as hydrochloric acid. The mercury is probably absorbed as mercuric oxide, which may be formed in the solution by the hydrolysis of the mercuric chloride, thus :—

$$HgCl_2 + H_2O = HgO + 2HCl$$

The acid properties of the bleached cotton are attributed to the presence of oxycellulose.—J. S.

Absorption of Mercuric Chloride in Dilute Solutions by Cotton. L. Vignon. Comptes rend. **116**, 645—647. (See preceding abstract.)

When bleached cotton is immersed in a dilute solution of mercuric chloride it takes up a larger proportion of mercuric oxide than hydrochloric acid. The relative amount of absorption may exceed 3HgO for 1HCl. Cotton which has been treated in this way and dried at the ordinary temperature, loses only a portion of its mercury (as mercuric chloride) and hydrochloric acid when immersed in water for some days. It still retains mercuric oxide and mercurous chloride, which is probably formed in accordance with the equation—

$$HgCl_2 + HgO = Hg_2Cl_2 + O,$$

the oxygen being absorbed by the cellulose with formation of oxycellulose.

If the cotton be heated at a temperature of 60° for some hours, the mercuric chloride and oxide diminish in quantity, whilst the proportion of mercurous chloride increases. It is likely that this action also takes place at the ordinary temperature only at a much slower rate. The author points out that a knowledge of these facts is useful in the preparation of materials for surgical operations containing mercuric chloride.—J. S.

PATENTS.

Manufacture of β-Cymidine—

$$C_6H_3(CH_3)(NH_2)(C_3H_7)(1:2:4)$$

from the Oximes of certain Camphors. C. D. Abel, London. From Haarmann and Reimer, Holzminden a/d Weser, Germany. Eng. Pat. 20,498, November 12, 1892.

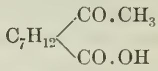
The crystallisable oximes obtained from certain camphors, such as tansy, absinthe, sage, or thuja oils, are heated to boiling in alcoholic solution and gradually decomposed by sulphuric acid, the acid being added mixed with its own volume of 50 per cent. alcohol.

The solution obtained is diluted with water, the unchanged oxime and regenerated camphor extracted with ether, and the aqueous solution concentrated, in which the cymidine is subsequently liberated by the addition of alkali.

β-cymidine boils at 118° — 121° C. under 15 mm. pressure, and forms a pale yellow oil, which does not solidify in the ordinary freezing mixtures. It is of value for pharmaceutical preparations and for the manufacture of colours.—C. A. K.

Manufacture of Monobasic Acids having the Composition $C_9H_{14}O_2$, of Dibasic Acids having the Composition $C_9H_{14}O_4$, and of Anhydrides of the Latter having the Composition $C_9H_{12}O_3$. C. D. Abel, London. From Haarmann and Reimer, Holzminden a/d Weser, Germany. Eng. Pat. 20,499, November 12, 1892.

Certain camphors found in those portions of tansy oil, absinthe oil, sage oil, and thuja oil, boiling, between 80° and 90° C. under 14 mm. pressure and having the composition $C_{10}H_{16}O$, act as methyl ketones ($R.CO.CH_3$). When treated with bromine and alkali they form monobasic acids —that from tansy oil, called "Tanacetogenic acid," is a liquid boiling at 113·5° C. under 15 mm. pressure, and solidifying in a freezing mixture. It has the empirical formula $C_9H_{14}O_2$. When oxidised at a low temperature with potassium permanganate, these camphors yield ketonic acids of the formula—



$$C_7H_{12}\begin{cases}CO.CH_3\\CO.OH\end{cases}$$

that from tansy oil, called "Tanacetoketocarbonic acid," is a crystalline body distilling at 169° C. under 15 mm. pressure. When subsequently treated with bromine in alkaline solution, this ketonic acid yields two isomeric dibasic acids, $C_9H_{14}O_4$; the less soluble of these, called "Tanacetogendicarbonic acid," forms white plates melting at 141° C. Heated with acetyl chloride it forms an anhydride which melts at 55° C. and boils at 171° C.

These products are intended for use in perfumery and pharmacy.—C. A. K.

Improvements in Means or Receivers for the Preservation and Application of Chloride of Ethyl and other Volatile Liquids, to be employed principally in the Production of Cold. B. J. B. Mills, London. From A. Gilliard, P. Monnet, and J. M. Cartier, Lyons, France. Eng. Pat. 23,287, December 17, 1892.

The receiver or holder, which is made of glass, has a capillary orifice, and is fitted with a metallic closing cap provided with a bayonet joint. The receivers have either a straight or a bent neck, to which the metallic cap is fitted by cement or other suitable means. In the hollow of the metal cap is a caoutchouc plate or pad, which is kept firm over the capillary orifice of the holder by means of a spring inserted and fixed within the hollow of the cap and to the inner surface of the top thereof, the other end of the spiral spring being attached to the rubber pad or plate. On fixing the cap by its bayonet joint, the spring tightly presses down and holds the rubber pad on the capillary opening of the receiver or bottle.—C. A. K.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

An Improved Appliance for Printing Vignette Photographs. J. C. Rowbotham, Bradford. Eng. Pat. 16,481, September 15, 1892.

This consists in a plate of zinc or other metal having an aperture approximately the size and shape of the vignette. The margin of this aperture is curved upwards, and is perforated with one or more rows of holes, which may be reduced in size and number as their distance from the edge of the aperture is increased. By this arrangement the light admitted beneath the margin of the aperture is diffused and softened for vignette purposes.—J. C. C.

Improved Solutions for Toning Photographic Prints. R. G. Williams, Manchester. Eng. Pat. 17,768, October 5, 1892.

These solutions are more particularly applicable to gelatino-chloride prints, the object being to replace salts of gold, platinum, &c. The solution described consists in a mixture of 40 parts by volume of either potassium, sodium, or ammonium sulphide and 600 parts of strong ammonia, which mixture is made up to 2,000 parts by the addition of water. The print is first washed, and then fixed in hyposulphite of soda solution, to which a little ammonia has been added. The print must then be thoroughly

washed to remove all traces of hyposulphite, and is transferred to the toning bath, made by adding one part of the solution described to 50 parts of water; when sufficiently toned the print is washed, thoroughly drained, and dried.
—J. C. C.

A New or Improved Paste for the Prevention of Discoloration of Photographs Mounted upon Bristol Board and the like. H. W. Vogel and J. Weinberg, Berlin. Eng. Pat. 21,622, November 26, 1892.

The object of this invention is to remove the sulphurous impurities, which cause the discoloration of photographs. For this purpose the inventors employ as a glue a paste of starch mixed with iodine in varying proportions; for instance, 10 cc. of a solution containing 1 grm. of iodine in 10 cc. of alkali are added to 100 cc. of freshly-prepared pure starch paste. In case blue spots are formed from excess of paste, these may be removed by applying, with a sponge, a 0·1 per cent. solution of pure sulphite of soda.
—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

PATENTS.

An Improvement in the Treatment of Nitrated Cellulose for the Manufacture of Explosive and other Compounds containing Dissolved Nitrated Cellulose. A. H. Durnford, Dartford, Kent. Eng. Pat. 20,880, November 17, 1892.

The object of the patent is to obviate the necessity of drying nitrated cellulose before dissolving it for the purpose of making explosive compounds. The nitrated cellulose in the wet condition is first subjected to pressure to expel as much of the water as possible, and then treated with a "dehydrator," a substance capable of dissolving away the water, such as alcohol, or preferably a solvent of the nitrated cellulose, acetone being preferred in the case of trinitrocellulose. A slight rise of temperature occurs during the treatment with the "dehydrator." After this treatment, the residual product is pressed to remove the dehydrator, which carries along with it the absorbed water. When the nitrated cellulose contains much water a second treatment is sometimes necessary. The trinitrocellulose is left in a putty-like condition when a solvent, such as acetone, is used as the dehydrator. The dehydrated cellulose nitrate is then ready for being mixed with its solvent as required. The substance used as the dehydrating agent can be separated from the dissolved water by distillation and used over again.—C. A. K.

Manufacture of Explosives. O. Imray. From Westfalisch-Anhaltischen Sprengstoff Actien Gesellschaft. Coswig, Anhalt, Germany. Eng. Pat. 15,566, August 16, 1893.

The invention refers to the manufacture of explosives from alkali-nitrates and resins. The dried alkali-nitrate, preferably ammonium nitrate either in the form of a powder or granulated, is poured along with a solution of the resin into a suitable fluid medium and the mixture ground for 1 to 2 hours in a ball mill. The resin and nitrate become thoroughly mixed in the grinding, and after evaporating off the solvent the residue is ground, and is then ready for being filled into cartridges. The resinous substance must be brittle—colophony, hard pitch, and asphalt are recommended. As solvents alcohol, petroleum spirit, carbon bisulphide, and similar bodies are employed. The best solvents for the resins are the above, mixed with the esters of nitric acid, especially the methyl, ethyl, and amyl compounds. These in the proportion of 10 parts to 90 parts of spirit slightly nitrate the organic substance, so that the explosive effect is increased without however producing much flame.
—C. A. K.

XXIII.—ANALYTICAL CHEMISTRY.

INORGANIC CHEMISTRY.—QUALITATIVE.

The Application of Schaeffer's Nitrite Reaction to the Examination of Drinking Waters. C. M. van Deventer and B. H. Juergens. Ber. **26**, 932—939.

For the detection of nitrites in drinking water, 1 litre of the water is placed in a large beaker and immediately covered with a thin layer of petroleum. The beaker is also covered with a greased glass plate; 0·1 grm. potassium ferrocyanide and about 1 grm. of acetic acid are then added, the appearance of a yellow colouration in about three minutes indicating the presence of nitrites. A control experiment is made with pure water in order to correct for the slight coloration due to the action of the oxygen dissolved in the water.

The complete exclusion of the air is essential, as the oxygen it contains increases the coloration, which is produced by the potassium ferricyanide formed in accordance with the equation—

$$2K_4FeCy_6 + 4C_2H_4O_2 + 2KNO_2 = K_6Fe_2Cy_{12} + \\ 4C_2H_3O_2K + 2H_2O + 2NO$$

The nitric oxide, also produced, is oxidised to N_2O_3 or NO_2 by the oxygen of the air, and these are then reduced to nitric oxide again at the same time that K_4FeCy_6 is oxidised to $K_6Fe_2Cy_{12}$ Exclusion of the air also prevents the danger of the interference of traces of nitric acid or chlorine contained in the laboratory air.

To detect traces of nitrite the water is treated with a little potassium permanganate and sulphuric acid, and, after standing four hours, evaporated with some alcohol and soda lye. The residue is then heated with lead shavings and potassium ferrocyanide, and acetic acid added when cold. A control experiment should be made with pure water.

Hydrogen peroxide but slightly affects the reaction, and nitrates are without influence.

Schaeffer's reaction is not inferior in sensitiveness to the potassium iodide and starch one for the detection of nitrites, but does not lend itself so well to the estimation of the oxygen dissolved in water.—J. G. W.

INORGANIC CHEMISTRY.—QUANTITATIVE.

Note on the Iron Thiocyanate Reaction. H. Schulze. Chem. Zeit. 1893, **17**, 2.

Fresenius in his treatise points out that the thiocyanate reaction for ferric salts is not obtained in a solution of a ferric salt to which sodium acetate has been added, until the solution is strongly acidified with hydrochloric acid. The author finds also that the test does not answer for solutions of basic ferric salts, obtained by digesting dilute ferric chloride with ferric hydroxide or by adding ammonium carbonate to ferric chloride solution, as long as the precipitate is redissolved. Very dilute ferric solutions free from acidity are inactive towards thiocyanate solution at ordinary temperatures, and somewhat stronger solutions do not give the colour when hot. This is explained by the complete hydrolytic dissociation which occurs in dilute solutions at ordinary temperatures, and in stronger solutions at higher temperatures. Acidification of the solution, however, always renders the thiocyanate test applicable.—W. J. P.

The Volumetric Estimation of Lead. A. P. Laurie. Chem. News, **67**, 1893, 211.

In the course of some experiments for the Home Office, the author found it necessary to determine rapidly the amount of lead present in a large number of solutions containing free hydrochloric acid.

The amount of lead to be determined was small, varying from about 0·05 to about 0·005 grm. He determined, after several trials to use the direct estimation by titration with bichromate of potash, using nitrate of silver as an indicator, which is described on page 348 of Crookes's "Select Methods in Chemical Analysis" (Second Edition).

The sensitiveness of this indication is affected by the amount of chloride present in the liquid to a certain extent. If very little chloride be present, the amount of precipitate formed is too small to show the coloration distinctly, and if too much chloride be present the large quantity of the precipitate conceals the effect of the dye.

To obtain the most sensitive reaction, the amount of chloride present should be equivalent to from 0·5 to 0·2 grm. of sodium chloride in 100 cc.

Under these conditions, three parts of bichromate in 1,000,000 parts of water will produce a perceptible change of tint in the chloride of silver precipitation.

In estimating the lead the author made use of a solution of bichromate which was made up to approximately precipitate 0·002 grm. of lead per 1 cc. of solution, and he standardised it against pure lead.

One serious practical difficulty is the obstinate way in which the lead precipate remains floating in the liquid. This is fatal to the method, as any lead chromate taken up with a drop of liquid seems at once to stain the silver chloride, and so render the indicator useless. The best way to get over this difficulty is to add most of the bichromate necessary to precipitate the lead, and gradually raise the liquid to boiling with frequent stirring. This will cause most of the chromate of lead to settle, merely leaving a little floating on the top. On touching the surface of the liquid this floating precipitate is repelled in all directions, and a little liquid can be withdrawn by means of a capillary pipette (made by drawing out a piece of glass tubing), and blown out into the drop of silver. The fresh precipitate formed on adding more bichromate will usually settle on stirring without much difficulty. The precipitate ceases to form just a little before the yellow reaction appears.

In order to obtain results which agree one with another, certain precautions must be taken. The presence of large quantities of other salts in the liquid should be avoided; the liquid, if acid, must be carefully neutralised, and sodium acetate must be added before titration. In standardising the solution the author dissolved the pure lead in as little nitric acid as possible, added ammonia till a slight permanent precipitate was produced, and then added a little sodium chloride and some potassium acetate. The amount of potassium acetate added was about twice the weight of the lead present. He then titrated in the way already described.

The results obtained are fairly satisfactory, and seem to show that this method may be safely used for rapidly estimating small quantities of lead.

On adding the acetate to the neutral solution, basic salts usually separate, and the addition of the chloride causes a slight cloudiness as well. The long heating evidently converts these precipitates completely into chromate, and the result does not seem to be affected by the varying amounts of precipitate that may be formed.

The method might doubtless be used for estimating larger quantities of lead by adding a weighed quantity of pure potassium bichromate, heating, and then finishing the precipitation with the standard solution.

A Rapid Method for Testing Hydrogen Peroxide. F. Mörk. Amer. J. Pharm. 1893, 65, 65.

This method is based upon the equation—

$$5H_2O_2 + K_2Mn_2O_8 + 3H_2SO_4 =$$
$$5O_2 + 8H_2O + K_2SO_4 + 2MnSO_4$$

and is carried out as follows:—To 500 cc. of water contained in a basin, are added 5 cc. of dilute sulphuric acid, and then sufficient permanganate solution to give a distinct coloration; 5 cc. of the hydrogen peroxide solution, which is to be tested, are now introduced, and standard permanganate solution is then run in until the red colour no longer disappears. The standard permanganate solution contains 2·625 grms. to the litre, and the number of cc. employed, divided by 10, gives the volume of oxygen liberated by 1 cc. of the hydrogen peroxide.—A. K. M.

Determination of Chromium in Ferrochrome. J. Spüller and S. Kalman. Chem. Zeit. 1893, 880.

The authors decompose finely-powdered ferrochrome by fusing it with three parts of caustic soda and one part of sodium peroxide. The same mixture will also serve for the qualitative detection of manganese and chromium. Vessels of platinum, however, should not be used, this metal being easily attacked. Vessels made of silver should be employed for the fusion.—J. L.

Direct Determination of Potash and Soda by the Bitartrate Method. A. Bayer. Chem. Zeit. 1893, 686.

The author has worked out a reliable method of determining the fixed alkalis, basing his process on the difference of the solubilities of potassium and sodium bitartrates in alcoholic solution of varying concentration. The analysis is carried out by adding to the solution of the alkalis a quantity of sodium carbonate, sufficient to bind the whole of the sulphuric, phosphoric, and hydrochloric acids present in the form of sodium salts, and afterwards acetic acid, and an excess of tartaric acid. On heating, the formation of potassium bitartrate is completed. Finally, so much absolute alcohol is added that the solution contains 25 per cent. of alcohol. The precipitate is allowed to settle out for two hours, the clear supernatant solution is poured off through a filter, the precipitate washed at first with a measured quantity of 25 per cent. alcohol to remove the last traces of sodium bitartrate, and at last with 50 per cent. alcohol. The precipitate and the filter are then titrated whilst boiling with $\frac{n}{20}$ caustic soda, using phenolphthaleïn as indicator.

An example will best show the working of this method. Dissolve about 15 grms. of a commercial potash (potassium carbonate) in 500 cc. of water. To 25 cc. of this solution placed in a beaker, add 0·3 grm. of crystallised sodium carbonate, 6 cc. of 80 per cent. acetic acid, and 2·4 grms. of crystallised tartaric acid, and boil. After cooling add 11 cc. of absolute alcohol and allow to stand for two hours, when the precipitate is washed with 30 cc. of 25 per cent. alcohol, and at last with 50 per cent. alcohol, until 5 cc. of the filtrate require only two drops of $\frac{n}{20}$ soda to become blue to litmus. Thus there have been obtained 60 cc. of a filtrate containing 25 per cent. of alcohol, and 60 cc. of 50 per cent. alcohol have been used for washing. The solubilities of potassium bitartrate in alcoholic solutions as used is then determined separately by titration with $\frac{n}{20}$ soda and the quantities dissolved by the wash alcohol, expressed in terms of $\frac{n}{20}$ soda added to the main quantity of $\frac{n}{20}$ soda. 100 cc. of 50 per cent. and 25 per cent. alcohol respectively require 2·4 cc. and 7 cc. of $\frac{n}{20}$ soda. The corresponding solubilities for sodium bitartrate are 33·6 cc. and 116 cc. of $\frac{n}{20}$ soda. In commercial potassium carbonates the proportion of sodium salts can never be so great as to interfere with the method. When, however, a mixture of unknown composition is under examination, the separated crystals have to be examined for the acicular crystals of sodium bitartrate, and if these have been noticed, the solutions have to be treated in such a way as to obtain saturated solutions of sodium bitartrate in 25 per cent. alcohol, in which potassium bitartrate is absolutely insoluble. The method gives very accurate results, as a comparison with the platinum method proves. Ammonia, however, must be absent from the solutions, and has to be removed previously.

For a somewhat complicated method of determining in a direct way the amount of sodium, based on the foregoing facts, the reader must consult the original paper.—J. L.

ORGANIC CHEMISTRY.—QUALITATIVE.

Recommendations of the German Pharmacopœia Commission. Apoth. Zeit. 1893, **8**, 349, 360; through Chem. Zeit. Rep. 1893, 206.

Ferrum reductum is tested by bringing 1 grm. into a 50 cc. flask with 30 cc. of water, 15 cc. of hydrochloric acid, and 2·5 grms. of zinc; the evolved gas is allowed to impinge from a narrow glass tube on to lead acetate paper; this must not undergo any change in five seconds. The ignited gas must give no spot upon a porcelain plate. The iron must contain at least 90 per cent. of the metal; the quantity is determined by heating 1 grm. of the metal with 5 grms. of finely-powdered mercuric chloride and 50 cc. of water in a 100 cc. flask, on the water-bath for one hour with frequent shaking; the cold flask is filled to the 100 cc. mark and the contents filtered. 10 cc. of the filtrate are acidified with 10 cc. of dilute sulphuric acid, and potassium permanganate solution is run in until the pink colour does not immediately fade; the excess of permanganate used is destroyed by the addition of a few drops of alcohol, 3 grms. of potassium iodide are added, and, after the well-closed flask has been allowed to stand for one hour at the ordinary temperature, the liberated iodine is titrated with $\frac{N}{10}$ sodium thiosulphate.

Cocaine hydrochloride is identified (1) by rubbing down 0·01 grm. with 0·01 grm. of mercurous chloride, when the mixture should blacken; (2) by treating a solution of 0·01 grm. of the salt in a few drops of alcohol with some powdered caustic potash, when the agreeable odour of ethyl benzoate will be perceived. To test the purity of cocaine hydrochloride: (1) 0·05 grm. are dissolved in a mixture of 1 cc. of sulphuric acid and 1 cc. of nitric acid; no coloration should be developed; (2) the addition of three drops of dilute sulphuric acid and one drop of a solution of potassium permanganate (1 : 1000) to a solution of 0·1 grm. of the hydrochloride in 5 cc. of water should leave the liquid coloured violet; (3) 0·05 grm. of the hydrochloride should leave no residue when heated on platinum foil.

Oil of anise, officinally anethol, should have a specific gravity of 0·985 at 25°, should boil at 234°, should dissolve in alcohol to a clear solution, neutral to litmus, and should not be coloured by ferric chloride.

Oil of caraway, officinally carvol; one part of carvol must dissolve to a clear solution both in one part of dilute alcohol (50 per cent. at 20°) and in one part of sodium salicylate solution (1 : 2). The alcoholic solution should give at most a feebly reddish colour with one drop of ferric chloride.

Oil of cloves, officinally eugenol, should boil at 253°—254° and be of sp. gr. 1·072 at 15°. Five drops shaken with 10 cc. of lime-water should give a flocculent precipitate, which has a tendency to stick to the glass. Two drops dissolved in 4 cc. of alcohol should give a green colour with ferric chloride. One grm. of eugenol shaken with 20 cc. of hot water should yield a liquid which only feebly reddens blue litmus paper, and the filtered liquid should give no blue colour, but only a greyish-green, with one drop of ferric chloride. One part of eugenol must dissolve to a clear solution in two parts of dilute alcohol, and in one part of sodium salicylate solution (1 : 2).

Cinnamon oil.—One part must dissolve to a clear solution in one part of aqueous sodium salicylate solution (1 : 2). No precipitate should be produced when a saturated alcoholic solution of lead acetate is added to twice its volume of a solution of one part of cinnamon oil in 3—4 parts of dilute alcohol. The oil should not leave more than 8 per cent. of hard solid residue.—A. G. B.

Determination of the Flash Points of Lubricating Oils. A. Martens. Mitth. Königl. Tech. Versuchsunstalten, 1893, 37—45.

See under XII., *page* 936.

Adulteration of Margarine with Sunflower Oil. A. Jolles and E. Wild. Chem. Zeit. 1893, 879.

See under XII., *page* 935.

Detection of and Qualitative Test for Monovalent Alcohols. B. v. Bitto. Chem. Zeit. 1893, 611.

The author describes the following method, by which, in his opinion, larger quantities of monovalent alcohols can be detected. Dissolve about 0·5 grm. of methyl-violet in 1,000 cc. of water, add 1 to 2 cc. of this solution and about 0·5—1 cc. of a solution of an alkaline polysulphide to the liquid to be tested (several cc.) and shake.

In the presence of a monovalent alcohol a cherry-red to violet-red coloration appears, the liquid remaining perfectly clear. On standing the colours undergo some change. In the absence of monovalent alcohols the liquid has a greenish-blue coloration, and, after some time, reddish-violet flocks are precipitated, the liquid at the same time becoming yellow.—J. L.

The Detection of Dulcine in Beverages. G. Morpurgo. Selmi. 1893, **3**, 87; Chem. Zeit. Rep. 1893, **17**, 135.

Dulcine (*p*-phenetolcarbamide) is a shining crystalline powder, having a sweetening power 200 times as great as that of sugar (this Journal, 1893, 464). It melts at 160°, is slightly soluble in cold water, and easily so in warm water, in alcohol, benzene, and ether. To detect it in wines and other beverages, the author recommends the following process:—The suspected liquid, after the addition of $\frac{1}{10}$ its weight of lead carbonate, is evaporated on a water-bath to a thick paste, which is then treated several times with strong alcohol. The alcoholic solution is evaporated to dryness and the residue extracted with ether. The residue, if any, obtained on evaporation of the filtered ethereal extract consists of almost pure dulcine, and will be recognised by its physical properties and its sweet taste, and also by the following reaction:—The residue is warmed for a short time with two drops of phenol and two drops of concentrated sulphuric acid; the resulting reddish-brown syrup is diluted with a few cc. water, poured into a test-glass and cooled. On to the top of it is then carefully poured a little caustic soda or ammonia solution, and the appearance of a blue or violet-blue zone at the junction of the two liquids, indicates the presence of dulcine.—J. G. W.

ORGANIC CHEMISTRY.—QUANTITATIVE.

A New Method of examining Fats. W. Fahrion. Chem. Zeit. 1893, 610.

The author proposes to shorten Hazura's method of examining fats for fatty acids of the unsaturated series by avoiding the preliminary preparation of the fatty acids and the separation of the saturated solid fatty acids from the liquid unsaturated acids.

He is led to this abbreviated method by the consideration of the facts that saturated fatty acids are not acted upon by potassium permanganate so long as unsaturated ones are present, and that oxalic acid, the oxidation product of glycerol, passes into the aqueous solution. The separation of the hydroxy fatty acids from the saturated acids and from the non-oxidised unsaturated acids, is effected by means of petroleum ether, which does not dissolve the former acids.

The method is carried out as follows:—Saponify 10 grms. of the fat to be tested by means of 10 grms. of caustic soda, with further addition of alcohol, and of a little water, in a porcelain dish of 1,500 cc. capacity. Evaporate to dryness on the water-bath, dissolve the soap in 1,000 cc. of water, heat to boiling, and add gradually a 5 per cent. solution of 10—25 grms. of potassium permanganate (according to the iodine absorption value of the fat), with constant stirring. Heat finally for a short time, filter through a plaited filter, and acidulate the filtrate with hydrochloric acid. The separated acids, when quite cold, are filtered through linen, expressed as completely as possible by hand, and finally exhausted with petroleum ether. The saturated fatty acids, and that part of the unsaturated ones which escaped oxidation, are dissolved by the petroleum ether, whilst the hydroxy acids remain behind. If isolinusic acid be present, part of it may be found in the aqueous solution.

The yield is a very poor one. Thus 10 grms. of tallow gave only about 1 grm. of solid acids, viz., dihydroxystearic acid containing some azelaïc acid. The former, after recrystallisation from alcohol, melted at 126° C. (137° C.; Hazura).

For the purpose of detecting linoleic acid in non-drying oils the precipitated fatty acids need not be exhausted with petroleum ether, but may be boiled with 1,000 cc. of water; the boiling solution is filtered, the filtrate evaporated to 100—150 cc., and transferred, while still warm, into a separating funnel; the solution, when quite cold, is acidulated with hydrochloric acid and shaken out with common ether. The presence of sativic acid, the oxidation product of linoleic acid, will be indicated by white flocks floating about in the lower part of the ethereal solution. 10 grms. of cotton oil examined by this method yielded 0·6 grm. of flocks, melting, after recrystallisation, at 152° C. (173°; Hazura). The author further claims to have detected linoleic acid in lard, which had been rendered by himself in order to ensure the purity of the fat.—J. L.

Formalin. H. Lüttke. Pharm. Zeit. 1893, **38**, 281; Chem. Zeit. Rep. 1893, **17**, 137.

See under XX., *page* 947.

The Saponification of Fats by Means of Concentrated Sulphuric Acid according to Kreiss, and the Various Modifications of this Method. A. Prager and J. Stern. Chem. Zeit. 1893, 880.

The proposal made by the authors, viz., to remove the sulphurous acid by blowing air over the saponified mass, having been considered as superfluous by the originator of the method, they have repeated their experiments, closely following Kreiss's prescriptions as to concentration of the acid, &c. They obtained better results than before when pure butter had been used, but for mixtures of margarines with butters the values obtained were always found higher in proportion as more margarine had been admixed. In each case the Reichert-Meissl values, of course, were used as standards for comparison. It appears therefore to the authors that in doubtful cases—say for an admixture of 10 per cent. of margarine with butter, which cannot be detected with certainty by the Reichert-Meissl method—a comparison of the Reichert-Meissl values with Kreiss values may yield useful information as to adulteration practised on the butter. The authors give some of their results in a table, and compare their modification of Kreiss's method with that of Pinette. They insist on the necessity of removing the sulphurous acid as proposed by them (this Journal, 1893, 872).—J. L.

Hübl's Iodine Absorption Method. Helfenberger Annalen, 1892; through Chem. Zeit. Rep.

Holde (Chem. Zeit. 1892, **16**, 1176) recommends the use of an excess of 75 per cent. of iodine in this method. This excess is not merely unnecessary, but actually detrimental, inasmuch as the error due to the falling off of the titre of the iodine solution is thereby magnified (see Fahrion, this Journal, 1893, 381; also 68). At Dieterich's Chemical Works, at Helfenberger, the following method is adopted:—0·2—0·3 grm. of the oil (or 0·3—0·4 grm. of the fat) is introduced into a 500—700 cc. stoppered flask and dissolved in 20 cc. of chloroform; 20—30 cc. of the iodine solution (= 30—36 cc. of $\frac{N}{10}$ sodium thiosulphate solution) are added, and the flask set aside for 24 hours, after which time 20 cc. of potassium iodide solution (1 : 10) and 200 cc. of water are added, and the excess of iodine is titrated with $\frac{N}{10}$ sodium thiosulphate. Two blank determinations are made, using exactly the same quantities of the reagent as are used for the actual determination; the one is titrated at once and the other after 24 hours.—A. G. B.

On Hübl's Iodine Absorption Method. W. Fahrion. Chem. Zeit. **1893**, 1100.

The observation made by several authors that in Hübl's method, not only absorption of iodine takes place, but that substitution also occurs to some slight extent, led the author to the opinion that the alcohol might be the cause of it. He compared, therefore, solutions prepared with ethyl alcohol and methyl alcohol, determining the change they undergo on standing. It was found that the titre of the methyl alcoholic solutions decreases considerably more slowly than that of the ethyl alcoholic ones. Experiments, however, made with methyl alcoholic solutions on oils proved that also in this case substitution took place. The magnitude of the error due to this latter cause depends, as the author reiterates, on length of time, temperature, and exposure to light.—J. L.

Iodine as an Indicator in the Estimation of the Acidity of Coloured Plant Extracts, Worts, Beers, &c. H. Petersen. Zeits. ges. Brauw. 1893, **16**, 243; through Chem. Zeit. Rep. 1893, **17**, 204.

The indicator is prepared by heating 50 cc. of a saturated solution of potassium iodate with 0·5 grm. of starch; when this is "dissolved," 10 grms. of potassium iodide are added. The liquid is best stored in a full flask in the dark; when required for use it is heated and treated with dilute sodium thiosulphate until just colourless. To use the indicator, two drops are placed on a white plate and spread out to a diameter of 2 cm.; in the middle of this a drop of the liquid, the acidity of which is being titrated, is brought; a dark ring surrounding the introduced drop indicates the presence of free acid. Nearly all acids (except boric) can liberate iodine from this indicator, which the author claims to be less dependent upon personal equation than are the ordinary coloured indicators.—A. G. B.

The Estimation of Beer, Wort, and Malt Extracts by Means of the Maltometer. M. D. Sidersky. Monit. Scientif. 1893, 450—452.

In this paper the author describes his maltometer. This is a hydrometer each degree of which corresponds to 1 grm. of maltose in 100 cc. of solution. The fermentation of one part of maltose, however, gives 0·61 part (by volume) of alcohol, and this is equivalent to 0·21 part extract. Hence the disappearance by fermentation of 1 grm. of maltose per 100 cc. of solution gives an *apparent attenuation* of 1·21° on the maltometer, and in order to obtain the *actual attenuation*, the number representing the apparent attenuation must therefore be multiplied by 0·82, this being a constant whatever the concentration of the liquid. Thus an apparent attenuation of 1° indicates the decomposition of 0·82 grm. of sugar in 100 cc., and the alcohol produced will be $0·82 \times 0·61 = 0·5$ cc.; or, in other words, the percentage of alcohol in a beer is half the apparent attenuation expressed in degrees of the maltometer. The following example illustrates the use of the instrument:—A wort had a gravity corresponding to 13° of the maltometer before fermentation, and showed 6° after fermentation. Apparent attenuation $= 13 - 6 = 7°$; hence 100 cc. of the beer contained $7 \div 2 = 3·5$ cc. alcohol, and the dry extract of the beer will be $6 + (7 \times 0·18) = 7·26$ grms. per 100 cc., 0·18 being the excess of the apparent over the actual attenuation $(1·00 - 0·82 = 0·18)$.—A. K. M.

Examination of Glue. R. Kissling. Chem. Zeit. 1893, **17**, 726—727; (this Journal, 1887, 565; 1890, 399).

The adhesive strength of glue was determined as follows:—100 grms. of the sample are allowed to soak over night in 300 grms. of water contained in a beaker which, on the following day, is covered with a clock glass and warmed in a boiling water bath until solution of the glue is complete. The prepared surface of each wooden test-piece, which, if the piece has not been used before, should be first coated with a thin layer of glue and then washed with water and allowed to dry, in order that the pores of the wood may be filled with glue, is dipped into this solution, and the two pieces are immediately pressed together, any glue which does not of itself drop away being wiped off. The test-pieces are next subjected to a pressure of 10 kilos. for 24 hours. [From a datum subsequently given, the area of the glued surface of the test-piece appears to be 2 sq. cm. Another 48 hours, during which the pieces are allowed to remain without pressure in a dry room, must elapse before the breaking strain is applied. One of the test-pieces is now fastened on to a table by means of a screw clamp, so that the glued surfaces project 10 mm. beyond the edge of the table, and the weights are suspended from a scale pan attached at a point 200 mm. from the glued surface, 5 kilos. being first applied and 1 kilo. added after the lapse of each minute. The breaking strain per sq. cm. of glued surface (f) is calculated by the formula—

$$f = \frac{pl}{\frac{h^3}{6}}$$

in which p = the weight, l = the length of the lever arm (*i.e.*, distance from the glued surface to the point of suspension of the weight), and h = the height of the glued surface.

The following table shows (1) that there is no apparent relation between the price of a glue and its breaking strain as determined by the above method, and (2) that the breaking strain depends on the particular test-pieces employed. The breaking strain is expressed in kilos. per sq. cm. :—

No. of Sample.	Leather Glue.				Mixed Glue.		Bone Glue.			
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Price in marks per 100 kilos.	92	80	55	?	60	55	50	45	44	41
Experiment No. 1— Breaking strain	165	165	150	120	135	180	165	180	120	150
Pair of test-pieces	*a*	*a*	*a*	*f*	*e*	*a*	*e*	*c*	*c*	
Experiment No. 2— Breaking strain	120	105	135	180	135	210	195	150	195	255
Pair of test-pieces	*b*	*b*	*b*	*c*	*f*	*b*	*f*	*d*	*d*	*d*
Experiment No. 3— Breaking-strain	135	255	120	180	105	..	..	..	105	..
Pair of test-pieces	*a*	*e*	*c*	*f*	*e*	..	..	..	*c*	..
Experiment No. 4— Breaking-strain	225	165	135	..	135	..	..	..	105	..
Pair of test-pieces	*b*	*f*	*d*	..	*f*	..	..	..	*d*	..

The absorbtive power of the glue is determined by immersing the plate of glue, supported on fine wire gauze, in water and weighing it at intervals of 24 hours, allowing it to drain for 15 minutes before each weighing. The following figures illustrate the results obtained, and show that the difference between leather-glue and bone-glue in this respect is inappreciable (compare Schattemann, Dingler's Polyt. J. **96**, 115):—

No. of Sample.	Water Absorbed by 100 grms. of				
	Leather-glue.			Bone-glue.	
	1.	2.	3.	4.	5.
In 24 hours	134	174	218	168	..
In 48 hours	221	..	332	262	302
In 72 hours	297	340	448	335	366
In 96 hours	368	400	525	368	416
In 120 hours	441	436	..	..	..
In 144 hours	..	477	657	452	498
In 168 hours	518	490	679	424	518
In 192 hours	547	..	703	..	..
In 216 hours	..	..	723	..	..
Price in marks per kilo.	92	90	80	43	40

The gelatinising quality of the glue is determined by soaking 100 grms. of the sample in 300 grms. of water over night, warming it next day for a short time on the water-bath and allowing it to cool, the temperature of the jelly is then maintained as nearly as possible at 20° for four hours, and its consistency valued by the number of seconds which pass while a brass, a zinc, and a glass rod sink into it, each to a zero mark. The scale of valuation is given as follows:—

——	Glass Rod.	Zinc Rod.	Brass Rod.
Time of sinking in seconds	1—150	1—600	1—850
Value of consistency	1—15	15—45	15—100

Thus when the brass rod takes 850 seconds or longer to sink the consistency is 100, whilst if the glass rod sinks in a shorter time than one second the consistency is 0. Compare the author's method of testing oils (this Journal, 1891, 555; Chem. Zeit. 1891, **15**, 223). Some examples of values obtained by the method here follow:—

——	Price in Marks per 100 Kilos.	Relative Gelatinising Power.
Leather-glue, 1	90	50
„ 2	80	25
„ 3	75	100
„ 4	70	100
Mixed glue, 5	55	0
„ 6	55	3
Bone-glue, 7	50	5
„ 8	45	2
„ 9	43	22
„ 10	41	24

The superiority of leather-glue in gelatinising power is very evident. Further distinctions between leather-glue and bone-glue are that leather-glue has less disagreeable odour, and a smaller content of fat and of free volatile acids. In water-content, ash-content, adhesive power, and absorptive power there is no apparent difference between them.—A. G. B.

Analysis of Aniline Oils. H. Reinhardt. Chem. Zeit. 1893, **17**, 413—414.

This method is founded upon the following reactions:— 1. When a solution of aniline in dilute acid is treated with a mixture of potassium bromide and bromate, it is converted into tribromaniline whilst *o*- and *p*-toluidine under similar treatment yield dibromo-derivatives. 2. When oxalic acid is added to a solution of the three bases in hydrochloric acid, *p*-toluidine is first precipitated, then aniline, *o*-toluidine remaining in solution.

The brominating solution is prepared from 480 grms. of bromine, 336 grms. of potassium hydrate (100 p.c.) and 1 litre of water; the solution is boiled for 2 to 3 hours and then diluted to 9 litres. In conducting an analysis, 1·5 to 2 grms. of the oil are dissolved in 100 cc. hydrobromic acid (sp. gr. 1·45—1·48) and 1000 cc. distilled water, and the brominating solution is added until a reaction is obtained with potassium iodide and starch paper. The following formula is used for calculating the amount of aniline in a commercial oil:—

$$x = 2{\cdot}3777\,vt - 1{\cdot}3777\,a$$

a = weight of oil taken, v = volume of brominating solution and t its strength.

In the oxalate method a preliminary experiment is made to determine approximately the amount of oxalic acid required, which must be in excess of that required by the *p*-toluidine present. 100 grms. of the oil are mixed with 106 grms. of hydrochloric acid (20° B.) and the mixture is at once treated with a previously prepared and nearly boiling solution of the oxalic acid in 10 times its weight of water. The solution, which at first should be quite bright, is allowed to cool with frequent stirring and after 48 hours it is filtered. The precipitate is washed with three quantities each of 25 cc. water, decomposed by hot dilute potash solution, and the separated oil is weighed and titrated as above with the brominating solution.

The author gives results obtained with oils of known composition which show the method to be trustworthy.
—A. K. M.

Analysis of Alkylanilines. W. Vaubel. Chem. Zeit. 1893, **17**, 465—466.

The author discusses Reverdin and de la Harpe's method (this Journal 1889, 422) which he shows to possess some defects and proposes the following modification. A weighed quantity (1—2 grms.) of the oil is introduced into a perfectly dry liter-flask which is fitted with a doubly perforated cork; through this passes a dropping-funnel and a glass tube; the latter being connected by rubber tubing with a second glass tube fitted into the mouth of the dropping-funnel and extending towards its bottom. The oil is mixed with 50 cc. of a 7 per cent. solution of acetic anhydride in xylene and after standing for an hour, water is added from the dropping-funnel, so that the displaced air is caused to bubble through the water in the funnel and thus no anhydride vapour is lost; the excess of anhydride which becomes hydrated is then estimated by means of standard baryta solution and phenolphthaleïn. From the difference between the amount found and that originally present, the mono-ethylaniline may be calculated (the aniline having been previously determined and allowed for).

The method for determining aniline (loc. cit.) is likewise by no means free from faults, the amount of aniline found being generally too high. The author attributes this result to the employment of common salt for the precipitation of the dye produced in the reaction, for this will also precipitate some of the R-salt and thus give rise to an error. The author has made a systematic series of experiments on the change in temperature which occurs when the anilines are mixed with acetic anhydride and with the help of the following tables it is possible to carry out a fairly satisfactory assay in a very short time.

I.

Mixed			Added Acetic Anhydride.	Rise in Temperature.	Difference.	Difference due to each 4 per Cent. Ethylaniline.
Xylene.	Ethylaniline.	Diethylanillne.				
Cc.	Cc.	Cc.	Cc.	°		
50	25	0	25	68·3	3·1	3·1
50	24	1	25	65·2	2·5	2·5
50	23	2	25	62·7	3·1	3·1
50	22	3	25	59·6	2·9	2·9
50	21	4	25	56·7	2·5	2·5
50	20	5	25	54·2	2·7	2·7
50	19	6	25	51·5	2·7	2·7
50	18	7	25	48·8	7·5	2·5
50	15	10	25	41·3	14·4	2·9
50	10	15	25	26·9	14·5	2·9
50	5	20	25	12·4	3·0	3·0
50	4	21	25	9·4	3·1	3·1
50	3	22	25	6·3	3·0	3·0
50	2	23	25	3·3	3·1	3·1
50	1	24	25	slowly to 0·3	3·2	3·2
50	0	25	25	– 2·9		

II.

Xylene.	Mixed Aniline.	Diethylaniline.	Added Acetic Anhydride.	Rise in Temperature.	Difference.	Difference due to each 1 per Cent. Aniline.
Cc.	Cc.	Cc.	Cc.	°		
50	25	0	25	98·5	3·7	3·7
50	24	1	25	94·8	8·3	2·1
50	20	5	25	86·5	19·5	3·9
50	15	10	25	67·0	22·4	4·5
50	10	15	25	44·6	22·8	4·6
50	5	20	25	21·8	4·8	4·8
50	4	21	25	17·0	4·5	4·5
50	3	22	25	12·5	5·0	5·0
50	2	23	25	7·5	5·1	5·1
50	1	24	25	2·4	5·3	5·3
50	0	25	25	– 2·9		

The assay is carried out as follows :—The aniline is first determined by the R-salt method. Twenty-five cc. of the oil is then mixed with 50 cc. of xylene and the mixture treated with 25 cc. of acetic anhydride, both being at the same temperature to start with. The rise in temperature is noted and from it is deducted that which would be caused by a mixture (25 cc.) of aniline in the proportion previously determined with diethylaniline ; the remainder is due to ethylaniline, the amount of which can then be found from the table.—A. K. M.

ANALYTICAL AND SCIENTIFIC NOTES.

Myricylic Alcohol. M. A. Gascard. J. Pharm. Chim. 1893 [5], **28**, 49, through Chem. Zeit. Rep. 1893, 201.

Heretofore bees-wax, canauba wax, and shellac, have been regarded as containing different alcohol radicles, probably because of the difficulty of isolating the corresponding alcohol in a pure condition. Careful investigation shows that the radicle is the same in each of these waxes and is that of myricylic alcohol. This alcohol can be isolated from carnauba wax by saponifying with alcoholic potash, crystallising from alcohol, dissolving in water, precipitating with barium chloride and extracting the precipitate with petroleum. To obtain myricylic alcohol from beeswax the cerotinic acid is dissolved out with alcohol and the residue hydrolysed with hydrochloric acid. A mixture of palmitic acid and impure myricylic alcohol is thus obtained ; this is heated in a tube at 140° with melissic acid and the resulting ethereal salt crystallised from ether and saponified ; after several recrystallisations the myricylic alcohol is obtained in a pure condition ; its formula is $C_{31}H_{63}OH$, and it melts at 88°, not 85°.—A. G. B.

A Soluble colloidal Modification of Barium Sulphate. G. Buchner. Chem. Zeit. 1893, 878.

The author claims that he has discovered a soluble colloidal modification of barium sulphate, obtained by him on mixing a hot concentrated solution of barium acetate (40 per cent.) with a hot concentrated solution of aluminium sulphate (60 per cent.) in approximately equivalent proportions. The aluminium solution had been previously acidulated by a few drops of acetic acid. On cooling to 15° C. a thickish, transparent, pasty mass was obtained, from which no barium sulphate separated. It was not before adding water that the well-known white precipitate appeared. On filtering the pasty mass, a clear filtrate was obtained, which, on addition of water, became opalescent and yielded barium sulphate. Experiments having shown that the cause of this abnormal phenomenon cannot be traced to the use of concentrated solutions, the author concludes that barium sulphate exists also as a colloidal modification.—J. L.

On colloidal Modifications of Crystallisable Salts. H. Schiff. Chem. Zeit. 1893, 1000.

Buchner's notice on colloidal barium sulphate induced the author to recal an older notice of his own on the same subject (Annalen, **125**, 1862, 135). He mentions the colloidal precipitates obtained from alcoholic solutions of lead and barium acetates on adding sulphuric acid, and the oily mass obtained from a concentrated aqueous solution of potassium tartrate by alcohol. On adding free tartaric acid to such a precipitate, provided the precipitation had not been complete, the bitartrate separated as a slimy mass.

—J. L.

The Diathermancy of Aqueous Solutions of Ferrous Salts. R. Zsigmondy. Annalen der Physik und Chem 1893, **49**, 530, Proc. Inst. Civil Eng. 1893 [4], 89.

Alum, whether in crystal or in solution, is credited with a special power of stopping the ultra-red rays of the spectrum, in spite of the fact shown by Melloni, that in the solid state it absorbs a smaller percentage of the invisible heat-rays than ice, and that in aqueous solution it is less effective in this respect than water. Franz, in 1855 and 1857, called attention to the thermal properties of coloured salts of iron and copper, and the author has now studied the action of colourless solutions of ferrous compounds. The source of heat used was an Argand burner, the measurements were made with a bolometer, and the liquids were contained in tanks with glass sides 9·5 millimetres (⅜-inch) apart.

The power of the solution to absorb heat appears to depend upon the percentage of the metal present in the ferrous state, ferric salts having comparatively little power. The influence of the acid is in general not marked. A solution of ferrous chloride, containing 2·8 per cent. of the metal transmitted 4·06 per cent. of the total heat : a similar solution of ferrous sulphate had an equal effect. Ammonio-sulphate of iron allowed 4·4 per cent. to pass, but ferric chloride of the same strength transmitting 11·2 per cent. of the heat rays, *i.e.*, only 1 per cent. less than pure water under like circumstances. Using a larger tank, a layer of liquid containing 0·35 per cent. of iron as proto-salt with a depth of 54·3 millimetres (2¼ inches) was found to arrest all but 3·29 per cent. of the heat-rays, and to appear practically colourless by daylight.

New Books.

ILLUSTRATED ABRIDGMENT CLASSES OF BRITISH PATENTS for the Period 1877—1883. 9*d.* each.

THE Comptroller-General of Patents, Designs, and Trade Marks announces the appearance (to be found on page 980 of the Illustrated Official Journal of the Patent Office, No. 249, October 11, 1893) of a new series of illustrated Abridgment Classes. Each of these forms a well-bound 8vo. volume.

Hitherto no volumes of abridgments of British Patents taken out before the year 1877 have been at the disposal of those making search as to novelty of invention, the abridgments in existence only dating for the period A.D. 1884 onwards. The volumes just announced will consequently prove of great value in the process of searching, though, as the Comptroller-General opportunely remarks, "To complete a search, however, as to absolute novelty, a further exhaustive examination of technical literature would be necessary."

The following volumes relating to Chemical Industry have now been issued, and are on sale, at the price above named, at the Patent Office, Sale Branch, 38, Cursitor Street, Chancery Lane, E.C. :—

	Postage.
Distilling, Concentrating, Evaporating, and Condensing Liquids	2½*d.*
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TABELLARISCHE UEBERSICHT DER NAPHTALIN DERIVATE. Auf Grundlage des Werkes: Sur la Constitution de la Naphtaline et de ses Dérivés, par F. Reverdin et E. Noelting, unter Berücksichtigung der neueren Literatur, bearbeitet von F. REVERDIN und H. FULDA. Basel, Genf, Lyon: Verlag von Georg and Co. 1894. London: H. Grevel and Co., 33, King Street, Covent Garden.

THIS work forms a kind of dictionary of the naphthalene derivatives. It is divided into two parts, one almost entirely composed of tables and tabulated details, and the other dealing with the literature of the subject. The two parts are completely connected by cross-references, and the whole work is based upon that of Reverdin and Noelting, "*Sur la Constitution de la Naphtaline et de ses Dérivés*," already noticed in this Journal, 1888, 138. The two volumes under notice are of quarto size, with paper covers, and the first contains 35 large tables, so graduated as to pass gradually and systematically from the least to the most complex of the naphthalene derivatives and substitution compounds. The second volume (Literature) contains 60 pages, filled by Tables I. to VI. The complete literature of the subject is here indexed. By means of this work, a complex and important branch of organic chemistry has been actually reduced, by the method of classification adopted, to a state of comparative simplicity.

BIBLIOGRAPHIE DE LA TECHNOLOGIE CHIMIQUE DES FIBRES, TEXTILES, PROPRIÉTÉS, BLANCHIMENT, TEINTURE, MATIÈRES COLORANTES, IMPRESSION, APPRÈTS. Par M. JULES GARÇON, Ingenieur-chimiste, &c. Ouvrage couronné par la Société industrielle de Mulhouse. Paris: Gauthier-Villars et Fils, Quai des Grands-Augustins 55. 1893. London: H. Grevel and Co., 33, King Street, Covent Garden. 6 Fr.; about 4*s.* 10*d.*

THIS valuable bibliographic index received the special award of the Société industrielle de Mulhouse in 1892. As stated in the preface, it is designed to serve as a guide to all those interested in the textile fibres, and the industries concerned in their preparation and treatment throughout their whole range. It comprehends an alphabetical list of the names of authors of works and treatises (*Section I.*), a list of periodicals (*Section II.*), and a tabular arrangement of the matters contained in Section I. (*Section III.*).

Thus in Section I. we find indexed (1) French works; (2) German works; (3) English works; (4) American works; (5) Italian, Spanish, and other works. This is followed by a table of the names of authors mentioned in Section I.

In Section II. are French, German, English, American, and other periodicals, and followed by a table of the names of authors or editors.

At the end of the book is an alphabetical index of matters treated of in the text. The work is of pamphlet form, 8vo. size, and contains 170 pages of printed matter.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

UNITED KINGDOM.

The Exportation of Medicinal Tinctures and Perfumery.

The following general orders have been issued by the Inland Revenue authorities (see also this Journal, 1892, 785) :—

Use of "Standards" for Testing Capacity of Bottles of Perfumed Spirits Exported.

(General Order No. 20.)

The Board sanction the use of the following system of determining by means of "standards" the capacity of bottles used for the exportation of perfumed spirits on drawback :—

The trader should furnish the officer with a standard bottle for each size to be filled. This bottle is to be carefully filled as for corking, measured to the thousandth part of a gallon, labelled with the exact content, and then treated as the "standard" for all bottles of the same size and description.

When lots or "lines" of bottles of the same size are ready for packing, the officer should select as many as he considers requisite, not less than six, and compare each with the "standard," and if there is no apparent disparity (subject to measurement as stated below) he should count the bottles and multiply the number by the capacity of the "standard," so as to get the bulk gallons of the whole lot.

If after an examination by the eye of not less than six bottles, and the selection of one that appears to be of the smallest internal capacity, the contents of such selected bottle be found to be not less than that of the "standard," the bottles of that size may be passed as of the same content as the "standard"; but if the content be less than that of the "Standard," the usual measurement of not less than six bottles if there be 36 or more of the same size, or one in six if there be less than 36, be carried out in terms of the present regulations on the subject.

The standard bottle is to be kept under Revenue lock in a secure place on the premises of the trader.

Dated October 25, 1893.

Exportation of Tinctures.

(General Order No. 21.)

With reference to the regulations governing the exportation of tinctures on drawback, as contained in paragraphs 440 to 471 of the licence and cautionary instructions, the

Board direct that the following extension of the regulations be allowed :—

Tinctures may be exported by weight in bottles containing $\frac{1}{4}$ lb., $\frac{1}{2}$ lb., 1 lb., 2 lb., 4 lb. exact net weight of tincture, and vessels of larger size than is at present sanctioned may be used—subject to the conditions mentioned below, namely :—

1. That the bottles in each package be of the same size or the contents of the same net weight, and that no single package be filled with bottles of which the contents are partly calculated by weight and partly by measure.
2. That the form 111—4 be filled up as at present, but that when the tinctures in a case are estimated by weight, the title, "No. of lbs. in the gallon," be substituted for "Number of bottles to the gallon," and that in place of the column, "whether prepared from proof or rectified spirit," columns be substituted showing (1) number of bottles and (2) weight in each bottle of each tincture.
3. That, as at present, the bulk gallons, strength, and proof quantity be entered by the trader in relation to each kind of tincture.
4. That the column for laboratory use be divided so as to show the bulk quantity in the sample as well as the strength.
5. That in all other respects the existing regulations be observed.
6. That no less quantity that 2 bulk gallons be exported in any case or package, and that any package larger than half a gallon or 4 lb. respectively, shall contain not less than 1 gallon, 2 gallons, &c., or 8 lb., 16 lb., &c.

Dated October 31, 1893.—*Chemist and Druggist.*

Italy.

Classification of Articles in Customs Tariff.

Note.—Quintal = 220·4 lb. avoirdupois. Lire = $9\frac{6}{10}$*d.*
Kilogramme = 2·204 lb. avoirdupois.

The following decisions affecting the classification of articles in the Italian Customs tariff have recently been given by the Italian Customs authorities :—

Pure acetate of amyl. Category 8 c. Duty, 3 lire per kilo.

Red ink with an alcoholic basis. Category 75. Duty, 15 lire per quintal.

United States.

Customs Decisions.

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the Custom authorities in that country.

Dross or residuum from burnt pyrites, known commercially as "blue-billy" and "purple ore," imported in blocks or so-called bricks 9 × 6 × 5 inches in dimensions and weighing about 30 lb. each, and not in the form in which dross or residuum from burnt pyrites is usually imported, viz., in a powdered or granulated condition, is specifically provided for in paragraph 133 as dross or residuum from burnt pyrites.

No allowance of drawback is made on carbonised wool.

On the exportation of the compound known as "fish preserver," manufactured by Johnson & Shaw, of Boston, Mass., from imported boracic acid and domestic common salt, a drawback will be allowed equal in amount to the duty paid on the boracic acid so used, less the legal deduction of 1 per cent. The respective quantities of the salt and acid so used must be stated in each export entry, and the total weight thereof must not exceed the net weight of the exported article as ascertained by the United States weigher. The statement in the entry shall be further verified by an analysis at the appraiser's office of a sample to be taken by the inspecting officer on each shipment.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Australasian Mineral Products.

United States Consular Reports, No. 149, *February* 1893, 185—199.

Gold.

In Victoria 576,399 oz. of gold were raised in 1891, being a decrease of 12,161 oz. ; of this 387,832 oz. were from quartz and the rest from alluvial sources. 93,114 oz. of gold were exported, besides specie from all sources, to the value of 2,217,734*l.* The number of miners was 13,006 working in quartz, and 10,520 in alluvial. In Tasmania the yield fell from 29,240 oz. in 1889—90 to 26,000 oz. in 1890—91, but a good deal of prospecting has been done, which may lead to future developments. In Western Australia 15,000 oz. of gold were raised in six months on the Ashburton River. The Pilbarra field in the north-west of the colony gives good promise. Six crushing plants have been erected in the Gilgam field, where the yield is over 1 oz. per ton. At Kimberley 4,336 tons of stone were crushed for 4,260 oz. of gold. The output in Queensland in 1891 was 576,439 oz., being 34,148 oz. less than in 1890, owing to the less production at Mount Morgan. The deposit at Mount Morgan is attributed to geyser origin, and contains large amounts of aluminium and iron sulphates ; the latter yields as much as 24·4 per cent. of sulphuric anhydride, and might with advantage be utilised for sulphuric acid manufacture. The natural purity of the Mount Morgan gold is unequalled. In the year ending 31st May, 124,290 oz. of gold were obtained from 59,788 tons of stone. In New Zealand the yield of gold in 1891 is the lowest on record, chiefly owing to the want of water. Up to 31st March, 171,080 oz. had been entered during the previous 12 months for exportation, as against 201,760 oz. for the same period of 1889—90. The Thames is the largest field in the Hauraki Peninsula and supports a large population. A system of dredging has been adopted for ocean beaches, river beds, &c., but only a small percentage of the gold is recovered owing to the difficulty in washing appliances.

Tin.

In Queensland 2,236 tons of tin were raised by 984 mines, being 734 tons less than the production of 1890. The value was 116,387*l.* The diminished production was partly due to scarcity of water. The tin of Mount Broun contains a small quantity of bismuth, rendering it unsaleable in the colony. In New Zealand, the supposed rich discoveries of about two years ago have not been a success. Victoria produced 1,778 tons of tin ore, valued at 5,092*l.*, in 1891, or 869 tons more than in 1890 ; 18 tons of block tin, valued at 1,701*l.*, and 13 tons of ore, valued at 650*l.*, were exported, against an import the year before of 173 tons of the former and 6 tons of the latter. From Tasmania, 1,561 tons of tin, valued at 139,364*l.*, were exported during the first half of 1891, the total for 1890 having been 3.209 tons, valued at 296,368*l.* In Western Australia the Greenbushes field has prospered steadily, but very few areas are now being worked.

Great Britain obtains most of her tin, apart from Cornwall, from Australasia and the Straits ; the former contributed, in 1890, to the value of 569,264*l.* The price at the commencement of this year was 90*l.* 10*s.* per ton in London : in 1884 it was as low as 72*l.*, and in 1887 as high as 168*l.* During the first seven months of 1892, Great Britain sent tin to the United States to the value of 2,255,000*l.*, as against 2,622,000*l.* in a like period of 1890.

Mercury.

Queensland produced a certain amount of mercury from cinnabar in 1891, but operations were suspended owing to the low price.

Silver.

In 1891, only 873 tons of ore were raised in Queensland, valued at 21,879*l.*, as against 1,913 tons in 1890. This is largely due to the closing of the Mountalbion works. From Victoria, 13 tons of ore, valued at 130*l.*, and 10 tons of silver and lead, worth 80*l.*, were exported in 1891. In Tasmania, 119,000 acres were leased and applied for up to the 30th June 1891 for silver ore, and the Zecham and Dundas are said to be of vast extent and richness. But time will be required for development, owing to the wild character of the country. In New Zealand, silver mining is yearly attracting more attention, but no correct statistics are yet available.

Copper.

This industry is said to be at a standstill in the Cloncurry district of Queensland, owing to the stagnant state of the market and the want of cheap transit to port. In Victoria only 60 tons, valued at 216*l.*, were raised in 1891.

Coal.

In 1891, Victoria produced 22,834 tons of coal, worth 19,731*l.*, and 6,322 tons of lignite, worth 1,673*l.* The import during the same period amounted to 732,185 tons. It seems very doubtful whether Victoria will be able to meet her own coal requirements. Victorian coal costs 19*s.* per ton, against 14*s.* 5*d.* for imported Newcastle coal, yet during the first seven months of 1892 the railway department used about 12,000 tons of the former, amounting to a Government subsidy of 4*s.* 7*d.* per ton in favour of the local industry. Tasmanian coal is of excellent quality; the output in 1890 was 50,519 tons, worth 43,467*l.* Anthracite is also found. Recent discoveries have been made in Western Australia, and the seams are said to be good enough to encourage future explorations. The coal is clean, solid, breaks without forming much dust, is suitable for furnaces with a sharp draught, and gives but little ash and smoke; it is useless for gas-making. Owing to the strike of 1890 the output of coal in Queensland rose to 338,344 tons, but in 1891 it receded to 271,702 tons. In New Zealand there were 123 mines in 1890; 110,989 tons, worth 102,166*l.*, were imported and 76,388 tons, worth 74,928*l.*, exported. Nearly all the imported coal (100,421 tons) was from New South Wales. Of the exported coal 42,984 tons were sent to the United Kingdom.

Kerosene Shale.

In New Zealand boring for oil was carried on as far back as 20 years, when, it is stated, about 50 gallons a week was got for a short time. An English company has recently commenced operations at New Plymouth. The difficulty is to prevent loss by permeating the loose, unformed ground.

Kauri Gum.

In New Zealand 14,957 tons of the gum, worth 708,133*l.*, were exported in 1890 and 1891. It is an industry which demands no capital on the part of the collector.

—N. H. J. M.

MINERAL PRODUCTS OF NEW SOUTH WALES.

U.S. Consular Rep., No. 149, February 1893, 163—185.

Notwithstanding the fact that many mines are standing idle from ignorance of proper methods of treating the ores, the mining industries have made considerable progress during the past year. Were the difficulties as regards refractory ores, &c. overcome the output might become enormous. The following table shows the production of minerals and their value in 1890—1891.

		1890.		1891.	
		Quantity.	Value.	Quantity.	Value.
			£ s. d.		£ s. d.
Alumite	Tons	200	3,000 0 0	704	1,888 0 0
Antimony	„	1,026	20,240 8 6	914·85	22,057 0 0
Bismuth	„	2·1	306 0 0	0·4	500 0 0
Coal	„	3,060,876·48	1,279,088 19 5	4,037,929·3	1,742,795 12 6
Cobalt	„	..	..	1·15	470 0 0
Coke	„	31,097	41,147 3 7	30,310·35	34,473 5 10
Copper	„	3,745·9	173,311 0 0	4,525·55	205,093 0 0
Fire Clay	„	..	..	16·8	55 0 0
Gold	Oz.	127,760·64	460,284 16 2	153,335·62	558,305 12 3
Grindstones	Number	..	..	471	311 0 0
Iron (from old iron)	Tons	3,413·44	39,948 12 2	4,125·81	36,101 0 3
Lead, pig	„	126	1,587 0 0	190·65	2,025 0 0
Lime	„	..	..	410	958 0 0
Limestone flux	„	41,136·8	41,989 5 9	74,057	65,357 6 2
Manganese	„	100	325 0 0	138·2	340 0 0
Marble	Packages	..	..	635	2,577 0 0
Iron oxide and pig iron	Tons	455·3	884 0 0	288·75	434 0 0
Shale	„	56,010	104,103 7 5	40,349	78,160 0 0
Silver	„	496,552·2	95,410 0 0	729,590·05	134,850 0 0
Silver lead and ores	„	131,039·65	2,667,144 0 0	147,779·7	3,484,739 0 0
Slates	Number	..	..	31,234	351 0 0
Stone: building	Tons	..	..	4,735	5,205 0 0
„ ballast	„	..	..	619	713 0 0
Nable opal	Lb.	195	15,600 0 0	..	..
Tin	Tons	3,668·75	329,841 0 0	3,144·52	271,412 0 0
Zinc spelter	„	210·45	2,378 0 0	218·6	2,622 0 0
Sundry minerals	„	973	7,252 0 0	788·95	3,217 0 0
Total		..	5,283,840 13 1	..	6,655,009 17 0

Antimony.—Some lodes of ore were found about 300 miles north of Sydney, and 1,580 tons were won 50 miles further south, but the market value was too low to give satisfactory results.

Bismuth.—Twenty-eight assays were made for bismuth from various places, yielding from 1·45 to 25 per cent. of metal.

Coal.—Coal was first discovered at Port Stevens in 1796, and, was exported for the first time in 1800. In 1826 a company was formed, which operated for 18 years with an average annual output of 18,000 tons. Subsequently other companies were formed, and, from 67,600 tons in 1867, the output rose to 4,037,929 tons in 1891. The coal districts now cover an area of about 24,000 square miles; those in the north are worked chiefly by shafts, those of the south by tunnels, except at Helensburg, where there is a shaft 1,150 feet deep. The percentage composition of the coal from the three districts is as above.

—	Water.	Hydrocarbons.		Ash.	Sulphur.	Average Specific Gravity.	Average Yield of Coke.
		Volatile.	Fixed.				
Northern............	2·45	35·51	54·29	6·8	0·88	1·3	61·14
Southern............	1·55	24·11	63·53	10·01	0·76	1·35	73·88
Western	2·67	28·99	58·13	9·73	0·73	1·35	67·9

As regards the inter-colonial trade, the total has increased from 1,039,764 tons in 1888 to 1,519,976 tons in 1891. The demand for Oceania has increased, as has also the trade with all continental American countries except the United States, due to the large importation of Japanese coal. New South Wales has also to contend against British competition for 800,000 tons consumed by the East Indies and the Pacific seaboard of America. After deducting 200,000 tons of the best Welsh coal, used for war vessels, there remains still 600,000 tons for which the colony could compete but for the difficulty of the return freight. Coal formations extend all over the country, and comparatively little has been extracted.

Kerosene Shale.—The colony exported 34,652 tons, worth 101,288*l.*, in 1891, whilst the total production amounted to 40,349 tons, as against 56,010 tons in 1890. The quality varies materially in different parts, the best being used for gas-making and the rest for oil, &c. This is made by heating 25 cwt. in a retort (the gas being collected) and draining off the oil into stills to be freed from other volatile matter, after which it is purified by means of chemicals. A good lubricant, a clear wax, suitable for candles, and other valuable products are obtained. Nearly 2,000,000 gallons of oil are imported annually from the United States, and, owing to the low price, proves a formidable competitor to to the native manufacturer.

Chrome.—Deposits of chrome have been discovered 350 miles north of Sydney, one bunch being calculated to yield 52 tons of ore for every foot of sinking, and another 172 tons. It contains 39·7 to 55·27 per cent. of chromium oxide. If iron and steel works should be established, the deposits could be profitably exported for the manufacture of chrome steel.

Copper.—In 1891, 3,860 tons of copper in ingots, worth 191,878*l.*, and 665 tons in ore and regulus, worth 13,215*l.*, was exported. The great Cobar Mine, which employs 500 people, and the plant of which is worth 85,000*l.*, has been idle throughout 1891, owing to the low price of copper.

Gold.—The output, which was 425,129 oz. in 1872, fell to 87,503 oz. in 1888, but has steadily increased since to 153,356 oz. in 1891.

Iron.—No iron is made from ore at present, although attempts have been made to form a company to work the very rich iron deposits of the south. It is estimated that 2,872,000 tons of brown hematite (with 48·4 per cent. of metal) is in sight in the Miltagong district, and within 40 to 100 miles by rail further deposits are roughly set down at 4,000,000 tons. In the Wallerawang district the total deposits available for melting amount to about 2,480,000 tons.

Mercury.—A deposit of cinnabar was found, in 1891, near Bengera, but the amount is too small to pay working expenses, unless it could be concentrated by some cheap process.

Precious Stones.—Diamonds to the extent of 1,200 carats have been won at Tingha and at Inverell, and about 25,000 carats of emeralds have been raised in the New England district. Little progress has been made at the opal mines of the Wilcanta division, owing to the scarcity of water.

Silver and Lead.—Although the export of silver and lead was largest in 1891, the output would be more increased by a thorough knowledge of the best processes for treating every variety of ore. In the Brocken Hill and in the Silverton district 471,101 tons of ore, worth 3,969,677*l.* was raised in the year.

Tin.—The alluvial deposits of the older fields are largely exhausted, and no new discoveries have been tested. In 1891 the output was less than in any year since 1872. The export for 1891 was 2,941 tons of ingots and 203 tons of ore, as against 3,409 tons of ingots and 259 tons of ore in 1890.

Wolframite.—Assays of this mineral were made last year, but as yet no permanent deposit has been found.

Zinc.—Zinc assayed in 1891 was from Emmaville, from Bungarra, and from Inverell, and gave, respectively, 17·62, 9·72, and 2·71 per cent. of zinc, with 20 oz. 2 dwt. and 21 grains, 25 oz. 5 dwt. and 5 grains, and 80 oz. 16 grains of silver per ton.—N. H. J. M.

GENERAL TRADE NOTES.

IRON ORES IN GREAT BRITAIN.

"Bulletin of British Iron Trade Association" through "Engineering and Mining Journal."

The most recent returns show that the iron trade of Great Britain is increasingly dependent on imports of iron ore for the supply of the blast furnaces of the principal districts, and the north of England and Scotland are increasingly competing with South Wales for the produce of the mines of Bilbao and the south of Spain. The imports of iron ores into Great Britain for the first eight months of 1893 were 2,968,000 tons, as compared with 2,538,000 for the corresponding period of 1892. The iron ore import trade, however, like the home trade, has been specially subject to adverse influences during the current year. Advices from Cardiff show that owing to the restrictive quarantine regulations at present in force in the south of Spain, and to the absence of general demand at current prices, the import of iron ores from the south of Spain has almost stopped. The imports from Bilbao are, however, continued on a large scale, and the improvements that have recently been made in the harbour and in the navigation of the Nervion River, have facilitated the despatch of cargoes to a considerable extent. One of the most interesting recent events in connection with the development of the ores of Spain is the acquisition by the firm of W. Baird & Co., of the Gartsherrie Works in Scotland, of the Pedrosa Mines, near Seville, whence ores will be shipped by the Guadalquiver River. One of the remarkable features of the recent course of the iron ore industry has been the increase of imports. A full detailed statement shows that in 1880 the total consumption of iron ores in Great Britain was 20,660,000 tons, of which the imported ores were 2,634,000 tons, or 12·7 per cent., while in 1892 the total was 15,091,000 tons, the amount of foreign ores being 3,778,000 tons, or 25·2 per cent. The percentage of foreign ores used to the total consumption for 13 years past is shown in the following table:—

1880	12·7
1881	12·3
1882	13·4
1883	15·4
1884	14·4
1885	15·4
1886	16·9
1887	22·3
1888	19·6
1889	21·7
1890	24·5
1891	19·9
1892	25·2

In 1892, as compared with 1880, 12 years before, there was a falling off in home production of nearly 7,000,000 tons, and a falling off in total consumption to the extent of over 5,000,000 tons. The percentage of our total consumption imported from other countries was larger in 1892 than in any previous year, and was fully 5 per cent. above that of the year 1891, when the importation of ores fell off very considerably, in comparison with either of the four previous years.

The decline in the production of iron ores at home has not been special to any particular locality, but has been distributed over nearly the whole of them. The largest amount of decrease has taken place in Cleveland and Scotland, which for a few years past have been using increasing quantities of iron ore, until now they produce over 20 per cent. of their make of pig from ores brought from other countries or districts. The present condition of the home iron ore industry appears to be extremely unsatisfactory. Very few mines are yielding profits, and many of them are carrying on operations with more or less considerable loss. This result is largely due to the increased cost of labour, as compared with the level of four years ago, but it is also to some extent affected by the falling off in the production of pig iron.

Russian Petroleum Production.

The Russian *Novoe Vremya* devotes an article to the subject of petroleum production in Rusaia. It seeks to prove that this branch of industry has not progressed properly, that sufficient benefit is not reaped from the extraction of the product, the quantity of petroleum produced being in disproportion with the quantity of naphtha used. It shows that in four years the extraction of naphtha and the production of petroleum at Baku has been as follows:—

Extraction of naphtha, 1889, 205,000,000 pouds; 1890, 239,000,000 pouds; 1891, 288,000,000 pouds; and 1892, 298,000,000 pouds.

Production of petroleum, 1889, 61,100,000 pouds; 1890, 67,300,000 pouds; 1891, 74,000,000 pouds; and 1892, 78,700,000 pouds.

From these figures it appears that petroleum constituted in 1889, 29·8 per cent. of the quantity of naphtha extracted; in 1890, 28 per cent.; in 1891, 25·7 per cent.; and in 1892, 26·4 per cent.

With respect to the small proportion of petroleum extracted from the raw material, this results from the very nature of the Caucasian naphtha. Experiments made 12 years ago proved that, whilst American naphtha gave 75 per cent. of material capable of use for purposes of lighting, Russian only yielded 30 per cent., at least, such as is used for petroleum lamps.—*Board of Trade Journal.*

Mineral Production of Ontario.

The Toronto *Monetary Times* for the 29th September contains the following particulars of the mineral production of the province of Ontario for the year ended the 31st October 1892, extracted from the second report of the Ontario Bureau of Mines.

Two-thirds or more of the cement made in Ontario is the product of natural rock, but Portland cement was begun to be made in 1691, when 2,033 barrels were made, valued at 2·50 dols. per barrel. This year the natural rock output is 7,977 barrels greater than in 1891.

Gypsum mining in the province shows only 72 per cent. of the output of 1891, being 3,870 tons, valued at 14,100 dols.; but alabastine and plastico manufacture is considerably increased.

Owing to the low prices at which Florida phosphate of lime sold in European markets during 1892, the output of apatite in Ontario last year was extremely small. Only three mines were worked, and these to much less than full capacity, the total product being 2,381 tons, valued at 23,810 dols. In the years 1881 to 1885 inclusive the shipment of Canadian phosphate to Great Britain and Germany were 15,000, 17,000, 18,000, 22,000, and 24,000 tons respectively.

Only one Ontario mica mine was worked last year. Its output was 7 tons, valued at 1,500 dols.

According to a report made by the secretary of the Salt Association, Mr. John Ransford, the quantity of salt made in the province in twelve months ended with October last was 43,387 tons, valued at 162,700 dols.

On the subject of nickel, copper, and cobalt, the report has this to say: The quantity of ore raised last year was 72,349 tons, and the quantity smelted 61,924. Three of the four companies operating have erected Bessemerising plants, employed to enrich the matte, but only a portion of the matte is treated by this process. The quantity of ordinary matte produced at all the furnaces was 6,278 tons, and of Bessemerised matte 1,880 tons. The estimated metal contents of these mattes and their value at the works is thus given:—Nickel, 2,082 tons, value 590,902 dols.; copper, 1,936 tons, value 232,135 dols.; cobalt, 8½ tons, value 3,713 dols. The value of the metal contents was thus 826,750 dols.; nickel being 14·2 cents per pound, copper 120 dols. per ton, cobalt 437 dols. per ton. London quotations for nickel ruled steadily at 42 cents per pound and New York 48 to 52 cents.—*Ibid.*

Chlorine.

According to a report by Hasenclever in *Die Chemische Industrie* researches have been made in two works in England with the object of obtaining chlorine from common salt and nitric acid. Mond's process, which has already been described in these columns, should at the end of this year be producing regularly five tons of bleach per day.

In the Rhenania Works at Rheinau, near Mannheim, chlorine is manufactured as a commercial product, the process being patented in Germany. The chlorine gas is liquefied by subjecting it to a pressure of 50 atmospheres, and is stored in this state in strong cast-iron vessels holding about 60 kilos. each. In this form it is sent into the market. The chlorine can be taken from these "bombs" in either the fluid or gaseous state, suitable valves being provided for this purpose. It is applied to a great variety of purposes, and especially for bleaching textile fabrics.

Many chemical works are also endeavouring to find suitable methods for producing chlorine by electrolysis. The Gesellschaft Elektron already places upon the market more than a thousand tons of bleaching powder yearly, which is obtained by the electrolytic decomposition of chloride of potassium. Further, an association under the technical guidance of the Allgemeinen Elecktricitäts-Gesellschaft, of Berlin, conducted a long series of researches, in a large soda and bleaching powder factory, on the electrolytic decomposition of common salt. The manufacturing process, it was said, was worked at first in Bitterfeld, near Halle.

All these attempts menance the bleaching powder works far more than the soda works, because from 100 tons of common salt more than double as much bleaching powder as soda is prepared. The yearly production of soda in Europe is about five or six times as great as the quantity of bleaching powder produced, and the sale of the latter is more limited.

In Germany, the preparation of bleaching powder from Stassfurt chloride of magnesium by the electrolytic method has changed to an important degree the position of the market. As the following table indicates, there is now more bleaching powder exported than imported, and it appears very probable that when the newly projected electrolytic installations are at work, the paper-maker will soon have cheaper bleaching agents.

GERMAN IMPORTS AND EXPORTS OF BLEACHING POWDER.

Year.	Imports.	Exports.	Import Balance.	Export Balance.
	Tons.	Tons.		
1882	5,817	377	5,440	..
1883	5,127	671	4,456	..
1884	6,339	898	5,441	..
1885	6,179	432	5,747	..
1886	5,630	300	5,330	..
1887	3,450	475	2,975	..
1888	5,257	745	4,512	..
1889	4,716	807	3,907	..
1890	6,647	552	6,095	..
1891	3,430	1,356	2,074	..
1892	2,913	3,539	..	626

SODA.

Soda is also now being prepared by the electrolytic method, and especially threatens to completely abolish the Le Blanc process. The following table shows very clearly how this latter process is yielding to the cheaper ammonia soda.

During the past few years the following quantities of common salt were decomposed for the production of soda :—

——	1890.	1891.	1892.
	Tons.	Tons.	Tons.
Le Blanc method	602,769	567,863	519,563
Ammonia method...........	252,260	278,528	304,897
	855,029	846,391	824,460

In Great Britain there are now eight ammonia soda works producing yearly about 200,000 tons. The sale of soda in Germany has diminished in consequence of general bad trade. Its price also has gone down. The steady advance of the newer methods gives trouble to manufacturers, especially those employing Le Blanc's process, and it is because of this aspect of the present state of things that Chance's process for the recovery of sulphur from "soda waste" has not been universally adopted. According, up till now, 35,000 tons of pure marketable sulphur are recovered in England; some thousands of tons at St. Cobain, in France; and about 1,500 tons in Hruschan, in Austria. In Germany, Chance's process has not been realised as a manufacturing operation on a commercial scale.—*Chemical Trade Journal.*

INDIAN PAPER MILLS.

According to a statement published by the Government of India there are nine paper mills—four in the Bombay Presidency, three in Bengal, one at Lucknow, and one at Gwalior. Of the nine, three are private concerns (in the Bombay Presidency); the others have an aggregate nominal capital of Rx. 492,200. The fibrous materials used for making paper are chiefly rags, babui, and moonj grasses, rice, straw, jute and hemp cuttings, and old jute bags and cloth. The quality of the papers made has much improved in recent years, and they have a large and increasing sale. Most of the white and blue foolscap and much of the note paper and envelopes used in the Government offices is now obtained from the Indian mills. The total quantity of paper made in 1892 was about 26½ million lb.; 10 years ago it was about 7¼ million lb. The number of persons employed is 2,465.

There are a number of small paper works for the manufacture of what is known as country paper, scattered through most provinces, but of these petty industries no account can be taken in the return.—*Board of Trade Journal.*

MAGNESITE AS A REFRACTORY MATERIAL.

Within the last 10 years there has been a notable demand for the mineral magnesite, or carbonate of magnesium, and recently this has increased very rapidly. Magnesite is used chiefly in the manufacture of refractory brick and for the preparation of hearths for basic furnaces. For the latter purpose it is superior in many respects to dolomite, which is the material commonly employed, and it is only the high cost of the mineral that prevents its general introduction into furnace construction.

The chief sources of magnesite at the present time are the Austrian province of Styria, the island of Euboea in Greece, and Frankenstein in Prussian Silesia, the first mentioned being the most important. In 1892 the shipment from the Veichsthal, Styria, amounted to 3,690 metric tons of crude magnesite and 9,020 tons of calcined (equivalent to about 18,000 tons of crude), representing a total production of 21,690 tons of material. The exports from Greece, which include the total output of that country, were only 2,228 tons, having declined from 8,734 tons in 1890, probably on account of the increasing competition of the Styrian rock, which has better binding properties than the Grecian and is preferred on that account. The Silesian magnesite is no longer used for the manufacture of brick.

In the United States magnesite has been discovered in workable deposits, so far as we are aware, only in California, where a mine was opened in 1891, during which year about 1,500 tons of raw mineral were produced, 100 tons being used in the manufacture of steel on the Pacific Coast.

Large deposits of magnesite are known to exist in Bolton and Sutton, Broome County, Quebec, but it is of inferior quality, being high in silica and iron, which are very undesirable impurities, detracting from the refractoriness of the rock. Nevertheless a small percentage of ferric oxide' as in the brown Styrian magnesite, is claimed to be advantageous, giving it the property of fritting or setting at a high temperature, while the binding qualities of the purer white Grecian magnesite are not so strong. Magnesite should not, however, contain more than 3 to 5 per cent. silica after calcination, and its tenor in magnesia should not be less than 90 per cent.

The total consumption or calcined magnesia in the United States in 1892 by the steel works was between 900 and 1,000 tons, all being imported from Greece and Austria, with the exception of a small quantity of Californian mineral used by the Pacific Rolling Mill Company. The value of imported magnesite brick of the normal size in New York is 47·50 dols. per ton, calcined magnesite 22 dols. per ton, and crude mineral 14·74 dols. With the increasing demand for the rock and the high price it brings, it would pay prospectors to look for workable deposits.

To assist prospectors we may say that magnesite is a mineral resembling limestone and dolomite in its occurrence, being found both crystalline and massive. Its hardness is 3·5 to 4·5, and specific gravity 2·8 to 3·2. Its colour is white, yellowish, or greyish-white and brown. Like calcite and dolomite it is dissolved with effervescence in hot acid, but, unlike the first, effervesces very slowly or not at all with cold acid, whereby the two minerals may be distinguished. After ignition before the blowpipe, moistened with a solution of cobalt nitrate, magnesite turns pink under the oxidising flame.—*Engineering and Mining Journal.*

The Price of Aluminium.

The price of aluminium, which a year or so ago declined to 50 cents a pound, but subsequently rose to 75 cents a pound, at which it now stands, is about to decline again to lower figures than ever before reached. The day is not distant when this interesting and, for many purposes, valuable metal will be produced in what would now appear enormous quantities, and at prices which will give it many new uses. The Aluminum-Industrie-Actien-Gesellschaft, of Neuhausen, in Switzerland, states that the increase of its dynamo capacity to 4,000 h.p., and some improvements in the processes employed, have enabled it to increase largely the production of aluminium, and that the price from January next will be five francs per kilo., or 45 cents per pound. It must be remembered that owing to the low specific gravity of aluminium, if equal bulks, not weights, of the different metals are taken, this price is really lower than that of copper as recently as 1890, and is actually less than that of tin at the present time. Such a reduction in price is likely to be followed by a very considerable increase in the use of the metal for various purposes.—*Ibid.*

Clay Filters for Chemical Work.

A description of clay filters made by the Royal Porcelain Manufactory, Berlin, has been given in the "Journal of the Chemical Society." They are made of unglazed hard-baked clay, so hard that steel will not scratch them, endure a pressure of several atmospheres without breaking, and are attacked only—and then but to a slight extent—by hot concentrated sulphuric acid, or caustic soda. They are made in the shape of a flask with flattened bottom, of capacity 50 cc., 135 cc., and 1,000 cc. in the respective sizes, or as cylinders 19 cm. long of 50 cc. capacity. These filter at the rate of, roughly, 4,900 cc., or 8,600 cc., 29,600 cc., and 5,950 cc. of pure water per hour, respectively, with a difference of pressure of 700—720 mm. The rate is not much less when a turbid mixture is filtered instead of pure water. The filtration is very perfect. From water containing barium sulphate precipitated in the cold, or stannous sulphide, perfectly clear filtrates were obtained, and the complete washing of the precipitate was effected in from three-fifths to two-fifths of the time required with a folded filter. From milk and starch solution perfectly clear filtrates were also obtained, but these became somewhat turbid on standing. The filter is usually immersed in the liquid to be filtered, and connected, several at once if required, with a large exhaustion vessel, into which the clear filtrate is run. This vessel is exhausted by means of a water pump and then left to itself. A great saving of the water used by the pump is thus effected, as compared with the ordinary method of filter-pump filtration. The filters may be cleaned for further use by rubbing with sand, or, if this is not successful, by dipping in strong acids. If they have been used for filtering oil, for which they are also adapted, they may be cleaned by ignition in a muffle.—*Ibid.*

The Chemical Exports of North Germany to the United States during 1892.

M. Diezmann. Chem. Ind. 1893, **16**, 100—102.

During the year 1892 the value of the chemical exports from the whole of Germany to the United States reached the sum of 47,144,000 marks; to this amount West and South Germany contributed 29 millions, in the shape chiefly of tar colours, leaving 18 millions distributed over the northern and eastern portions of the empire. From the report of the Berlin Consul-General the latter trade is shown to be made up principally of the potassium salts obtained from the Stassfurth deposits, this industry, taken as a whole, having steadily increased in value, being double what it was 10 years ago. The products included under the heading of "Kainite and Manures" reached nearly 5 million marks, and potassium chloride was valued at $4\frac{3}{4}$ millions, all coming chiefly from Magdeburg, while potassium sulphate (including the magnesium double salt) amounted to 1,338,000 marks, being worth 85 marks per ton.

Of other articles, saccharine has increased in value from 24,000 marks in 1891 to 92,120 marks in 1892, and asphalt from Brunswick has also shown considerable increase. The total export trade of Brunswick to America was returned at $1\frac{3}{4}$ million marks, being made up chiefly of "various chemicals," such as quinine, cocaïne, sealing-wax, and lithopure Berlin exported $2\frac{1}{2}$ million marks' worth, made up of tar-colours and pharmaceutical and photographic chemicals. Leipsic exported $1\frac{1}{3}$ million marks, chiefly in the form of ethereal oils. From Hamburg and Bremen, beside the potassium salts, the exports reached $2\frac{3}{4}$ million marks, made up of drugs, colours, and matches.

—F. H. L.

General Meeting of the Society for the Protection of the Interests of Chemical Industry in Germany.

Dresden, September 15, 1893. *Chem. Ind.* **16**, 393—410.

The overproduction manifested in all industries in the years 1887—1890 was closely followed by a reaction. The bad harvest of 1890—1891, and the consequent enhanced price of agricultural produce caused a deterioration of the home consumption, followed by a considerable increase of wages. German capital suffered sensible losses in South America and Portugal; the fall in the value of silver caused a diminution of exports; the McKinley tariff for the first time made its baneful influence felt; and the quarantine regulations necessitated by the prevalence of cholera in Germany's principal harbour caused abroad a marked disinclination to place orders in this country, and thus greatly damaged the export trade. On the other hand, the commercial treaties concluded with the Central European States, affording a guarantee of the stability of commercial relations, could not fail to stimulate industry in general, whilst in consequence of the abundant harvest of 1892 the value of grain decreased considerably. Living being thus cheapened no great efforts were made among the working population in the direction of obtaining an advance of wages. Among other items, the price of coal declined by $7\frac{1}{2}$ per cent.

The position occupied by chemical industry in the year 1892 cannot be considered as unfavourable. True, exports decreased somewhat and the prices realised were in many instances below those obtained in previous years. But, on the other hand, manufacturing operations have been perfected and cheapened, and by continual application of the results of scientific research to manufacture new products have been turned out and profitable fields opened up. The McKinley Bill left the position of chemicals practically unchanged, whilst the prevalence of cholera only stimulated the consumption of drugs and disinfectants.

The official returns of the imports and exports of Germany in the years 1891 and 1892 are revealed in the following table:—

—	1892.		1891.	
	Tons.	£	Tons.	£
Turnover	1,972,686	27,620,400	2,061,802	27,132,150
Imports	1,261,978	13,318,250	1,293,594	13,233,500
Exports	710,708	14,302,150	768,208	13,898,650

The turnover decreased by 89,116 tons, but its money value increased by 488,250*l*. The imports decreased by 31,616 tons, and increased in value by 84,750*l*. The exports decreased by 57,500 tons, and increased in value by 403,500*l*. The average value of the imports amounts to 10·555*l*., per ton, that of the exports to 20·125*l*. per ton, already indicating that the imports consist chiefly of raw materials and partly-manufactured goods, whilst wholly-manufactured goods come to be exported. This is further evinced by a sub-division of the goods into raw and finished materials :—

——	Imports.		Exports.	
	Tons.	£	Tons.	£
Raw materials	1,051,654	7,829,800	252,470	1,556,200
Finished products	210,324	5,488,450	458,236	12,745,950

Comparing the exports with last year's, the quantity has decreased by 5,732 tons, but the value increased by 456,830*l*. This might lead one to suppose that a higher price has been obtained for the goods. But this is not the case; on the contrary, most goods have depreciated, and on the basis of the 1891 prices they should have yielded almost 350,000*l*. more. The alkalis and acids form in this respect an exception, inasmuch as their value increased by 4,250*l*. The increase of 457,000*l*. in the value of the exports must be due to the fact that the manufacture of goods of lower value has been given up in favour of those of higher value. The first table shows clearly that not only was chemical industry enabled to pay for an increase of imports of 551,070 tons, but to obtain from abroad a balance of 983,900*l*.

The number of works engaged in the manufacture of chemicals rose from 5,273 in the previous year to 5,393, with employment for 102,101 workmen. The wages and salaries paid amounted to 4,490,683*l*. The number of those insured was 103,020, averaging an income of 43·59*l*. per year. Compared with last year's returns, this shows a rise of wages of about 4¼ per cent.

The balance sheets of 89 companies may give an idea of the profits of chemical industry. These companies declared on an average 11·92 per cent. (last year 11·29 per cent.) on a paid up capital of 10,761,662*l*. The average is made up in the following way :—

Companies.	Percentage of Total Number.	Dividend paid.
23	25·84	None
1	1·12	Up to 2½ per cent.
10	11·24	2½—5 „
12	13·48	5—7½ „
19	21·35	7½—10 „
11	12·36	10—15 „
14	11·61	Above 15 „

Alkali and acid works paid during last year 6·38 per cent., of which amount a larger share falls upon the soda industry and a lesser amount on the potash industry. The advantage in favour of the former industry is due to the action of the alkali syndicate, in keeping the output in proportion to the demand. The moderate returns show the difficulty of further reducing the price of these products. The production of soda had to be reduced in the course of last year, and the outlook for the future is not particularly bright since extensions and new plants for the *electrolytic production* of caustic soda and bleaching powder from salt, are sure to still further limit the output of the old works. The new method may admit of the production of twice as much bleaching powder as ash, and since the market for the former is comparatively speaking limited (Germany produces 25,000 tons of bleaching powder against 200,000 tons of ash) it is likely to suffer first from the competition. In view of this it is very doubtful whether it will be possible to further maintain the soda syndicate.

The export of *ash* fell from 35,330 tons to 34,579 tons, that of *soda-crystals* from 7,875 to 3,838 tons.

Caustic soda exports showed an increase from 3,190 to 5,819 tons, whilst *bleaching powder* rose from 1,356 to 3,569 tons. *Sulphuric acid* was flat and is likely to remain so since the extensive plant for the utilisation of the gases from roasting blende are nearing completion, in Germany as well as in Belgium.

The position of the *potash industry* is less satisfactory. The Kainite production increased from 472,256 tons to 548,445 tons, but the other potash salts fell back from 898,993 to 802,630 tons.

Chlorate of potash was very much in request and occasionally scarce owing to increased demand in Russia for the manufacture of explosives. There was no perceptible increase in the make of electrolytic chlorate. Prices rose 40—50 per cent., but at present, business is quieter, and prices are dropping. The consumption of *saltpetre* has still further receded, and very little of it is wanted in consequence of the superiority of smokeless powder and the continually spreading use of dynamite, roburite, and other explosives. There was plenty of demand for *potash*, but business suffered from the competition of vinasse cinder and suint potash.

Yellow prussiate of potash was in increased demand owing to the extensive use of cyanide of potassium for the extraction of gold. The additional competition of works producing potassium cyanide from other sources has not interfered in any way with the output of the other works.

Permanganate of potash was much in request during the cholera scare. But increased production and disappearance of the scourge caused accumulation of stocks and quotations dropped almost below cost of production.

Potassium chromate is being rapidly replaced by the corresponding sodium-salt, and there is much steadiness in this industry owing to the combined action of the German and English manufacturers.

An improvement has taken place in the position of *photographic materials*, *fine chemicals* and other *technological products*. The average dividends paid in 1892 amounted to 12·6 per cent. *Disinfectants* and certain *drugs* were very much in request, but in many instances prices receded. Trade with foreign countries was satisfactory.

Among the *alkaloids*, quinine, morphine, veratrine, and philocarpine were dearer, whilst there was a further drop in atropine.

Iodine and *bromine* were steady, no doubt owing to the influence of conventions. The industry of *organic acids* offers very little of a cheering nature. There was a further fall in *oxalic acid* owing to the English competition, and the same statement holds good for *tartaric acid*. Smaller works producing the latter had to be closed and larger ones are likely to follow suit. The influence of the American competition is becoming perceptible in the *acetic acid* industry.

Metallic salts receded somewhat in accord with the movement of the metals, *copper sulphate* being an exception no doubt owing to the restricted production. There is no change in the production of mineral *pigments* and in the more common varieties of *ultramarine*, "the sale of bad English job lots interfered with that of the better German products."

The manufacture of *spirit preparations* has not improved, the low import duties of Germany and the protective duties of other countries materially interfering with this industry. The manufacture of *soaps* and *perfumes* suffers from over-production, in consequence of which prices are very low and unremunerative. Under the sheltering influence of high protective duties more and more new works are being daily erected abroad. The position of the manufacture of *coal-tar colours* has greatly improved, the dividends paid averaging 23·19 per cent. on the paid up capital, against 20·92 per cent. paid in the previous year. The tar colours offer an inexhaustible mine to the inventive faculties of man. True the treasures lie no longer at the surface and in measure as digging is carried on into deeper and more remote regions there is a proportionate increase of yield. The position of the coal-tar industry is less satisfactory

Benzol fell from 3*l.* to 2*l.* 5*s.*, and it was not till the end of the year that a syndicate of English manufacturers raised the price to 2*l.* 10*s.* *Xylol* and *Toluol* were little in request, whilst there was a further drop of 25 per cent. in *Anthracene*, and of 15 per cent. in *Naphthalene*. Brisk trade was done in phenol, cresol, tar, &c.

Explosives paid 15·86 per cent. There was increased demand for nitroglycerin preparations, partly due to the opening up of the Transvaal market. The feature of the gunpowder manufacture consisted in the production of *smokeless powder* from nitroglycerin and nitrocellulose. The output of blasting materials was insignificant.

The *match industry* suffered from home competition, from the powerful Japanese competition in the east of Asia, and from the increased prices of potassium chlorate and phosphorus. The consumption of safety matches is on the increase at the expense of matches prepared from white phosphorus.

Artificial manures paid an average of 9·85 per cent., which is hardly in excess of the previous year's performance, although the German output was unable to meet the increased demand. The output of Florida phosphates increased from 56,000 tons in 1891 to 287,000 tons in 1892; the price receded continually, accompanied, without any tangible reason, by a material fall in the price of the finished product. Agricultural chemists nowadays warmly recommend the use of phosphatic manures, and especially of water-soluble phosphoric acid, and the consumption accordingly increased during last year by at least 20 per cent.

Ground Thomas-slag, although in great demand, is rendered unremunerative through a rise of 25 per cent. in the price of Thomas slag. According to railway statistics 568,300 tons of superphosphate and 267,900 tons of the Thomas-slag powder were carried in the year 1892—1893.

The *bone-meal* and *glue* industry sustained a loss owing to Russian competition and the increased sale of superphosphates. Many bone-ash works betook themselves to the manufacture of glue, thus further depressing the position of that industry.

Ammonium sulphate, on the contrary, was very much in request, and notwithstanding increased production, prices advanced by 25 per cent.

In the course of the deliberations of the Society it transpired that the German Government are not likely to object to Sunday work so far as necessitated through immediate technical necessities, nor to the 24 hours' shift at works employing day and night labour. An 18 hours' shift seemed to be altogether impracticable in the opinion of the meeting and to working men alike. The Society unanimously declined to take part in the forthcoming exhibition at Antwerp. The committee of the proposed industrial exhibition at Berlin is prepared with a guarantee fund of 150,000*l.*—H. A.

BOARD OF TRADE RETURNS.

Summary of Imports.

Articles.	Month ending October 31st.	
	1892.	1893.
	£	£
Metals	1,427,118	1,973,508
Chemicals and dyestuffs	416,392	470,759
Oils	539,259	579,112
Raw materials for non-textile industries.	4,331,414	4,459,104
Total value of all imports	34,726,858	35,355,469

Summary of Exports.

Articles.	Month ending October 31st.	
	1892.	1893.
	£	£
Metals (other than machinery)	2,775,161	2,591,244
Chemicals and medicines	755,144	644,944
Miscellaneous articles	2,530,601	2,399,247
Total value of all exports	18,725,460	18,179,792

Imports of Metals for Month ending 31st October.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Copper:— Ore	Tons	8,676	9,826	56,866	50,502
Regulus	„	8,246	12,424	181,606	276,586
Unwrought	„	2,823	6,472	132,623	292,608
Iron:— Ore	„	279,931	256,389	191,605	172,157
Bolt, bar, &c.	„	10,238	8,956	91,644	80,745
Steel, unwrought	„	248	1,306	3,018	15,112
Lead, pig and sheet	„	11,286	18,796	115,489	162,586
Pyrites	„	40,535	41,001	67,502	67,747
Quicksilver	Lb.	30,975	44,500	2,665	3,875
Silver ore	Value £	..	..	133,798	319,042
Tin	Cwt.	46,162	65,070	214,639	260,603
Zinc	Tons	3,872	4,888	73,873	85,350
Other articles	Value £	..	..	161,790	186,595
Total value of metals		..	..	1,427,118	1,973,508

Imports of Oils for Month ending 31st October.

Articles.		Quantities.		Values.	
		1892.	1893.	1892.	1893.
				£	£
Cocoa-nut	Cwt.	11,891	7,040	13,967	8,650
Olive	Tuns	1,186	559	47,682	21,953
Palm	Cwt.	90,343	94,542	91,916	116,212
Petroleum	Gall.	12,093,704	15,957,618	204,385	230,424
Seed	Tons	2,450	2,366	57,351	58,100
Train, &c.	Tuns	1,856	1,495	36,444	29,141
Turpentine	Cwt.	9,498	33,991	10,055	35,728
Other articles	Value £	..	..	77,459	69,904
Total value of oils		..	..	539,259	579,112

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	5,075	9,836	4,102	8,806
Bark (tanners', &c.) „	13,905	32,274	3,538	11,865
Brimstone........ „	31,388	51,033	8,072	10,031
Chemicals...... Value £	..	..	146,765	130,901
Cochineal .... Cwt.	487	535	2,911	3,173
Cutch and gambier Tons	1,538	2,717	32,381	56,518
Dyes:—				
Aniline .... Value £	..	..	21,786	23,735
Alizarin ...... „	..	..	37,039	23,783
Other .... „	..	..	434	1,995
Indigo .... Cwt.	1,967	2,350	30,114	42,952
Nitrate of potash . „	24,503	22,142	21,887	19,201
Valonia........... Tons	650	478	9,346	6,216
Other articles... Value £	..	..	98,017	131,853
Total value of chemicals	..	..	416,392	470,759

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	9,041	2,435	15,932	4,621
Bristles.......... Lb.	280,844	292,698	39,265	38,917
Caoutchouc...... Cwt.	21,919	25,666	240,351	272,571
Gum:—				
Arabic......... „	8,256	3,173	22,280	8,567
Lac, &c......... „	5,976	4,557	24,269	22,525
Gutta-percha .... „	3,033	4,883	27,766	45,915
Hides, raw:—				
Dry............ „	21,156	30,583	55,898	81,673
Wet........... „	48,254	80,262	111,708	168,850
Ivory............ „	1,061	2,259	56,002	108,586
Manure:—				
Guano......... Tons	2,634	968	12,880	6,486
Bones.......... „	2,870	2,490	12,686	10,129
Nitrate of soda... „	6,957	3,639	59,046	32,741
Phosphate of lime „	19,400	21,441	41,274	40,443
Paraffin.......... Cwt.	39,306	59,112	51,443	61,061
Linen rags....... Tons	519	1,498	4,247	12,116
Esparto.......... „	16,744	14,820	85,439	71,758
Pulp of wood .... „	19,920	23,030	104,090	120,578
Rosin............ Cwt.	58,186	90,906	11,980	22,217
Tallow and stearin „	97,024	167,047	121,528	222,265
Tar..............Barrels	19,899	9,284	15,669	4,979

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST OCTOBER—*continued.*

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Wood:—				
Hewn .... Loads	259,684	189,868	503,140	377,815
Sawn .... „	739,783	645,419	1,550,003	1,404,258
Staves .... „	17,036	14,619	58,981	43,654
Mahogany ..... Tons	4,651	8,756	41,137	77,131
Other articles....Value £	..	..	1,064,409	1,199,248
Total value.......	..	..	4,331,414	4,459,104

Besides the above, drugs to the value of 55,117*l*. were imported, as against 69,020*l*. in October 1892.

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass........... Cwt.	8,504	8,482	35,425	31,027
Copper:—				
Unwrought..... „	69,693	29,870	171,061	69,518
Wrought........ „	24,247	33,557	72,233	92,977
Mixed metal.... „	37,265	21,666	88,526	49,696
Hardware ..... Value £	..	..	189,688	167,949
Implements....... „	..	..	107,237	103,035
Iron and steel..... Tons	256,507	243,717	1,865,121	1,608,708
Lead .... „	2,705	4,219	33,868	46,363
Plated wares... Value £	..	..	35,151	32,389
Telegraph wires „	..	..	31,198	246,081
Tin .... Cwt.	12,221	13,301	58,694	56,631
Zinc .... „	15,969	17,302	14,352	13,472
Other articles .. Value £	..	..	72,607	70,398
Total value	..	..	2,775,161	2,591,244

EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST OCTOBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali........... Cwt.	640,884	396,622	227,485	119,309
Bleaching materials „	158,480	96,890	66,506	39,917
Chemical manures. Tons	24,483	21,881	138,211	163,839
Medicines....... Value £	..	..	88,394	86,418
Other articles ... „	..	..	234,548	235,461
Total value	..	..	755,144	614,944

Exports of Miscellaneous Articles for Month ending 31st October.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	427,600	357,700	12,194	8,524
Military stores.. Value £	..	..	101,875	107,888
Candles.......... Lb.	1,450,400	1,611,300	26,901	30,378
Caoutchouc ..... Value £	..	..	102,849	95,296
Cement.......... Tons	43,544	40,485	76,795	66,247
Products of coal Value £	..	..	113,773	110,350
Earthenware ... „	..	..	181,758	139,148
Stoneware ...... „	..	..	14,122	18,017
Glass:—				
Plate........... Sq. Ft.	159,760	110,035	9,210	5,703
Flint........... Cwt.	7,109	7,551	18,545	20,733
Bottles......... „	66,785	51,965	32,216	26,301
Other kinds.... „	21,817	13,957	18,665	11,090
Leather:—				
Unwrought .... „	11,519	12,159	105,818	112,220
Wrought ..... Value £	..	..	34,386	36,141
Seed oil.......... Tons	6,043	4,476	114,986	98,567
Floorcloth ..... Sq. Yds.	1,119,700	1,344,700	49,043	52,877
Painters' materials Val. £	..	..	116,657	112,331
Paper .... Cwt.	74,180	77,992	126,539	125,438
Rags............. Tons	6,335	3,525	43,879	22,565
Soap............. Cwt.	43,056	48,055	49,861	51,478
Total value	..	..	2,530,601	2,399,247

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

19,443. F. R. Nevill. Improvements in the construction of annealing pots. October 16.

19,618. E. J. Preston. Improvements in apparatus for intensifying fluid pressure. October 18.

19,630. G. E. Davis. Improvements in the construction of ammonia apparatus. October 18.

19,760. J. H. W. Ortmann and C. W. C. Herbst. An improved apparatus for sterilising or disinfecting liquids. Complete Specification. October 20.

19,894. R. E. Dickinson. A new or improved bung for metallic casks or drums for containing mineral and other oils or the like. October 23.

19,988. J. W. Claridge. Improvements in mechanical stokers and self-cleaning furnaces for perfecting the combustion of fuel. October 24.

20,012. P. Dvorkovitz. Improvements in apparatus for supplying to and burning liquid fuel in furnaces. October 24.

20,295. J. R. Wylde and D. Williams. Improvements in the utilisation of the broken bricks used in the Deacon chlorine process and the recovery of copper therefrom. October 27.

20,303. T. F. Ennis and B. B. Waller. *See* Class II.

20,331. C. Bartelt and F. Bartelt. Improvements in apparatus for impregnating liquids with gases. October 27.

20,359. J. Musgrave and G. Dixon. Superheating steam. October 28.

20,549. C. W. Davis. Improvements in triturators. Complete Specification. October 31.

20,582. F. V. Matton. Pressure devices for retort lids. Complete Specification. October 31.

20,797. L. H. Bristowe. Improvements in filtering apparatus. November 2.

21,000. P. D. de la Grée. Improvements in and relating to evaporating apparatus. November 4.

21,014. J. Mitchell and G. B. Bennett. Improvements in or connected with reverberatory or like furnaces for metallurgical and other manufacturing purposes. November 6.

21,054. T. May. A hydrometer or saccharometer holder for holding a densimeter, and for drawing and returning samples of liquids to be tested. November 6.

21,058. A. J. Boult.—From X. Meny and G. Versluys, Belgium. A composition for the prevention of boiler incrustation. November 6.

21,349. F. N. Mackay. Improvements in refrigerating apparatus. November 9.

Complete Specifications Accepted.*

1892.

21,454. J. C. Calvert. Improvements in apparatus for controlling the flow of fluids under pressure. November 8.

23,281. T. Mudd. Improvements in condensers. October 25.

23,297. Sir Lowthian Bell, Bart. Improvements in evaporating brine and other solutions. October 25.

23,876. M. Arndt. Apparatus for ascertaining the volume of a particular gas in a gaseous mixture, and for ascertaining the weight of gases. November 8.

24,109. J. J. Meldrum and T. F. Meldrum. Improvements in or connected with puddling, heating, and other furnaces. November 8.

1893.

439. J. Dewar. Improvements in the production of vacuum and means for that purpose. November 15.

3507. G. C. Douglas.—From W. Don and T. Watson. Improved non-conducting composition for retarding the radiation of heat from boilers, pipes, cylinders, or other heating apparatus. November 15.

15,640. A. Burkart-Stalder. Improvements in stoves and furnaces for attaining a smokeless combustion and a high temperature. November 8.

15,843. C. J. Lundstrom, D. H. Burrell, and E. J. Burrell. Improvements in centrifugal liquid separators. November 15.

17,262. E. Partington and S. Bamforth. Improvements in taps and cocks for use with corrosive liquids. November 8.

18,341. R. Krix. Improvements in the method of and apparatus for filtering liquids under pressure. November 8.

II.—FUEL, GAS, AND LIGHT.

Applications.

19,426. N. G. Kimberley. Improved treatment for rendering coke non-hygroscopic and increasing its calorific power and for apparatus required for carrying the improved treatment into effect. October 16.

19,434. A. G. Brookes.—From F. D. Marshall, Denmark. Improvements in gas retorts. October 16.

19,520. F. W. Clark. Improvements in and relating to apparatus for carburetting or enriching gas. October 17.

19,521. A. Kitson. Improvements in the method of and apparatus for producing gas. Complete Specification. October 17.

19,533. W. C. Bell. Improvements in means or apparatus for use in charging retorts in gasworks. October 17.

19,992. G. F. Long and C. Rose. Improvements in illuminating gases, and in carburetting and improving gas or air of a non-illuminant or inferior quality. October 24.

20,053. W. B. Hartridge. Improvements in and relating to the manufacture of fuel. October 24.

20,215. J. A. Wanklyn and W. J. Cooper. Improvements in the manufacture of gas for heating and illumination. October 26.

20,252. T. A. Bullough. Improvements in the method of condensing gases produced in chemical or other works. October 27.

20,303. T. F. Ennis and B. B. Waller. An improved gas-stoking tool. October 27.

20,356. E. Morway and J. Fielding. A new method of producing hydrogen. October 28.

20,894. The Northern Counties Hydro-Oxygen Gas Co., Lim., and H. S. Rayner. Apparatus for the manufacture of oil-gas. November 3.

20,993. S. Chandler, jun. Improvements in apparatus for washing, purifying, and scrubbing gas. November 4.

21,048. F. Coe and R. J. Harrison. Improvements in the construction of an apparatus for automatically registering the pressure of gas. Complete Specification. November 6.

21,089. C. D. Abel.—From the Gas Motoren Fabrik Deutz, Germany. Improvements in gas producers. November 6.

21,118. R. Fegan. Improvements in the manufacture of coal briquettes. November 7.

21,123. W. Young. Improvements in the production of illuminating gas, benzole, and other products from liquid hydrocarbons, and in apparatus therefor. November 7.

21,187. W. G. Solly. Improvements in or relating to artificial fuel. November 7.

21,485. J. Gray. Improvements in or connected with retorts for distilling shale or oil-yielding minerals. November 11.

Complete Specifications Accepted.

1892.

15,748. T. W. Lee. Improvements in the manufacture of blocks or briquettes of fuel. November 8.

21,647. P. Dvorkovitz. Improvements in apparatus for the manufacture of gas and of by-products from liquid hydrocarbons. November 1.

22,174. H. E. Newton.—From R. N. Oakman, jun. Improvements in gas-producing plant. October 25.

22,941. W. Willis, E. J. Humphery, and W. H. Smith. Improvements relating to the production and use of light, and to apparatus therefor. November 8.

1893.

35. J. Laing. Improvements in apparatus for the manufacture of illuminating gas from mineral oils and like bodies, applicable also for distilling oils. October 25.

906. F. S. Cripps. A complete hydraulic main-valve for gas, tar, and ammoniacal or other liquors. October 25.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

Applications.

20,615. W. P. Thompson.—From L. Schuette, Landsberg, and Co., Germany. Improvements in the treatment of benzine. November 1.

20,882. R. G. Bennett. Improvements in treating anthracenes, naphthalines, and anilines. November 3.

21,123. W. Young. *See* Class II.

IV.—COLOURING MATTERS AND DYES.

Applications.

17,141A. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of sulpho acids derived from β_1 naphthylamine β_2 β_4 disulpho acid. Filed October 20. Date claimed, September 12, 1893.

17,141B. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of α_1-naphthylamine β_1 α_3 β_4-trisulpho acid, and of other sulpho acids derived therefrom. Filed October 20. Date claimed, September 12, 1893.

17,141C. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of sulpho acids derived from naphthalene α_1 β_2 α_3 (or α_2 β_3 α_4) trisulpho acid or analogous sulpho acids. Filed October 20. Date claimed, September 12, 1893.

19,623. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters and new materials therefor. October 18.

19,624. H. E. Newton.—From The Farbenfabriken vormals F. Bayer & Co., Germany. The manufacture or production of sulpho acids derived from naphthalene β_2 β_4 disulpho acid. October 18.

19,880. R. Vidal. Improvements relating to the manufacture of colouring matters. Filed October 21. Date applied for, July 1, 1893, being date of application in France.

19,962. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture and production of mordant dyeing colouring matters. October 23.

20,301. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new unsymmetrical diamido bases, and of new tetrazo colouring matters. Complete Specification. October 27.

20,312. H. H. Lake.—From Sandoz and Co., Switzerland. An improved process of manufacturing blue colouring matters. October 27.

20,579. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new colouring matters. October 31.

20,580. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of a new amidonaphthol disulpho acid and colouring matters therefrom. October 31.

20,605. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. The manufacture and production of new compounds suited for use in the preparation of diazo-compounds and their application in the production of dyes. October 31.

20,790. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new unsymmetric diamido bases, and of tetrazo colouring matters derived therefrom. Complete Specification. November 2.

20,979. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new colouring matters derived from dioxydiphenylmethan. Complete Specification. Filed November 4. Date applied for, April 13, 1893, being date of application in France.

Complete Specifications Accepted.

1892.

19,411. R. W. E. McIvor and A. Cruickshank. A process for the production of blue ultramine from the material known as green ultramine. November 1.

21,139. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. Improvements in and relating to the manufacture and production of diphenylnaphthylmethane dyes, and of materials therefor. October 25.

22,572. S. Pitt.—From L. Cassella and Co. A new group of basic colouring matters, and means for producing the same. November 8.

23,211. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new colouring matters. November 1.

23,397. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. The manufacture and production of new basic dyes and of new materials for use in their preparation. October 25.

23,639. S. S. Bromhead.—From Landshoff and Meyer. Improvements in the production of iron and further amine bases from the ferruginous residue left in the production of amine bases. November 8.

23,672. H. H. Lake.—From Kalle and Co. Improvements in the manufacture of colouring matters. October 25.

23,893. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Improvements in the production of paramagenta and its homologues from the corresponding leuco bases. November 1.

1893.

188. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of yellow to red-brown colouring matters suitable for dyeing wool. November 8.

558. H. E. Newton.—From The Farbwerke vormals F. Bayer and Co. The manufacture or production of new colouring matters. November 15.

957. O. Imray.—From The Society of Chemical Industry. Manufacture of blue colouring matters. November 15.

14,982. A. J. Boult.—From E. Frohlich. Process for the preparation of iodo compounds of the phenol series of the aromatic oxycarbon acids and pyrrol. October 25.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

19,984. E. Maertens. Improved process and apparatus for treating textile fibres and for manufacturing coloured tops and slivers. Complete Specification. October 24.

20,108. A. E. Pike. A process for treating textiles and other fabrics in a novel manner. October 25.

20,315. P. A. Newton. — From A. Nobel, France. Improvements in the manufacture of artificial silk. October 27.

21,049. G. E. Stead. Improved manufacture of woven cloth. Complete Specification. November 6.

21,197. H. H. Stewart and W. Browne, jun. Medicated and cottonised peat fibre. November 8.

21,249. G. J. Junk. A new or improved method of treating canvas, shirting, silk, paper, and like substances for the purpose of rendering the same sensitive to light. Complete Specification. November 8.

21,313. H. H. Boyle. Improved process and apparatus for the treatment of rhea grass and similar fibres for commercial purposes. November 9.

Complete Specifications Accepted.

1892.

22,736. F. Lehner. Improvements in the process and machinery for producing a thread or filament similar to silk. November 8.

23,325. A. Campbell. Improvements in the manufacture of linoleum and similar floorcloth preparations. October 25.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

19,396. R. N. Redmayne. A process for bleaching rags by bisulphites in the manufacture of paper. October 16.

19,756. R. Wansleben and R. Wansleben. Process and apparatus for automatic dyeing of textile fibres in skeins. October 20.

19,807. C. G. Hagemann. Improvements in the process of bleaching fibrous materials. October 20.

19,984. E. Maertens. *See* Class V.

20,257. E. Labhardt. Appparatus for dyeing and washing loose and spun wool, cotton, and such like material. Complete Specification. October 27.

20,268. B. Haigh and J. Clark. Improvements in or in connection with dyeing operations. October 27.

20,548. I. M. Ineson. Improvements in machinery or apparatus for fulling and scouring or washing cloth and the like fabrics. October 31.

20,916. J. C. Walker and J. E. Stephenson. Improvements in apparatus for scouring or washing wool and other fibrous substances. November 4.

20,919. T. Illingworth. Improvements in the method of and apparatus for steaming or steaming and cooling textile fabrics. November 4.

21,087. O. Imray. — From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Process for producing insoluble azo colours on fibre. November 6.

21,135. L. Weldon. Improvements in dyeing machines. Complete Specification. November 7.

Complete Specifications Accepted.

1892.

21,189. R. B. Archibald. A machine for dyeing wool yarns and similar material. November 8.

1893.

713. The Thornliebank Co., Lim., and W. E. Kay. An improved process for the production of coloured patterns upon aniline black grounds in calico printing. October 11.

15,085. H. Gardner.—From C. P. Andersen. Improved means for cleaning, mordanting, and dyeing fabrics and tissues. October 25.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

19,388. W. Mills. Improvements in the manufacture of barium, calcium, potassium, and sodium. October 16.

19,530. R. E. Chatfield. A process for utilising acid sulphates of soda. October 17.

19,705. B. K. Rigby. F. A. Remington and A. C. Carr. *See* Class IX.

19,806. M. Guthrie. Improvements in the manufacture or production of substances such as bleaching powder, and in means or apparatus therefor. October 20.

20,132. G. E. Davis. Improvements in the preparation of caustic soda and in utilising products therefrom. October 25.

20,216. H. R. von Dahmen. Process for the separation of alkaline nitrates from liquors containing them. October 26.

20,295. J. R. Wylde and D. Williams. *See* Class I.

20,404. C. T. J. Vautin. An improved process and means used therein, for the production of caustic alkali. Complete Specification. October 28.

20,604. D. A. Péniakoff. *See* Class X.

20,937. C. H. Huntley and W. H. Hickson. Improvements in recovering saline and other substances from solutions. November 4.

20,976. T. H. Cobley. Improvements in the manufacture of lead chloride and oxides. November 4.

20,977. T. H. Cobley. Improvements in the manufacture of lead chloride and oxychloride. November 4.

20,978. T. H. Cobley. Manufacture of hydrochloric acid and an adhesive white preventive of mildew, applicable to fabrics and papers. November 4.

21,239. J. J. Hood and A. G. Salamon. Improvements in the preparation of cyanogen compounds. November 8.

21,240. J. J. Hood and A. G. Salamon. Improvements in the production of cyanides. November 8.

21,288. F. J. Falding. Improvements in the method of and apparatus for manufacturing sulphuric acid. November 9.

21,356. J. M. Milnes and A. Milnes. Improvements connected with apparatus for the manufacture of bleaching powder (chloride of lime) or similar commodities. November 9.

21,451. J. Brock, A. E. Hetherington, F. Hurter, and J. Raschen. Improvements in the manufacture of sulpho cyanides, in the recovery of by-products, and in apparatus therefor. November 10.

Complete Specifications Accepted.

1892.

17,661. H. H. Lake.—From F. Noriega. *See* Class X.

22,238. S. Walker and S. S. Walker. Improvements in the production of carbonic acid. November 8.

22,523. F. H. Gossage and J. Williamson. An improvement in the manufacture of bicarbonate of soda and soda-ash. October 25.

22,819. E. Placet and J. Bonnet. Improvements in the preparation of chromic acid and in the extraction of pure acids from alkaline salts. November 15.

23,101A. C. A. J. H. Schroeder and H. E. R. Schroeder. Improved methods of recovering zinc from the waste products of galvanic batteries. November 8.

23,616. F. H. Gossage and J. Williamson. Improvements in and connected with the production of caustic soda from sulphide of sodium or sulphydrate of sodium, partly applicable also to the manufacture of bicarbonate of soda and soda-ash. November 1.

1893.

92. F. M. Spence, D. D. Spence, and G. Sisson. An improvement in the manufacture of sulphate and other salts of ammonia. November 8.

824. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new chemical compounds derived from sulphuric acid. November 15.

5849. H. Cosnett, B. C. Bennison, S. Hayes, and P. Smallwood. A new or improved process for obtaining chlorine from the spent liquors of soda-ash, from brine, and from other similar substances, and means and apparatus for producing chloride of lime therefrom. November 1.

15,218. C. von Grabowski. Improvements in the process and apparatus for the recovery from sulphate lyes or liquor of sulphuric acid free from arsenic and antimony. October 25.

17,002. S. Marasse. An improved method of manufacturing potassium salicylate and salicylic acid. November 8.

17,054. C. D. Abel.—From C. Hirzel. Process and apparatus for obtaining common salt by the refrigeration of brine. November 1.

17,602. F. J. Falding. Method of and apparatus for manufacturing sulphuric acid. November 8.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

19,699. W. W. R. Nicholls and R. C. Daley (for and on behalf of The Lansalson China Clay Company). An improved system and apparatus for removing impurities from and refining china clay. Complete Specification. October 19.

20,533. J. Retzlaff. New or improved process of etching glass. Complete Specification. October 31.

20,862. J. Duckett and Son, Limited, and J. Duckett. Improved means of and apparatus for glazing earthenware pipes. November 3.

Complete Specification Accepted.

1892.

16,018. H. R. von Kralik and W. R. von Kralik. Improvements in the manufacture of rose-red glass. November 8.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

19,703. L. Jones. Improvements in the manufacture of fire-clay. October 19.

19,705. B. K. Rigby, F. A. Remington, and A. C. Carr. Improvements in the manufacture of cement from Chance or Le Blanc alkali waste or the like. October 19.

19,872. A. Martyn. New or improved process for facing and colouring asphalt or other such like surfaces. October 21.

19,939. A. Mack. Improvements relating to composite boards or slabs for building purposes. October 23.

20,145. A. Martyn. New or improved process for facing and colouring ashphalt or other surfaces. October 25.

20,742. E. J. R. Baldwin. Rendering asphalt, asphalt cement, and similar pavings non-slippery. November 2.

21,292. A. Patrick. Improvements in the manufacture of Portland cement, pigments, and other finely-pulverised materials, and in apparatus therefor. November 9.

23,192. J. H. Blakesley. Improvements in fireproof floors, roofs, girders, joists, girders, and the like. November 8.

Complete Specifications Accepted.

1893.

12,880. R. Bammann. A composition for the production of marble-like plaster. November 8.

15,008. H. Stanton. Improvement in fire-resisting floors. November 1.

16,840. A. Clery. A preservative composition, applicable also for the manufacture of artificial stone statuary and the like. November 1.

17,558. T. Lehmann. Improved process for making thin partition walls of plaster or cement mortar. October 25.

18,040. A. J. B. Ward. Ventilated fireproof floor. November 1.

X.—METALLURGY, MINING, Etc.

Applications.

19,388. W. Mills. *See* Class VII.

19,543. R. I. Roman. An improved aluminium alloy. October 17.

19,606. L. Bemelmans. A new process for reducing sulphurated ore into oxides and sulphur. Complete Specification. October 18.

19,716. R. J. Crowley. Flux and solder for aluminium. October 19.

19,910. H. H. Gunn and J. H. R. Paterson. Improvements in roasting auriferous sulphurets, concentrates, tailings, and refractory gold ores. October 23.

20,024. W. P. Thompson.—From W. Kiesel, Germany. An improved process for producing on steel, iron, or other metals a durable and smooth, either glazed or dull black surface. Complete Specification. October 24.

20,068. H. H. Lake.—From G. F. Simonds, United States. Improvements in metallurgical furnaces. October 24.

20,090. G. Hookham. Improvements in the treatment of metals by swaging, whether in the form of tubes, solid rods, bars, plates, or sheets, and in the tools used for such treatment. October 25.

20,233. D. W. Sugg. An improved metallic alloy. October 26.

20,295. J. R. Wylde and D. Williams. *See* Class I.

20,343. J. C. Montgomerie. Improvements in and in connection with the extraction of gold and silver from ores or compounds containing the same. October 27.

20,390. A. J. Boult.—From The Actien Gesellschaft de Dillinger Hüttenwerke, Germany. Improvements in or relating to the casting of iron and steel. October 28.

20,480. W. J. Clapp and S. D. Williams. Improvements in the manufacture and purification of iron and in means or apparatus employed therein. October 30.

20,604. D. A. Péniakoff. Improvements in the manufacture of alumina and aluminous compounds and metallic aluminium or alloys of aluminium, and obtaining chlorine hydrochloric acid, carbonate of soda, and other by-products resulting from this manufacture. Filed October 31. Date applied for, 5th April 1893, being date of application in France.

20,684. E. Commelin. An improved furnace for roasting and smelting ores and reducing them to the metallic state. November 1.

20,690. H. Ramage. Improved alloys or metallic mixtures for soldering or brazing aluminium or other metals. November 1.

21,269. E. B. Woodford. Improvement in metallic alloys. November 8.

21,352. L. W. Mallasee. An improved method of casting steel. Complete Specification. November 9.

21,530. H. F. Taylor. Improvements in apparatus for coating with tin, lead, or other metals or alloy with same. November 11.

Complete Specifications Accepted.

1892.

17,661. H. H. Lake.—From E. Noriega. Improvements in and relating to the preparation of reagents for working gold and silver ores. November 15.

20,025. F. G. Fuller. Improvements in the treatment of ores, and recovery of metals contained therein, and appliances therefor. November 15.

20,189. F. Feldhaus and J. C. Ollaguier. A process for augmenting the resistance of iron, steel, and other metals. November 8.

23,062. J. Moseley. Improvements in and connected with the processes of hardening and tempering steel wire. October 25.

23,101a. C. A. J. H. Schroeder and H. E. R. Schroeder. *See* Class VII.

23,286. P. M. Justice.—From J. Meyer. Improvements in the manufacture of steel or ingot iron. October 25.

23,332. E. Nelson. Improvements connected with the utilisation of ore-smelting furnace by-products. October 25.

23,506. H. H. Lake.—From La Société pour la fabrication des Munitions d'Artillerie. Improvements relating to the pressing, drawings, or otherwise working of plastic metal or other materials for the manufacture of various articles October 25.

23,507. H. H. Lake.—From H. A. Harvey. Improved sprinkling apparatus for use in the manufacture of armour plates and in similar operations. October 25.

23,534. E. H. Saniter. Improvements in the purification of iron. November 1.

1893.

7. J. Stranaghan. Improvements in stoppers for ladles used for casting steel and similar metals. September 27.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

19,542. C. Kellner. Improvements in apparatus for the electrolytical decomposition of salt solutions. October 17.

19,614. W. Jeffery. An improvement in secondary battery plates. October 18.

19,688. J. C. Richardson. Improvements in safety appliances to be used in connection with electrical decomposing apparatus. October 19.

19,791. F. Hurter, H. Auer, and E. K. Muspratt. Improvements in or connected with electrolytic cells. October 20.

19,967. W. Petschel. Improvements in secondary electric batteries. Complete Specification. October 23.

20,023. W. P. Thompson.—From C. L. Coffin, United States. Improvements in the method of heating, welding, or working metals electrically, and in apparatus therefore. October 24.

20,116. L. Mond and R. L. Mond. Improvements in electrolytic cells. October 25.

20,584. A. J. Marquand and E. Hancock. Improvements in the manufacture of elements for electric or secondary batteries. October 31.

20,923. H. T. Barnett. Improvements in the means of charging and discharging primary electric batteries. November 4.

20,975. J. A. S. Gregg. Improvements in voltaic batteries. November 4.

21,120. W. H. Longsdorf.—From G. Hewett, United States. Improvements in primary batteries. November 10.

21,529. L. Mond and R. L. Mond. Improvements in electrolytic cells. November 11.

Complete Specifications Accepted.

1892.

19,393. T. Froggatt. Improvements in electric battery apparatus. November 1.

20,598. C. Thérye and A. Oblasser. Improvements in and relating to the manufacture of electric accumulators. November 1.

23,733. E. T. Parker. Improvements in and apparatus for the manufacture of chlorine and alkali by electrolysis of compounds thereof, and anodes to be employed therein. November 1.

1893.

2320. R. Conedera. Electro-chemical cementation for separating copper from solutions by means of iron. November 8.

5525. T. J. Holland. Improvements in electrolytic apparatus for decomposing chloride of sodium or potassium in solution, and for leading away the products of decomposition. November 8.

8176. C. Hanbury. Improvements in electrolytic apparatus. November 15.

10,765. E. J. Clubbe and A. W. Southey. Improvements in secondary voltaic batteries. November 15.

15,906. D. Young.—From La Société Outhenin Chalandre Fils et Cie. Improvements in and relating to electrolytic apparatus. October 25.

17,127. T. Craney. Improvements in electrolytic cells. October 25.

17,564. A. Koch. Improvements in electric accumulators. November 8.

18,323. H. H. Leigh.—From A. Chevallier. Improvements in electric batteries. November 8.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

19,475. J. P. F. Field. Improvements in soaps and washing compounds. October 17.

19,731. M. Baerlein. Improvements in the manufacture of soap. October 20.

19,732. M. Baerlein. Improvements in the manufacture of soap compositions. October 20.

19,733. M. Baerlein and C. Dreyfus. A paste or mixture for cleansing various materials and articles. October 20.

20,218. C. R. Huxley and R. W. Iverson. Ammoniated soaps. October 26.

20,413. H. J. Bull. An improved method or process and apparatus for deodorising oils and fats. Complete Specification. October 28.

20,639. L. Krause and J. Meyer. Improvements in and connected with the separation of cholestrine from wool fats Complete Specification. November 1.

21,086. C. Wallstab. Process for the production of homogeneous mixtures of fats with water. November 6.

21,261. L. Ascott. *See* Class XVIII.—C.

Complete Specifications Accepted.

1892.

21,996. E. Hunter. An improved compound to be applied to driving straps. November 15.

1893.

1349. F. N. Turney. An improved process for treating and purifying sod and other oils, and apparatus therefor. November 15.

16,689. J. Schicht. An improved cleansing agent. October 25.

17,566. M. Ekenberg. An improved fat emulsion and method of producing the same. November 15.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

19,444. T. Cohn. A new or improved protective paint. Complete Specification. October 16.

20,159. W. B. Hart. Improvements in and connected with the "wet" or "cold" process of vulcanising india-rubber, and in apparatus employed therein. October 26.

20,234. P. A. Newton.—From A. Nobel, France. Improvements in artificial india-rubber. October 26.

20,239. J. H. Noad and S. Z. de Ferranti. Improvements in the manufacture of white lead. October 26.

20,253. W. M. Walters and F. R. Stone. Improved preservative coating for iron and steel. October 27.

20,411. F. Greening, jun. Improvements in the manufacture or production of a compound having nitro-cellulose or pyroxiline as a base. October 28.

20,564. D. D. White. The employment of compressed air for spraying paint, tar, whitewash, pigments generally, and the like. October 31.

20,976. T. H. Cobley. *See* Class VII.

21,226. H. Clapham. Improvements in compounding black lead. November 8.

21,292. A. Patrick. *See* Class IX.

Complete Specification Accepted.

1893.

15,500. J. Y. Johnson.—From The Virginia Phosphate and Paint Co. Improvements in titanic mineral compositons and industrial application thereof. October 25.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

19,481. N. Kumagaya. A new or improved material capable of being used in substitution for leather and for ordinary paper. Complete Specification. October 17.

20,470. J. Salomon and A. Rosenberg. Improvements in preparing or dressing skins. October 30.

20,575. M. Hönig and G. Spitz. A process for the production of tannic extract from the waste lyes obtained in the manufacture of sulphite cellulose. October 31.

21,088. T. J. W. Mackenzie and W. J. Nodin. A new ornamental leather and process for preparing the same. November 6.

21,542. S. L. Evans. Improvements in tanning. November 11.

XV.—AGRICULTURE AND MANURES.

Complete Specification Accepted.

1893.

18,600. W. C. Currie and W. E. Rowlands. An improvement in manures. November 8.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Application.

20,397. C. Steffen. Process for purifying and decolorising saccharine juices and sugar solutions. Complete Specification. October 28.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

19,549. F. N. Mackay. Improvements in and relating to brewing plant. October 17.

19,843. W. S. Squire. Improvements in the manufacture of yeast. October 21.

19,896. G. Wynn and C. R. Honiball. Improvements in the rapid drying of malt grain and other cereals. October 23.

20,060. E. W. Greening and E. O. Greening. An improved method of utilising and means for treating yeast. October 24.

20,146. A. Grañang. Improvements in the process and apparatus for producing and utilising carbonic acid resulting from fermentation. October 25.

20,943. W. Bruce and J. Bruce. Improvements in the manufacture of yeast. November 4.

20,952. J. P. Laws. A process for producing cider and perry by fermenting various saccharine fluids and worts with pure and selected yeasts. November 4.

21,332. J. Heron. Improvements in the manufacture of compounds suitable for the production of ginger beer, herb or botanic beers, or other fermented beverages. November 9.

21.415. H. de Bres. Improvements in the treatment or manufacture of barm or yeast. November 10.

Complete Specifications Accepted.

1892.

18,814. C. F. H. Hallett. An improved refrigerator or heater for cooling or heating wort or other liquid. October 25.

20,684. F. W. Wright. Improvements in and apparatus for effecting the raising and aërating of beer and other liquids. October 25.

20,787. F. M. Polsky. Improvements in the manufacture of yeast. November 15.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

19,928. W. Gearren. Hygienic cake or food. Complete Specification. October 23.

20,027. W. P. Thompson.—From C. Artus, France. Improvements in the treatment and preparation of butter, butter substitutes, margarine, and alimentary fats or compounds. October 24.

20,296. J. Nagel. An improved apparatus for obtaining distilled and sterilised water. Complete Specification. October 27.

20,354. M. Fehlen. Improvements in apparatus for the manufacture or production of butter. October 28.

20,477. T. Block. Improvements in the composition and manufacture of chocolate. October 30.

21,427. J. Swan. An improved method of treating eggs. November 10.

21,448. W. B. Walters. A new method of and apparatus for making butter and condensed milk. Complete Specification. November 10.

B.—Sanitary Chemistry.

19,719. G. E. Davis. Improvements in the purification of sewage and other foul liquids. October 19.

21,023. T. Twynam. Improvements in the treatment of sewage. November 6.

21,024. T. Twynam. Improvements in the utilisation of sewage sludge. November 6.

21,082. C. Raleigh. Improvements in separating solid from liquid matter, more especially relating to the treatment of slimes, finely-divided ore, precipitates, and sewage. November 6.

21,213. A. Goldthorp. An improved system of purifying and deodorising sewage by precipitation. November 8.

C.—Disinfectants.

19,588. W. Howitt and G. M. Satchfield. An improved powder for killing insects. October 18.

19,622. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture of antiseptics. October 18.

19,821. C. A. Burghardt. An improved preparation or compound for the treatment and purification of sewage or other foul water. October 21.

20,445. J. G. Tatters and J. T. Speakman. Improvements in the manufacture of disinfectants. October 30.

21,074. T. Stubbs and Sir W. G. M. Call, Bart. An improved antiseptic compound. November 6.

21,261. L. Ascott. Disinfecting and cleansing fluid. November 8.

Complete Specifications Accepted.

A.—Chemistry of Foods.

1892.

24,068. C. O. Harz and G. Deisenhofer. Improved process for sterilising and preserving liquids and perishable matters, and in apparatus therefor. November 1.

1893.

739. W. C. Leechman. An improved preparation of tea and the process of making the same. November 15.

13,537. A. Fjelstrup. An improved method of producing sterilised condensed milk and other substances. November 8.

B.—Sanitary Chemistry.

1893.

670. W. Weaver. Weaver's improved furnaces and apparatus for the treatment of towns' refuse. November 15.

C.—Disinfectants.

1893.

631. H. Noerdlinger. Improvements in disinfectants. October 18.

5566. A. Blackie. Improvements in preparing and packing materials for forming solutions containing arsenic, and applicable for dipping animals, preserving skins, for destroying germs, parasites, and weeds, and for other uses. October 25.

17,567. M. Ekenberg. An improved preserving agent and method of producing same. October 25.

XIX.—PAPER, PASTEBOARD, Etc.

Applications.

19,481. N. Kumagaya. *See* Class XIV.

20,036. C. D. Ekman. Improvements in obtaining useful products from the liquors resulting from the manufacture of cellulose or fibres by the sulphite process. October 24.

20,043. E. G. Law. Improvements in and relating to continuous paper for writing and copying purposes. October 24.

20,144. M. Levy, A. Rustin, and L. Boyer. Improvements relating to the manufacture of artificial whalebone, and to apparatus therefor. October 25.

20,150. F. W. Hayward, A. S. King, and A. W. Loveland. Improvements in ornamental paper, and means for producing same. October 25.

20,353. J. F. H. V. Hoop. Improved decorative paper. October 27.

20,659. C. H. Chapman. A new or improved "metal paper." November 1.

21,249. G. J. Junk. *See* Class V.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

Applications.

19,628. A. Müller and H. Dubois. An improved method of producing carbon tetrachloride. October 18.

20,245. L. O. Helmers. Improvements in the process of obtaining aqueous solutions of phenols and other substances. October 26.

21,009. J. Bradley. An improved pharmaceutical product. November 6.

21,417. A. R. Ling. A new improved process for the manufacture of anhydro-ortho-sulphaminebenzoic acid (orthobenzoic sulphinide), or of its salts, from commercial saccharin. November 10.

Complete Specifications Accepted.

1892.

22,757. J. F. F. von Mering. Improvements relating to the production of acetyl and propionyl compounds of *p*-oxyphenylurethanes or their ethers. November 15.

1893.

3735. P. R. de Lambilly. An improved method of producing formiate of ammonia and hydrocyanic acid. November 15.

15,767. F. H. Verdun. Improvements in compositions of camphor with other substances for making solid objects of any desired shape or colour. November 15.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

Applications.

19,518. J. W. T. Cadett and W. Neall. Improved means for drying photographic films when on celluloid, paper, or other flexible substances or material. October 17.

19,810. A. A. Barratt and A. J. E. Hill. A new or improved process for separating photographic gelatin films from celluloid supports or bases. October 20.

20,042. A. Hesekiel. Improved sensitive paper for photographic purposes. Complete Specification. October 24.

20,342. F. J. M. Gerland, W. C. Hespe, and M. Levy Improvements in half-tone negatives for photo processes. Complete Specification. Filed October 27. Date applied for, 28th March 1893, being date of application in United States.

20,474. R. Krügener. Improvements in the manufacture and treatment of photographic papers. October 30.

20,609. H. C. Buckingham.—From E. Meregalli, Japan. Improvements in the production of photographic prints. October 31.

21,379. A. G. Adamson. Improvements in the application of electric light for photographic purposes and apparatus therefor. November 10.

21,476. A. G. Adamson. Improvements in and connected with the developing of photographs. November 11.

XXII.—EXPLOSIVES, MATCHES, Etc.

Applications.

19,380. E. J. Warmington. Improvements in lucifer matches and their manufacture. October 16.

19,931. W. Evelyn-Liardêt. An improved safety explosive and method or process of manufacturing the same. Complete Specification. October 23.

20,066. M. E. Leonard. An improved gunpowder. Complete Specification. October 24.

20,327. A. Schindler. Improvements in the manufacture of gunpowder. October 27.

20,467. P. A. Newton.—From A. Nobel, France. Improvements in fuses for mining and similar purposes. October 30.

20,606. J. W. Swan. Improvements in the manufacture of gun-cotton and apparatus to be employed therein. October 31.

20,823. H. V. Keeson. Improvements in mechanical distance fuses or exploders for projectiles. November 3.

21,543. K. C. Edmunds. Improvements in explosives. November 11.

Complete Specifications Accepted.

1892.

19,322. C. H. Wolf. A process for the manufacture of fuses, such as framework fuses, and apparatus in connexion therewith. October 25.

20,231. R. W. Sedgwick and C. Lamm. Mode of exploding high explosives without the use of fuses, and also apparatus therefor. November 8.

22,023. A. Kramer. The "gigantic" explosive. November 1.

23,105. O. Imray.—From C. Glaser and Co. Process for manufacturing powder suitable for practice ammunition, sporting cartridges, and similar purposes. October 25.

1893.

17,061. J. P. O'Donnell. An improved detonating railway signal. November 1.

XXIII.—ANALYTICAL CHEMISTRY.

Complete Specifications Accepted.

1892.

23,399. C. Weitenkampf. New or improved apparatus for separating solid or fluid substances dissolved in alcohol, ether, or chloroform, without evaporation of the solvent. November 1.

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NOTICES.

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The attention of members is directed to the report of a Committee of the Society formed to consider the whole question of the Patent Laws. This report has been received and adopted by the Council, which has ordered it to be laid before the various sections with a view to elicit an early discussion of the points therein raised. In order that advantage may be taken of next session of Parliament to raise the subject, the reports of discussions and the resolutions formulated should be sent to the General Secretary not later than February 1st, 1894. A copy of the report will be found in the October issue.

Members are reminded that the subscription of 25*s.* for 1894, payable on 1st January next, should be sent in good time to the Treasurer, in order to ensure continuity in the receipt of the Society's Journal. Any changes of address to appear in the new List of Members now in course of preparation, should reach the General Secretary not later than January 15th, 1894.

BANKERS' ORDERS.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with this number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 41 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

LIST OF MEMBERS ELECTED 22nd DECEMBER 1893.

Berk, F. W., 1, Fenchurch Avenue, London, E.C., chemical manufacturer.

Blake, Arthur, Dean House, Red Hill, Surrey, veterinary surgeon.

Fiebing, J. H., Pfister and Vogel Leather Co., Milwaukee, Wis., U.S.A., chemist.

Garton, R. S., 17, Winson Green Road, Birmingham, chemist.

Heisch, Godfrey P., 325, Clapham Road, London, S.W., gas engineer.

Hicks, Jas. A., c/o B. Redwood, 4, Bishopsgate Street Within, E.C., chemist.

Kestner, Paul, 40, Bd. Vauban, Lille, France, chemist.

Lassing, H., M.D., 19, Park Place, New York, U.S.A., editor "American Analyst."

Miller, Dr. Harry E., 216, Bush Street, San Francisco, Cal., U.S.A., chemist.

Patterson, Prof. H. J., College Park, Prince George's Co., Md., U.S.A., agricultural chemist.

Ross, Arthur, 1, Glengall Road, Old Kent Road, S.E., chemist.

Shepherd, H. H. B., Anglo-Continental Guano Works, Tidal Basin, E., chemist.

Smith, Jas. F., 281, Stratford Road, Sparkbrook, Birmingham, chemist.

Tyrer, Chas. T., Stirling Chemical Works, Stratford, E., manufacturing chemist.

Watel, H. G., Buckhurst Hill, Essex, consulting engineer.

Wilder, F. L., c/o St. John d'el Rey Mining Co., Morro Velho, Minas Geraes, Brazil, assayer.

CHANGES OF ADDRESS.

Aikman, C. M., l/o St. Vincent Street; 128, Wellington Street, Glasgow.

Baker, Theo., l/o Oakland; The Warner House, Emporium, Pa., U.S.A.

Bell, J. Carter, l/o Brooklyn; 13, Park Row, New York, U.S.A.

Bourcart, Dr. R., l/o Lyons; c/o A. and F. Schoeller, Opladen, bei Cöln, Germany.

Brown, F. W., l/o St. John's Wood; 43, Elgin Avenue, Maida Hill, W.

Brown, Horace T., F.R.S., l/o Burton; 74, Addison Road, Kensington, W.

Butler, W. W., l/o Selly Park; The Cedars, Duchess Road, Edgbaston, Birmingham.

Couche, C. W., l/o Liverpool; United Alkali Co., Limited, Weston Works, near Runcorn.

Crosfield, A. L., l/o Birkenhead; Casino Ingles, Minas de Rio Tinto, Huelva, Spain.

Crossley, R., l/o Accrington; The Elms, Northwood, near Rickmansworth, Herts.

Edwards, Vincent, l/o Upton Park; 1, Coverdale, Montague Road, Richmond-on-Thames.

Francis, Edw., l/o Parkside; Ivy Bank, Park Valley, Nottingham.

Garner, D. C., Journals to c/o Hicks and Co., Queen Street, Cardiff.

Glendinning, T. A., l/o Leeds; retain Journals until further notice.

Green, J. E., l/o Claypath; 42, Gilesgate, Durham.

Hamilton, Jas. C., l/o Edinburgh; c/o H. Swinglehurst, Hincaster House, Milnthorpe.

Hamilton, O., Journals to British White Lead Co., Northfleet, Kent.

Hennin, A., l/o Springfield; Monongahela Furnaces, McKeesport, Pa., U.S.A.

Hogben, Walter, l/o Edinburgh; 7, Brighton Terrace, Joppa, Midlothian, N.B.

Hopkins, Erastus, l/o Hotel Hallett; 256, Benefit Street, Providence, R.I., U.S.A.

Homer, Jarvis W., l/o Barnsley; 27, Brookfield Road, Sheffield.

Jackman, E. J., l/o Upton Lane; Northern Outfall Works, Beckton, E.

Jackson, A. G., l/o Brisbane; Stockwell, Argyle Street, Paramatta, New South Wales.

Jackson, Saml., l/o Mold Green; 7, Mulgrave Terrace, Dalton, Huddersfield.

Jenner, E., l/o Leyton; 209, Markhouse Road, Walthamstow, Essex.

Johnson, E. E., l/o Oxford Road; 258, Brunswick Street, Chorlton-on-Medlock, Manchester.

Kleemann, Dr. S., l/o Botanic Road; 25, Greenfield Road, Stoneycroft, Liverpool.

Knight, A. H., l/o Liverpool; 2, Gerald Road, Oxton, Cheshire.

Koechlin, H., l/o Lyons; 19, Avenue du Mont Riboudet, Rouen, France.

Lagerwall, Dr. Ivar, l/o Stockholm; 63, Rue de Provence, Paris.

Lund, Jas., l/o East Cambridge; 142, Hawthorne Street, Malden, Mass., U.S.A.

Neilson, Wm., l/o Canning Town; 23, Terrace Road, Upton Manor, E.

Orr, Alex.; Journals to 109, Pitt Street, Sydney, New South Wales.

Peploe, D. H. T., l/o 39; 24, Sloane Gardens, London, S.W.

Powell, Legh S., l/o Notting Hill Square; 5, Campden Hill Square, W.

Richards, Edgar, l/o New York; 1621, H. Street, Washington, D.C., U.S.A.

Rigby, J. S., l/o Vancouver; 35, Bagot Street, Wavertree, Liverpool.

Schlichter, Dr. H., l/o Bowes Park; Thothmes House, Gisburn Road, Hornsey, N.

Sprengel, Dr. H.; Journals to Professor H. Sprengel, Ph.D., F.R.S., Savile Club, 107, Piccadilly, W.

Wadman, W. E., l/o Bergen Point; 102, Lord Avenue, N.J., U.S.A.

Watts, C. W., l/o Belfast; 40, Goldhurst Terrace, London, N.W.

Wilkin, W. H.; Journals to Sir Walter Wilkin; address as before.

Wingate, H. M., l/o Glasgow; c/o C. McCulloch, 25, National Mutual Buildings, Collins Street, Melbourne, Victoria.

MEMBER OMITTED FROM LIST.

Yoshimura, K., High Middle School, Zoshikwan, Satsuma, Japan.

CHANGE OF ADDRESS REQUIRED.

Billing, H. S.; l/o Regent Terrace, Plympton, South Devon.

Deaths.

Davies, R. H., l/o Apothecaries' Hall, London, E.C.

Evans, Dr. P. Norman, l/o 28, Great Ormond Street, London, E.C.

London Section.

The Chemical Society's Rooms, Burlington House, W.

Chairman: Wm. Thorp.
Vice-Chairman: W. Crowder.
Committee:

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F. G. Adair Roberts.
A. Gordon Salamon.
G. N. Stoker.
F. Napier Sutton.
T. Tyrer.
Frank Wilson.
C. R. Alder Wright.

Hon. Local Secretary: John Heron,
74, North Side, Clapham Common, S.W.

SESSION 1893-94.

1894:—
Jan. 8th.—Discussion on the state of the Patent Law.
Feb. 5th:—
Mr. W. P. Dreaper. "Theory of Dyeing." Part I. "Ingrain Colours."
Dr. A. Dupré. "Note on an interesting Explosion caused by Peroxide of Sodium."

Meeting held Monday, November 6th, 1893.

MR. WM. THORP IN THE CHAIR.

ESTIMATION OF ALIZARIN AND ALLIED COLOURING MATTERS.

BY W. P. DREAPER, F.I.C.

The general method of testing the purity and strength of these colouring matters is that known as the "direct dyeing" method. This is a more or less tedious process of dyeing mordanted samples of wool, cotton, or silk fibre under standard conditions, with known weights of the dyes, and comparing the results obtained with those dyed with pure samples. Unfortunately there are many details connected with this process which are essential to its success, and great care has to be taken that the samples receive the same treatment in the mordanting and dyeing, the ratio of liquor to fibre being kept constant, and the temperature nicely regulated. With care it is possible to obtain results which indicate, within certain limits, the value of any particular dye as compared with any standard, which must of necessity vary with the choice of each operator. It is thus impossible to compare the results obtained by different operators.

When working out my volumetric "copper" process, for the estimation of tannic and gallic acids (this Journal, May 1893), I attempted to adapt the process to the direct titration of "adjective" dyes, and I now give the results obtained. It is obvious that this process, if successful, will allow of the direct comparison of the different samples by a numerical standard.

These colouring matters are capable of forming colour lakes with metallic oxides, owing probably to the fact that they contain two hydroxyl (OH) groups, or one hydroxyl and one carboxyl (CO.OH) group in the ortho position.

When these compounds are produced in the fibre itself by first mordanting with the metallic oxide, and then immersing in a solution of the dye, the fibre permanently takes the colour of the lake. It is, however, possible to produce these lakes by precipitating the dye in solution; the undermentioned process is based on this fact.

A standard solution of copper sulphate is run into the dye, suspended or dissolved in a slightly acid solution of sodium acetate, to which a quantity of barium sulphate has been added; the titration is carried on at the boil. The general procedure adopted in this paper, and that recommended for general use, is as follows:—

The standard solution of copper sulphate is made by dissolving 30 grms. to the litre of water, equal to a value of 0·0095 grm. CuO per cc., and the sodium acetate solution by dissolving 100 grms. of the salt in a litre of water to which 5 cc. of acetic acid have been added.

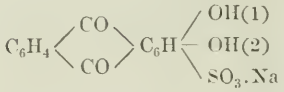
One grm. of the alizarin paste or 0·25 grm. of the powder, is transferred to a small flask and 10 cc. of the sodium acetate solution, added, and the solution made up to 50 cc. (roughly). About 1 grm. of barium sulphate is then added. The flask is placed on a sand-bath, the contents brought up to the boil, and the copper solution run in from a burette.

To test when sufficient solution has been added to precipitate all the dye as copper lake, the end of a glass rod is from time to time introduced into the liquor and gently pressed on to a folded slip of "Swedish" filter-paper, the slip afterwards being unfolded and the under surface tested for excess of copper solution with potassium ferrocyanide. The following results have been obtained with commercial products:—

Dye taken.	CuO precipitated.	CuO precipitated.	Mean CuO.
Alizarin Bordeaux, B., 20 per cent.	0·0532*g*	0·0523*g*	0·0527*g*
Alizarin brown, W., paste.	0·0589*g*	0·0608*g*	0·0598*g*
Alizarin orange, R., 20 per cent.	0·0503*g*	0·0513*g*	0·0508*g*
Alizarin cyanine, G.G., paste.	0·0399*g*	0·0408*g*	0·0403*g*
Gallein, paste..........	0·0494*g*	0·0484*g*	0·0489*g*
Cœrulein, paste........	0·0475*g*	0·0484*g*	0·0479*g*
Cœrulein, S.W., powder	0·1672*g*	0·1672*g*	0·1672*g*
Cœrulein, S., powder ...	0·1954*g*	0·1909*g*	0·1931*g*
Silvertown blue, paste..	0·0389*g*	0·0408*g*	0·0398*g*
Alizarin blue, R., paste.	0·0285*g*	0·0285*g*	0·0285*g*
Alizarin blue, S.R.W., powder.	0·1444*g*	0·1368*g*	0·1406*g*.
Alizarin red, G. 1, 20 per cent.	0·0427*g*	0·0446*g*	0·0436*g*
Alizarin red, S., powder	0·2128*g*	0·2052*g*	0·2090*g*
Alizarin red, S.S.S., powder.	0·1820*g*	0·1858*g*	0·1839*g*
Diamine fast red, F. ...	0·0722*g*	0·0760*g*	0·0724*g*

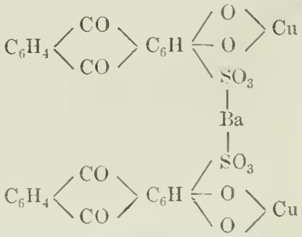
The above results are all expressed on 1 grm. of sample taken.

Alizarin red S and SSS powders are the sodium salts of sulphonic acids of alizarin. For instance the S brand is—



$$C_6H_4 \left\langle \begin{matrix} CO \\ CO \end{matrix} \right\rangle C_6H \left\langle \begin{matrix} OH(1) \\ OH(2) \\ SO_3.Na \end{matrix} \right.$$

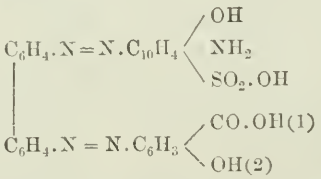
On adding the copper sulphate solution in the usual way no precipitation took place, the $SO_3.Na$ group preventing the formation of the copper lake. If, however, barium chloride be added to the solution before titration, the corresponding barium salt is produced, and the sulphonic group is so modified that the copper lake is readily formed, thus :—



$$\begin{array}{l} C_6H_4 \left\langle \begin{matrix} CO \\ CO \end{matrix} \right\rangle C_6H \left\langle \begin{matrix} O \\ O \\ SO_3 \end{matrix} \right. \rangle Cu \\ \qquad\qquad\qquad\qquad | \\ \qquad\qquad\qquad\qquad Ba \\ \qquad\qquad\qquad\qquad | \\ C_6H_4 \left\langle \begin{matrix} CO \\ CO \end{matrix} \right\rangle C_6H \left\langle \begin{matrix} SO_3 \\ O \\ O \end{matrix} \right. \rangle Cu \end{array}$$

Alizarin blue SRW powder, $C_{17}H_9NO_4.2HNaSO_3$, and Cœruleïn S powder, $C_{20}H_8O_6.2HNaSO_3$, bisulphite compounds, are precipitated by copper sulphate in the same way as the alizarins themselves.

Diamine fast red F.—



$$\begin{array}{l} C_6H_4.N=N.C_{10}H_4 \left\langle \begin{matrix} OH \\ NH_2 \\ SO_2.OH \end{matrix} \right. \\ | \\ C_6H_4.N=N.C_6H_3 \left\langle \begin{matrix} CO.OH(1) \\ OH(2) \end{matrix} \right. \end{array}$$

gave constant results when barium chloride was added, showing that the process is useful in cases where the colouring matter contains one carboxyl, and one hydroxyl group in the ortho position, and also contain a sulphonic acid group.

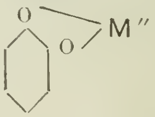
It is necessary to have a large excess of sodium acetate present. It was noticed that the results obtained in some cases were too low, when such was not the case. This was particularly noticed in the case of alizarin brown, and was probably due to the presence of free sulphuric acid in the solution. On the addition of a further quantity of acetate the normal figures were obtained.

It was sometimes noticed that the solution filtered free from precipitate was highly coloured, and it was quite impossible to distinguish the end reaction with the ferrocyanide. In nearly all cases this colouration disappeared on further addition of copper solution. This was particularly noticed in the case of gallein, and was due to the dyestuff being slightly soluble in hot water. With some of the recently introduced colours for dyeing on chrome mordanted wool, the above process in its present state is not applicable. However, the majority of these colours act in the normal way, good results being obtained with chrome-violet and chrome-blue.

The results have been calculated in terms of copper-oxide. If required they can be given in terms of the dye present, providing its exact composition is known. For instance, taking gallein as $C_{20}H_{10}O_7$ and the copper lake as $C_{20}H_8O_7.Cu$ from the mean of the two results obtained 0·0489 grm. of copper oxide; the percentage of gallein present is 22·40, with a probable error of ± 0·22 per cent.

The accuracy of this process is not likely to be disturbed by impurities other than substances that form colour-lakes. Any reducing sugars present will have no action, owing to the acid reaction of the solution.

Besides the testing of the strength of the colouring matters, the results obtained should be of practical use to the dyer and calico printer. It is known that the correct amount of mordant necessary to combine with the dye must be present on the fibre, if the best results as regards purity of shade and fastness against light and soaping, are to be obtained. In the ordinary way, these results can only be obtained by means of a long series of tests, using varying amounts of mordant and dyeing with excess of colour. The figures obtained by the above process can be used for this purpose, it being an easy matter to calculate the amount of mordant necessary to form the "normal" lake with any percentage of alizarin required to obtain a given shade. The "normal" lake being taken as



If "compound" lakes are required the problem is still an easy one, providing one knows the composition of the lake required.

In dyeing with other mordants the figures for copper oxide can still be used by means of conversion factors. For example

FeO	·911
CaO	·709
CrO	·866

In some cases the alizarins are mixtures, and it is also necessary for the dyer to mix the colours himself, in order to arrive at certain shades. The mixture itself can be titrated to obtain the "*mordant value*," or the result can be calculated from the values for the individual dyes.

DISCUSSION.

Mr. T. Royle said during the last 50 or 60 years many efforts had been made to determine the value of colouring matters by any precipitate that could be formed in a precipitation sense, but they all ended in entire failure. If that could be done the valuation of alizarin, cochineal, logwood, and other colouring matters would be very easy, whereas it was a matter of extreme difficulty. Speaking of alizarin alone any precipitation from copper, iron, or alumina would form itself firstly, probably at the expense of the alizarin that might be present, but any impurity out of the many that might also be present would go down and form colouring matter in the sense of being a precipitate, and be attributed to the value of the alizarin. It had never been found possible to value alizarin, except by a judgment of the colouring matter as determined by the brilliancy to the dye. Had this been possible there would have been easy times for many people in years gone by to find the value of alizarin, whereas it had been a matter of great difficulty indeed, even among people who lived all their lives in Turkey-red dye-works, to determine which of two or more colouring matters was the best.

The Chairman said he had hoped they would have heard from Mr. Royle something of his own experience which would have added to the usefulness of the paper, but he seemed to have condemned all such processes rather hastily and without exception. He should like to ask Mr. Dreaper how his tests corresponded with the actual experience in dyeing. He knew—not with alizarin, but with some other colouring matters—there were extreme difficulties in getting any chemical test to correspond with actual manufacturing experience. At the same time he should be extremely sorry to discourage investigations in this direction. Used as the great artists' colours were used, with brains, he thought many of these indications might be very useful together with other evidence in the valuation of dyeing materials.

Mr. J. Heron said he had practically no experience in the testing of colouring matters, but he wished to say a word as to the method employed by Mr. Dreaper, in estimating his copper. It was a well-known fact that, in working with Fehling's solution, and other solutions in which copper played the principal part, all volumetric processes were unreliable and misleading.

He had had very long experience of Fehling's solution in the determination of various carbohydrates, and his experience, as well as that of many others who had worked in the same direction, had been that the volumetric method was most unreliable, and that where absolute accuracy was required, the gravimetric method only should be used.

Mr. Dreaper said he understood Mr. Royle to say that his remarks only applied to alizarin reds, and he said the impurities would go down with the copper lake. This might be so with these matters which formed colour lakes, and for practical purposes they must be taken as the dye itself, for they would dye on to the mordanted fibre. The results obtained by the "copper" process should be the same as those obtained on the fibre, for the conditions were almost identical. As to the so-called colour tests obtained by dyeing samples of fibre, he was quite aware that these were necessary in cases where it was required to match a given shade. He was not attempting to do this, but simply estimating the mordant value of any given dye. The chairman had asked whether the titration values agreed with those obtained by dyeing on a mordanted fibre. He had only tried a few experiments in this direction and they seemed to indicate that such was the case. The difficulty was that the results one obtained with the above method were in terms of the mordant used, but when dyeing on the fibre, the results were expressed, so to speak, in terms of the colour obtained. Mr. Heron said, that with Fehling's and other copper solutions, working volumetrically, it was difficult to obtain identical conditions of working. He always worked with the same amount of solution at the boil, and at the end of the reaction, one of course had the same excess of copper-solution present. Also the copper-sulphate was present in acid solution, and consequently no reduction could take place. Before making the final test with the ferro-cyanide, the solution was boiled for two or three minutes, so that the lake might be thoroughly formed.

Meeting held Monday, December 4th, 1893.

MR. WM. THORP IN THE CHAIR.

A NEW RUSH FROM THE ZAMBESI.

BY THOS. CHRISTY.

Before the regular business of the evening commenced Mr. Thomas Christy exhibited some rushes from South Africa, which Colonel d'Andrada, of the Portuguese Government Mission, had found growing on the Zambesi. He said that they were of great commercial interest on account of the masses of fibre running throughout the stalk, and at a certain time of the year they died down, and the fibre then was most easily collected. He had distributed some specimens of them, but the first report was in the "Chemiker Zeitung," where the microscopic sections were very accurately drawn and the description given. It was stated to be the leaf of a plant unquestionably of the Sansivera species and looked like the Sansivera Cylindrica, the species which was used for making strings and bow strings. The fibre was of very great strength, but it was impossible to determine the exact species at present as there was no flower to it.

The subjoined drawing is taken from the *Chemiker Zeitung*, **12**, 1892, 1716.

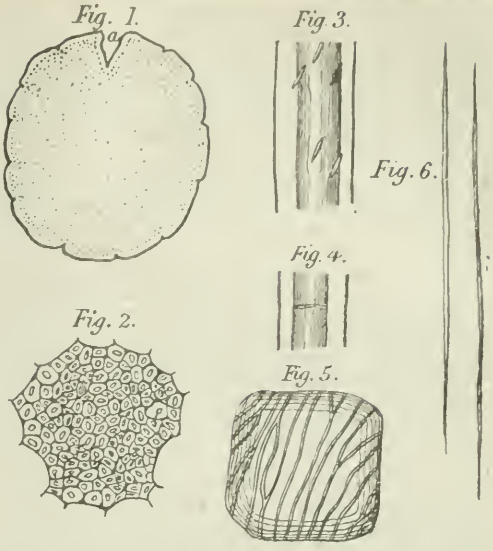


Fig. 1. Cross section of rush.
a = longitudinal furrow, which, together with other facts, show that the rush has more of the nature of a leaf than of a stalk.
Fig. 2. Cross section of portion of bast stem, showing fibres in section.
Fig. 3. Piece of an isolated bast cell, with projections.
Fig. 4. Piece of an isolated bast cell, with transverse rib.
Fig. 5. Isolated parenchyme cell.
Fig. 6. Two isolated bast cells.

APPLICATION OF AIR IN MOTION TO CHEMICAL INDUSTRY.

BY H. G. WATEL.

ADJOURNED DISCUSSION.

(See also this Journal, *ante*, p. 491 *seq.*)

Mr. B. E. R. Newlands said, that on the reading of this paper he proposed that the discussion should be adjourned so as to afford an opportunity of obtaining from a gentleman of Mr. Watel's great experience, in connection with this subject, some further useful information, and he should confine what he had to say mainly to asking a few questions with the view of eliciting such particulars. He noticed that in the paper it was stated that 220 lb. of water could be evaporated with 1 lb. of fuel, which seemed a very striking statement. In the best form of multiple effects, which was hitherto considered the most economical form of evaporating apparatus, 40 lb. of water with 1 lb. of coal was considered extremely good work, but here they had an evaporation of 220 lb. No doubt Mr. Watel would agree with him that the efficiency of air drying would depend entirely on the state of the atmosphere, on whether the air was charged with moisture, or was unusually dry, and he should like to know if the result which he had given was one obtained in very dry weather, or an average result obtained during the whole year. Then he said that there was a saving effected by the use of the fan to the extent of 130*l*. a year when used for collecting charcoal dust, and it would be interesting to know what kind of charcoal it was, and in what kind of works such a large sum could be obtained for dust. He thought there must be something of unusual value in the kind of char referred to. A reference was made to the use of the fan in manure works and acid factories, and it would be interesting to know of what materials these fans were made, because the experience of those who had to do with manure factories was that the gases were of a very corrosive character, and that it was very difficult to find anything except wood or lead which could resist their action. He thought it would be impossible to construct a Blackman fan of either of these materials. He should also like some information on the means of indicating automatically the temperature in drying stoves. Many persons had experienced the difficulty of the problem of finding some means of fixing the temperature of such stoves, so that the material exposed to the action of the hot air should be heated sufficiently, and at the same time not excessively. He had used a mercurial arrangement for the purpose, but he should be glad to know if Mr. Watel had any better plan.

Mr. T. Royle asked Mr. Watel if he found the propulsion of air through the substance to be dried was preferable to the abstraction of the air at the other end of the apparatus?

Mr. C. G. Cresswell said he should like to ask Mr. Watel one or two questions with reference rather to the theoretical side of his subject, which, although perhaps apparently simple when put in concrete shape, had not yet so far as he had ascertained been formulated into a law. The author had referred to a body which could not be dried at a high temperature, but which, after having been warmed very nearly to the critical point by a current of hot air, was then dried by a sudden current of cold air. They all knew what a warm south-westerly wind on the top of a frost meant; how the walls instantaneously ran with moisture in every direction. The walls, chilled by the frost, the moment they came in contact with a moisture-laden wind of higher temperature, condensed the moisture and probably absorbed a considerable portion. Again, on a fine dry day in March the sun heated every object on which it shone, while at the same time a cold wind with very little moisture in it blew. At once an intense sensation of cold was produced, moisture being drawn away with the usual effect of lowering the temperature. The connection of these things with the subject would be seen later. There was an invention brought out some years ago by a man, now dead, which he did not think met with the success it deserved. In "Storer's Dictionary of Solubilities" it was stated on the authority of Mansfield (J. Chem. Soc. I., 261), that gum animi resin was not soluble in ordinary solvents, but when those solvents were brought to bear upon it in the form of vapour, then this resin absorbed the solvent vapour and became soluble. The above-mentioned inventor found out that a necessary element in the solution was that the vapour should be always kept at a higher temperature than the gum itself, and on that he based a process for dissolving it (this Journal, 1889, 553). He thus dispensed with the very destructive process of heating the resin to so nearly its point of destructive distillation that the vapours evolved produce a revivification of the resin and restore it once more from its condition of a fossil resin to a live resin. At the same time there were vast numbers of pots of this resin destroyed in the process and the colour was very much deepened. By treating the resin by this solvent vapour at a higher temperature than the body itself he produced absorption of the vapour into its molecular structure, thereby rendering it capable of solution to a perfectly water-white fluid. Now one was struck at once there with a very peculiar fact; here was a moisture-laden vapour, very like the south-west wind, which came in contact with the cooler body, condensed upon its surface and was absorbed into it. Another remarkable observation of the same inventor was that if the molecular structure of the body was continuous the absorption took place quite regularly, but if there were any break in it, and the body was porous, then the absorption of the moisture-laden vapour was not observed. That observation was utilised for the impregnation of designs on ivory, for which and other purposes the Endolithic Co. was formed, and which he believed was doing well. He had been shown tablets of ivory on which a design had been painted on the outside, and which had been subjected to vapours under this condition. The design penetrated right through the whole of the plate of ivory, and if that were sliced up into tablets the impression was as clear on the bottom tablet as on the top. All these points seemed to show some necessity for a further investigation into the molecular structure of bodies, because if bodies of perfect molecular structure only would absorb these moisture-laden vapours and bodies of imperfect molecular structure would not, it showed that the absorption was only through the molecules and not through the interspaces in the molecules. He would not attempt to deal with the other side of the question, in which the author himself was more interested, and of which he had given a more elaborate explanation, the driving out of the vapours from bodies by the converse condition, viz., the passage over the heated body of the cool gases. The author had given many instances of that, clearly illustrating the principle he was teaching, but he should like to ask him in conclusion whether he had gone at all into the general theory of the molecular structure of bodies, the influence upon them of gases, and the reason why a moisture-laden warm gas was absorbed into a body, and why when a cold gas passed over a heated body the tendency was the reverse way.

Mr. T. Tyrer said he should like to ask Mr. Watel how he would deal practically with an ordinary drying stove. He drew a rough sketch of such an apartment on the black board, showing uprights with shelves for the placing of the material to be dried upon, and a row of steam pipes along the bottom. He wished to know, in particular, where the fan would be placed, and also the apertures for the admission of the air, and any other arrangement for perfect circulation and drying.

The Chairman, to put Mr. Tyrer's question in more general form, asked if the fan were put at the outlet, what were the best places for the inlets and what kind of inlets should they be. Another point was the heating of air. Some years ago he put up a stove for use with hot air as a drying agent. He heated the air by passing it through iron pipes placed in a furnace. It failed for two reasons; the hot air went direct to the ceiling and so to the outlet, without drying anything, and the iron pipe speedily burnt out, and the whole thing collapsed. The question was how to avoid this destruction of the channels, or what was the best way of warming the air if you wished to use it for drying. Again, was there any general law that could be expressed as to the best temperature for drying? Probably it must vary with the materials to be dried to a very large extent, but apparently the more rapidly you could remove the moisture by means of the air current, the lower the temperature which could be used. He did not know how far this could be carried. If you used air at the ordinary temperature you would get what was generally known as air drying, but the question was whether it was possible to formulate any definite rule for the best temperature for efficiency, taking into consideration time as well as cost of power and heat. As to the course of the air through the stove, could Mr. Watel give any information as to the general principles upon which this should be arranged, should it go upwards or downwards, or what was the best way of preventing that sort of short circuiting, which so many had experienced, where the air passed in at one end and out at the other in a compact column without really affecting the mass of the air in the other parts of the stove?

Mr. M. Prentice asked whether Mr. Watel had any experience of drying air chemically before using it. The object in heating air was mainly to increase its capacity for taking up moisture, and if the air was first of all drawn through a coke scrubber such as a Gay-Lussac column where the coke was saturated with oil of vitriol or other materials which absorbed moisture rapidly, the air would become excessively dry, and its capacity for taking up moisture would be increased. This no doubt would be useful where a low temperature was necessary, such as in drying those substances which a high temperature would decompose.

Mr. Bryan Corcoran asked what rate of speed of the air was the best to absorb moisture from a liquid as it passed over the surface. He had constructed a good many kilns for drying corn and similar materials, and there they brought the products of combustion right through the damp corn. He believed the process was that the heat raised a vapour, and the current of air carried it away, and it was found that according to the shape of the kiln so the work could be done more or less efficiently, and it was generally best for the hot air or hot gases to make their exit from the fire through a comparatively small opening, expanding as it went up, and after it passed through the wet goods to be carried off as quickly as possible. If there were more space below he was not sure how it acted exactly, but apparently the currents became curled, and you got a defective draught and a loss of efficiency.

Mr. C. E. Cowper said some time ago he tried some experiments with regard to drying air for a particular purpose, in which he tried chloride of calcium, but he was convinced, by calculation perhaps more than experiment, that nothing was gained by it. You soon put all the moisture into the chloride of calcium which it would hold, and before you could go on using it you had to take it out again, and, therefore, it was better to use air, which cost nothing.

Mr. H. G. Watel said, in reply to Mr. Newlands, that he believed the charcoal dust referred to was vegetable charcoal dust, which was used for crucible manufacture, and it was a dust of the very finest description. He made the statement on the authority of the user, who volunteered it to him, and, therefore, he presumed it was correct. It was a firm somewhere in the north, near Manchester, but he forgot the name. With regard to the evaporation of water, of course the amount of moisture in the air was all important, and in the example he gave in the paper he took it as a necessary fact that there should be 220 lb. of water evaporated whilst the temperature of the external air was 59°, and the temperature of the damp cool air at the exit 95°. Taking it in that manner the consideration of the relative dampness of the air might be neglected, although he provided for the amount of heat necessary for bringing it up to a proper temperature. He took the amount of saturation at 80 per cent. Of course if the air was at 75° he should obtain a better duty, and if it were at a less temperature he should obtain a lower one. But taking the figures from actual work he gave the figure of 15 lb. of coke for 1,000 ft. of air warmed to 100° F., which was allowing plenty of fuel. Taking really good coke—not the best—if you could obtain 1,000 ft. of air warmed to 100°, with 18 lb. of fuel in an hour, you would be working with 58 per cent. efficiency. It was not wise to reckon too much because there were all sorts of losses from air passing through flues, &c., but in practice he found if the heater was near the drying room they could do with 14 lb. or 12 lb., equal to about 65 per cent. to 75 per cent. of efficiency, and if they could stretch it to theoretical limits it could be done with 9 lb. There was a very large margin in hand compared with steam boilers, and comparing the relative specific heat of air and water it practically turned out about the same duty with perhaps a little advantage for the air. The question of dealing with corrosive gases had given him a lot of trouble. In many works they had tried copper plates even with phosphor bronze spindles, and they did for a time. He had even gone to the trouble of building a xylonite fan, and put one up, but the result was not encouraging. What they had done more lately in certain cases, though it was not always suitable, was to have the fan made of lead coated steel, which by some process with which he was not thoroughly acquainted, but he believed consisted in passing sheet steel through a bath of lead, over which rollers were running, and it seemed to drive the lead into the steel to such an extent that if you took the piece of steel and made it red hot, although you got the lead converted into litharge, you could not even then completely hammer the lead out of the metal. The only difficulty was that being on the surface it was perishable at the edge, and he had known some cases in which the edge of the fan appeared to be severed into two sheets, and the steel had gone. In another works recently for some very pungent acid gases he had tried one of the ordinary steel fans, giving it several coats of varnish, and that seemed to answer very well, and it was one of the best preservatives he had found yet. He had tried japanning or enamelling, and also the kind of enamel used for signs, but neither of these was to be recommended, because with the rapid revolution there was a tendency to crack and chip the enamel, so that something tough and pliable like tar or varnish seemed to be the best protection as an ultimate remedy. With regard to the means of indicating the temperature at a distance that was a very great problem in moving air, especially in refrigerating chambers where it was essential to keep all the meat at the same temperature. A very ingenious thermometer had been devised by Messrs. Long, of Eastcheap; at one end there was to all intents and purposes an ordinary thermometer graduated in the usual way, and starting from that was a lead pipe with a needle bore through it exceedingly fine, which was led to any reasonable distance and terminated in a second thermometer of similar construction. The two together registered very well indeed, and there was a very ingenious device for preventing any error arising from change in temperature in passing from the inside of the chamber to the outside, where the reading took place. A second lead pipe similar to the first was led along the side of it, and it was so arranged that the scale of the second thermometer was movable, and you could, therefore, by adjustment of the scale of the second thermometer, which depended upon the second pipe exactly adjust it to compensate for any variations in the temperature of the pipe on its way, and the two thermometers, when properly adjusted, gave the correct reading instantly. You could have several thermometers in different parts of a large room and all the recording instruments close together at any convenient point outside. The only thing to be observed was that the recording thermometer should be on the same level, otherwise it would be influenced by barometric action. To overcome that his firm had devised another thermometer. It was an ordinary mercurial instrument, and at given points, say at intervals of 2° or 3° a series of platinum wires were soldered into the tubes so as to form electric contact with the mercury as it arose. These various wires were connected with small coils outside with varying electrical resistances, and these were again connected with a recording galvanometer, which, therefore, showed whether the temperature reached the various points indicated—32, 34, 36, &c.

Mr. Newlands said he presumed a bell could be added to that to ring at a certain temperature.

Mr. Watel said yes, it could be easily arranged so as to give notice when the temperature was too high or too low. It had advantages over what was called a bent thermostat consisting of two plates of bent metal soldered together which only indicated whether the heat was too high or too low, but this indicated within certain limits the exact range of temperature. With regard to the time required for drying, everything depended on the substances dealt with. Some things parted very readily with their moisture, such as malt and things of that kind, and in those cases there was an immense saving of time by the use of the fan. For instance in washing, or even after dyeing, heavy woollen materials could be dried with a speed one had practically no idea of. But if you came to other substances there were very great differences, some would hardly dry with heat at all, but only with air in motion after being warmed up to a certain extent. As to the question of blowing in air or exhausting, that required a great deal of consideration before answering. As a general rule the choice depended on the condition of the room and the gases that were in it. As a rule it was preferable to exhaust, for this reason: that if you started an exhausting fan in a room the fan would pull its air in all directions, from every keyhole and crevice, and you got a very good distribution of effect, but in drawing air into the fan the air passed in practically in a column, though not quite parallel or cylindrical. If you were blowing into a room you might perhaps get an advantage for certain materials of a concentrated effect, but otherwise it became necessary to break up the column of air altogether before you could be sure it would reach all parts of the room. This of course might be done in various ways. As to the question of warming air or not he had gone into that matter very carefully, but he could not find there was the slightest difference, either in efficiency in the volume of air moved or in the consumption of fuel, whether you drew the air out or blew it in. The figures ran very close indeed, as far as he remembered there was only a difference of about 0·02 lb. per hour.

With regard to Mr. Cresswell's remarks there were no doubt one or two things which were very curious. If you took a fan simply running openly and stood in front of it you thought how nice and cool it was, but in reality it was nothing of the kind. The air in passing through the fan was of the same temperature as before; in fact it might in consequence of the friction be $\frac{1}{4}$° warmer, but the effect which made any one fancy it so much cooler simply was that the body always had a certain amount of vapour or perspiration about it, and as this was moved more rapidly by air in motion you immediately began to get the same effect of reduction of temperature as was made so evident by a wet and dry bulb thermometer. What applied to the fan in that case applied equally and more so to the sun and wind. Standing in the sun, being mostly dressed in dark clothes which absorbed the heat rapidly, you no doubt felt the sun's heat warm and pleasant, but if there were a cold wind striking on the warm body the immediate effect was, if only for an instant, that it got slightly warmed in its passage and the rate of evaporation from the surface of the body was increased and so you experienced at the same time warmth and cold. In France there was a special word used to describe that effect, meaning that the heart of the air was cold. It might be a nice warm sunny day, but if you turned a corner and got into the wind it was immediately cold. There was a great deal in Mr. Cresswell's remarks with regard to the molecular condition of bodies, but he had never been able to investigate, or to arrive at any fixed opinion on the subject; he was pleased to hear the two facts which he mentioned, which were exceedingly interesting. He thought there was very little doubt that air in motion did remove a certain amount of water mechanically, that the mere friction of the air in passing over the wet surface simply tore away a certain amount of water, he would not say in what state, probably in a sort of vesicular state, but not absolutely combined with the air. A gentleman said to him the other day that he tried some experiments and found how exceedingly difficult it was to properly humidify air, and there was no doubt of the fact. You might blow steam into a room or have water jets and sprays and all sorts of things, but they did not produce that moist air which was desired. It only went a little way and then you found the water had all positively dropped out of it. To carry moist air openly across a room of that size was one of the most difficult things possible. You might start all right, have the jets as fine as possible, but you could not get it across to the other side. In the southern countries for weaving and spinning sheds this became one of the most important problems. He thought there was no doubt that in the case mentioned of the gum there was something in the actual mechanical driving of the vapour into the body of the gum which tended to produce the result obtained. He had noticed very often that if a current of air was strong apart from any question of cubic feet it seemed to dry very much faster than if it were slow, but it was very hard to lay down anything definite. You might weigh every material at the beginning of the experiment and weigh it afterwards, and discover that it was so much lighter, but you could hardly analyse the bulk of air that had gone past it and find out how it had gone, so that the problem was very difficult to determine. To come again to the question of drying rooms, he often met with rooms of the pattern Mr. Tyrer had drawn, and they were sometimes very difficult to deal with.

Mr. Watel then proceeded to describe by the aid of diagrams two methods for adapting the fan system to drying rooms, the inlets and outlets for the air being so arranged that after passing over the heating surface it shoud circulate through the whole of the chamber before making its escape. In some cases also it was advisable to either partially or wholly shut off the exit during the process, so that the whole of the air should be kept circulating round and round through the chamber and the heater, thus economising the heat, especially in cold weather.

With regard to the temperature it was a very difficult question, every class of goods seemed to have a best temperature for drying. Taking such articles as photographic plates of gelatine, 75°, 77°, or 80° at the outside was all that was admissible, but for most classes of goods 140° F. probably answered better than any other. This was a temperature easily attained, and it was quite sufficient to give average English air (which was fairly moist) good drying capacity. It was very difficult to raise air rapidly to a temperature above that; you had to get the heater very hot to warm sufficient air in the time, and that led him to the point raised by the chairman of the durability of the heater. As the result of very many experiments he was satisfied that the great secret was to get the heat of the furnace perfectly distributed over the whole of the tubes. You must not make the bottom tubes red hot whilst having the top ones cool, but distribute the heat over the whole tube surface as thoroughly as possible. With vertical tubes the flame had such a tendency to act on the ends of the tubes which were not protected by water as they were in a steam boiler, that the ends would last no time at all, and, therefore, they more often arranged the tubes horizontally; the hot gases of the furnaces are then obliged to travel up and down, between, or among the pipes before finally making their escape, and this is arranged in a variety of ways, which he described. He had put up a heater which had done extremely hard work for six or seven years, and only once quite recently had the bottom row of tubes needed renewing. He was greatly interested in the question of chemical means for drying air, but he had had no great success with it. It was extremely inconvenient and often very "messy." Chloride of calcium as is well known absorbed moisture very well indeed, and you could dry it if necessary by putting the tins on the top of the boiler. He had also tried the same thing in many ways for very small manufacturing processes, he had used oatmeal which had wonderful absorbent power for moisture, and when thoroughly moist the tins were simply laid on the top of the boiler when they became baked, and more or less dry again, and so ready for use. He once had a rather curious problem in Spain in connection with some photographic process. They wrote to him complaining that the climate was so moist that they could not do any drying at all, and they wanted to know if it could not be done with chloride of calcium or sulphuric acid, or something of that sort. He did not quite see how to arrange it, but he found out ultimately that they had a very large supply of spring water at about the natural temperature of the earth, and so he arranged that the air should be first brought into contact with this cold water with an ordinary water tube cooling arrangement. Of course the warm summer air when cooled lost a lot of its moisture, and although it was cooled to a lower temperature than they required, it was then passed through a heater which again restored to it its drying capacity by the loss of its moisture, and the arrangement answered very well indeed. If some means of effectually drying air with chemicals could be arrived at, it would be of great service, but after trying a great many he feared they were only fit for laboratory or for very limited use. The question of the best speed of moving air was one involving a great many considerations. If you had to deal with a substance in a state of powder, you were limited to the greatest speed of air which would not disturb the powder, and for some light substances that was exceedingly low. As a matter of fact, he thought the best average working speeds of air were between 1,000 ft. and 2,000 ft. a minute. When you used higher speeds, if there were no other objection, there soon came a power limit to the use of the very high speeds that were used some time ago. In order to get a very high speed, the necessary power to produce it increased by squares. If air were running at 1,000 ft. a minute, with something like 0·13 of an inch of water gauge, and you wanted to make it level 2,000 ft., the water gauge would go up to 0·53, which was about four times as much, and, therefore, the power required was increased by four times, and if you increased it to 3,000 ft. you would have to employ nine times the power to move the same volume of air. It was never wise, therefore, to pass air through any fan faster than was necessary to obtain the desired end, except in special cases, where a certain amount of pressure was necessary. In the case of drying malt or grain, he had known the fan draw through 30 inches spread on two floors with 15 inches each very thoroughly on account of the many interstices in the material. But if one did not take care to exactly regulate the speed of the fan, it pulled the air through too easily and got all the air it wanted through a comparatively small space, while all round the sides of the floors remained practically untouched. Taking the case of an ordinary malting kiln with a small heater, it was all very well as long as the air had time to get well warmed, but if a fan were applied, unless suitable arrangements were made, the temperature went down so rapidly that the drying effect was practically nil. In these circumstances hot water pipes were at a very great disadvantage. He had shown a 3-ft. fan at the Electrical Exhibition, and not wishing to chill the spectators in the winter he put 1,000 ft. of pipes underneath and brought all the air thoroughly in contact with it, but the average rise in temperature was only about 4°, though he had plenty of hot water because he had the Palace boilers to fall back upon. If he had had steam pipes, and had the condensing power of that area, and all the latent heat of steam and the amount of calories between 212° of water and 212° of steam, he would have had any amount of warm air at his disposal.

ON THE PRODUCT OF THE ACTION OF MERCURIC CHLORIDE UPON METALLIC SILVER.

BY CHAPMAN JONES.

When a solution of mercuric chloride is caused to act upon a silver photographic image, whether in a gelatin or collodion film, the metallic silver is changed into a white substance which has been supposed to be a mixture of mercurous and silver chlorides. So far as I am aware, the properties of this substance have never been ascertained; it has been taken for granted that it is a mixture, and that its behaviour is simply that of a mixture of the two chlorides. I think, however, that the facts given below leave no reasonable room for doubt that it is a double chloride formed by the reaction $HgCl_2 + Ag = HgAgCl_2$.

Preparation.

The preparation of the substance in bulk at first presented considerable difficulty. Silver foil 0·03 mm. thick, after remaining in a saturated solution of mercuric chloride for three years, was found to be rotten, but when heated to volatilise the mercury and fuze the silver chloride, it showed that a considerable portion of unattacked silver remained. The attacked foil, when warmed with strong nitric acid to dissolve out the metallic silver and the mercury compound, left a residue of silver chloride, which was white and in just the same form and with the same surface marks as the foil.

By the use of silver in a pulverulent condition, as, for example, when reduced from its solution or from the chloride by means of grape sugar in the presence of caustic soda, or by ammonium sulphite in the presence of ammonia, the reaction is facilitated, but still slow. A quantity of silver reduced from the nitrate by means of ammonium sulphite by rapidly heating the solution in small quantities to prevent the production of large particles, was mixed with a considerable excess of solid mercuric chloride and sufficient water to make a thin paste of it. The mixture was shaken up well at frequent intervals and occasionally ground in a mortar, yet after three weeks it was still slate-coloured. After standing for three months it was of a light grey colour; fourteen months from the time when the reaction commenced the mass was creamy white, but speckles of unattacked silver were still visible, and after two years a sample of the preparation, after washing and drying, was found to contain more than 3 per cent. of silver in the metallic state. It is possible to get a fairly pure product by working entirely in the cold, if the product of the reaction is separated from the unattacked silver by elutriation. A sample so obtained from another preparation gave 37·75 per cent. of silver chloride, theory requiring 37·85 per cent., and this was separated only three weeks after the mercuric chloride and silver were brought into contact.

After trying many modifications that have suggested themselves for the preparation of silver mercurous chloride, the best that I have been able to discover is to add to the pulverulent silver a considerable excess of mercuric chloride made into a thin paste with water, to agitate the mixture frequently and occasionally to grind it in a mortar, for two or three weeks, and then to introduce it into a long-necked flask or bolt head and heat it in a water-bath for from 12 to 20 hours. The mass is then mixed with a considerable quantity of water, and as soon as the chief part of the excess of mercuric chloride has settled down the supernatant turbid liquid is poured off. By repeating this operation a comparatively small quantity of the preparation will be lost with the part that remains behind. The mercuric chloride crystals remaining greatly facilitate the retention of the particles of unattacked silver. The product rapidly settles from the water, and it is thoroughly washed and dried in a steam oven. A preparation which contained, after cold digestion, over 3 per cent. of unattacked silver, contained 1·84 per cent. after seven hours' heating in a water-bath, 0·55 per cent. after another seven hours' heating, and 0·27 per cent. after elutriation as described. I have tried heating in a sealed tube instead of in an open vessel, but this variation appears to offer no advantage.

An attempt to prepare this substance by direct precipitation with hydrochloric acid from a solution containing silver and mercurous nitrates was unsuccessful. Under these conditions the silver chloride is first thrown down, carrying with it a very small proportion (about a half per cent.) of mercurous chloride. Before all the silver is precipitated the mercury comes down in quantity. Three consecutive fractions contained respectively 5·35, 63·52, 92·97 per cent. of mercurous chloride. There seems, therefore, to be a tendency for the two salts to combine, and it would obviously be possible to prepare a solution that would yield a certain amount of the double chloride, or of the two chlorides in the same proportion.

Analysis and Properties.

The readiest method of analysing silver mercurous chloride is by simple ignition, when the mercurous chloride is volatilised and silver chloride remains. The silver chloride must be perfectly fused, but this is not likely to lead to any loss if nothing hotter than an ordinary Bunsen flame is employed. Any unattacked metallic silver in the preparation remains as chloride, its equivalent of metallic mercury passing off. The percentage of metallic silver in the preparation, provided of course that it is properly washed and dried, is the same as the silver chloride found in excess of 37·85 per cent., the amount in the pure double salt, provided that not more than 1 or perhaps 2 per cent. of metallic silver is present. It is a curious coincidence, and saves a rather tedious calculation.

I have not been able to find any method of estimating the metallic silver present with the double salt directly, but the indirect method given above appears to be quite satisfactory. To make quite sure that metallic silver is converted into chloride as stated, I have proved the absence of metallic silver in the residue left by ignition, and also that metallic mercury is given when metallic silver and silver mercurous chloride are warmed together at as low a temperature as 100° to 110° C. Into three tubes were introduced respectively silver mencurous chloride containing only 0·27 per cent. of metallic silver, mercurous chloride ground up with pulverulent silver, and mercurous chloride alone, all the substances being carefully dried. Some gold leaf was secured in the upper part of each tube and the lower ends were then heated in a glycerin-bath. After seven hours not only was the gold leaf in the first and second tubes perceptibly whitened, but a good deposit of mercury globules was visible by means of a microscope. In the third tube there was no free mercury.

It follows from this action of metallic silver on silver mercurous chloride, that a sample of the double salt containing an appreciable amount of metallic silver will not give a constant weight when heated (for drying) in the water oven.

The specific gravities of silver chloride, mercurous chloride, and the double chloride have been determined, with the following results:—

—	AgCl.	HgCl.	Calculated Specific Gravity of a Mixture in Equivalent Proportions.	Specific Gravity of $HgAgCl_2$ Experimentally Found.
1.	5·583	7·248	6·610	6·493
2.	5·572	7·235		6·489
3.	5·590	7·253	6·626	6·505
4.	5·590	7·264		

These specific gravities are at 20° C., and compared with with water at the same temperature. In the first and second series the air was got rid of by boiling the substance with water before introducing it into the bottles, while in the third and fourth the bottles containing the substance and water were put under a receiver, which was exhausted until the water boiled at the ordinary temperature. The figures in the last two series are a little higher than the others and probably more correct. The considerable difference between the calculated and found specific gravities appears to indicate that the two chlorides are not merely mixed, and if the small amount of metallic silver in the double chloride has any effect its removal would increase this difference.

As the specific gravities of the two single chlorides are very different, one would expect a partial separation of them if merely mixed, when allowed to settle down from suspension in water. To test this a quantity was agitated in a long tube full of water and allowed to settle, the deposit being seven inches deep. The top layer and the bottom layer were separately dried and gave on analysis exactly the same figures.

The double chloride is slowly affected by exposure to light, a small quantity in a sealed tube exposed in a window with west aspect from February to November this year being changed superficially to a salmon colour. Moisture facilitates this change. A piece of caustic potash enclosed at the top of the tube retarded the change, and the colour was grey, and this was the same whether the tube was rendered vacuous or not. When magnified from 10 to 20 diameters the colour appears discontinuous. It is possible that the small amount of metallic silver present furnishes centres of comparative instability. In the dark the substance does not change colour.

Action of Metallic Silver and Mercury.

As already stated, metallic silver, when heated with silver mercuric chloride, retains some of the chlorine, which otherwise would escape as mercurous chloride. An excess of metallic mercury has an analogous action, carrying off with it some of the chlorine which otherwise would remain as silver chloride.

Action of Ammonium Chloride.

A cold saturated solution of ammonium chloride was employed. When brought into contact with the substance a slight darkening was apparent, but on standing for a day the colour did not further increase. On boiling, the action was fairly rapid and a residue of metals was left, the solution giving a copious deposit of silver chloride on cooling. A weighed quantity of the double chloride was heated with repeated quantities of the solution, each heating being only of a few seconds' duration, the solution being immediately poured off from the residue to prevent reaction between the metals precipitated and the constituents of the solution. The atomic proportions of the silver and mercury were :—

——	Residue.	Solution.
Silver....................	1·00	2·00
Mercury................	0·96	1·85

the silver in solution being as chloride, which separated almost entirely on diluting and cooling, and the metals in the residue being in the metallic condition. The change may therefore be expressed thus :—

$$3HgAgCl_2 = Hg + Ag + 2AgCl + 2HgCl_2$$

The ammonium chloride probably forms double salts with both the chlorides. The deficiency of mercury is due to its volatilisation during the boiling in order to get the reaction, for both metallic mercury and mercuric chloride in solution are markedly volatile at 100° C.

A quantity of silver mercurous chloride was digested with ammonium chloride solution in a sealed tube at 135° to 140° C. Two or three hours apparently produced a complete reaction; to make sure, the heating was continued for five hours. The atomic proportions found were :—

——	Residue.	Solution.
Silver....................	0·82	2·18
Mercury................	1·28	1·69

The silver in solution had mostly crystallised out as chloride before the tube was opened. It is evident that under these conditions, when the dissolved metals are not removed, some of the silver from the residue dissolves and some of the mercury from the solution is precipitated. But the mercury precipitated is considerably in excess of the quantity equivalent to the silver dissolved. This anomaly can hardly be due to analytical error, because 99·75 per cent. of the total silver and 99·35 per cent. of the total mercury taken for the reaction are accounted for, and the anomaly also occurred in another similar experiment in which more than a half of the silver normally present as metal in the residue had changed into chloride.

Action of Potassium Chloride.

The solution of potassium chloride was saturated in the cold, and the reaction went much as with ammonium chloride, but rather more readily in the cold. The heating and immediate removal of the solution was done as before. The figures obtained, expressed in atomic proportions, were :—

——	Residue.	Solution.
Silver....................	1·006	1·994
Mercury................	0·944	2·020

Another experiment gave very similar figures, and showed a rather greater transference of mercury from the residue to the solution, and of silver from the solution to the residue.

It is obvious that the reaction is of the same character as when ammonium chloride is used, but that less mercury is volatilised during the boilings; and it appears that a little of the mercury in the residue has precipitated silver from the solution. That metallic mercury does slowly dissolve and precipitate silver when it is allowed to act upon silver chloride dissolved in potassium chloride, was amply proved in a qualitative way.

Action of Potassium Cyanide.

A 5 per cent. solution of crystallised potassium cyanide was employed. When poured upon the silver mercurous chloride, this produced an immediate blackening, and the reaction was therefore done in the cold. It was, however, necessary to persevere with several treatments to get a complete reaction, and, to prevent secondary changes as far as possible, the portions of solution first used, and containing the bulk of the dissolved metals, were poured off without delay. The residue consisted of metals in the free state, and the atomic proportions obtained were :—

—	Residue.	Solution.
Silver……………………	0·85	2·15
Mercury……………………	1·07	1·92

The primary action is evidently similar to that of the previous cases, and may be expressed thus :—

$$3AgHgCl_2 + 8KCy = $$
$$Ag + Hg + 2KAgCy_2 + 2HgCy_2 + 6KCl$$

It would appear that a secondary reaction takes place between the metallic silver and the mercuric cyanide in the presence of alkaline cyanide, the silver precipitating the mercury and itself dissolving. The metals reacting in this case are in equivalent proportions. That metallic mercury is precipitated by metallic silver under these conditions was confirmed by qualitative experiments, and it was also shown that metallic mercury did not precipitate silver from a solution of silver chloride in potassium cyanide. In the presence of cyanide, therefore, the precipitation of one metal by the other is the reverse of that which takes place when potassium chloride is used as the solvent.

Action of Potassium Silver Cyanide.

The potassium silver cyanide was prepared by saturating a $2\frac{1}{2}$ per cent. solution of potassium cyanide with precipitated silver cyanide. This reagent produced a deep black colour immediately on coming into contact with the silver mercurous chloride. The reaction was therefore done in the cold, taking the same precautions as before to prevent secondary reactions as far as possible, and finally the residue was ground with the solution to perfect the change. It was found, by preliminary qualitative experiments, that the greater part of the mercury dissolved, and that the residue consisted of metallic silver, metallic mercury, silver chloride, and silver cyanide. The following percentage figures give the analytical results obtained :—

—	Residue.				Solution.
	Hg (sol. in HNO_3)	Ag (Metal).	Ag as AgCl	Ag as AgCy	Mercury.
1	..	Not	estimated.	..	37·94
2	12·57	28·35	24·53	6·69	40·56
3	10·61	27·56	20·99	14·64	Not estimated.

After the second experiment I was puzzled to account for the considerable amount of mercury in the residue, because, as the whole of the silver of the silver mercurous chloride appeared in the metallic condition, it seemed impossible that there should be any metallic mercury. But in the nitric acid solution of the silver and mercury I noticed hydrocyanic acid by its smell, and confirmed its presence by the Prussian blue test.

In the third experiment more than six times the theoretical quantity of the reagent was used, and every precaution was taken to ensure a complete reaction. The washing was continued until all traces of soluble silver salts were removed, and it was found on continuing the washing that mercury was slowly dissolved from the residue, and that this mercury was associated with hydrocyanic acid. The washing with water was continued until practically no more mercury could be got away, and 6·87 of the 10·61 per cent. was thus removed, leaving 3·74 per cent. still in the residue. The latter quantity was dissolved out in nitric acid with the metallic silver. The mercury in the residue bears the same proportion to the silver chloride in both cases, the ratio being 1 molecule of silver chloride to 0·276 atom of mercury in the second experiment, and 0·273 in the third.

It appears therefore that the primary change may be expressed by the following equation :—

$$HgAgCl_2 + KAgCy_2 = Ag + AgCl + HgCy_2 + KCl$$

Some of the mercury cyanide appears to be held in the residue by the silver chloride so tenaciously that prolonged washing with water removed only a part, and that slowly. It is known that silver chloride takes up mercuric chloride, and this may be an analogous effect, but in a few experiments that naturally suggested themselves I have not been able to induce silver chloride to take up or combine with mercury cyanide and hold it with anything like the tenacity shown in the reaction under discussion.

The appearance of silver cyanide in the residue is easily accounted for. We know that silver chloride is quickly changed to cyanide by a solution of potassium cyanide and then dissolved, and I find that potassium silver cyanide has the same effect except the solution of the silver cyanide, which obviously is impossible. The reaction—

$$AgCl + KAgCy_2 = KCl + 2AgCy$$

takes place readily and a double proportion of silver cyanide is precipitated. By adding to the silver found as chloride half the silver found as cyanide in the residue, we get in the second experiment 27·87, and in the third 28·31 instead of the theoretical 28·5.

Comparing the second and third experiments, we see the effect of the rather longer action of the reagent in the last case in the greater amount of silver chloride changed into cyanide and in the slight deficiency of the metallic silver in the residue. It is probable that finely-divided metallic silver has a tendency to dissolve in a solution of potassium silver cyanide.

I thought at first that it must be impossible for mercury cyanide and metallic silver to be dissolved in nitric acid without the hydrocyanic acid, which was perceptible to the smell, precipitating the silver; but I find that silver nitrate added to a solution of mercuric cyanide very tardily gives a precipitate, and that the precipitate is dissolved on adding a little dilute nitric acid.

Action of Ammonia.

When dilute aqueous ammonia is poured upon silver mercurous chloride the solid is changed immediately to a fine black colour, which, however, is modified to a brownish or slatey tint by washing and drying. I have analysed the products of five reactions and find that the residue contains silver, mercury, chlorine, and nitrogen, and that the solution contains silver, a little mercury, which appears to increase as the action of the ammonia is prolonged, and chlorine. My results seem to indicate that probably two doubly substituted ammonium chlorides are formed, namely, $NH_2AgHgCl$ and $NHAgHg_2Cl$ in varying quantities, silver chloride dissolving, and that secondary reactions also take place. I will postpone further notice of the action of ammonia until my results have shown more definitely the changes that take place.

Action of Caustic Soda.

Mercurous chloride is readily decomposed by warming it with caustic soda solution, the whole of the chlorine being taken up by the soda. Silver chloride is tardily decomposed, especially if it has been dried, indeed it is stated that cold caustic soda is without action on dried silver chloride. As in silver mercurous chloride we undoubtedly have chlorine joined to silver, it was anticipated that the total removal of chlorine would be difficult.

A 2 per cent. solution of pure caustic soda was used. The salt immediately blackened in contact with it. The black products remaining gave the following qualitative reactions. Dilute nitric acid dissolved the greater part, leaving silver chloride behind, and the metals were completely precipitated from the solution on adding hydrochloric acid, showing that the mercury was not oxidised to the mercuric condition. Concentrated hydrochloric acid restored the original white colour and then darkened the compound, as is shown below in the section on the "action of hydrochloric acid." On heating in a bulb-tube oxygen was given off, mercury sublimed, and a residue of metallic silver and silver chloride was left.

It was found that whether the soda solution was used hot or cold made little difference to the completeness of the reaction. The chlorine came away easily at first, then more slowly, and it was found impossible to go on until chlorine ceased to come away without repeating the treatment with soda so often that the bulk of solution would be very great. I do not know whether complete decomposition would be finally possible, but collateral evidence indicates that probably it would. One of the residues obtained in this manner when dried over sulphuric acid amounted to 86·60 per cent. of the silver mercurous chloride taken, and an estimation of the metals and chlorine gave results agreeing with the composition—

Mercurous oxide	52·94
Silver oxide	18·92
Silver chloride	14·47
	86·33

A little of the mercury is dissolved by the soda; in this experiment 1·8 of the 52·7 per cent. present in the original substance, and in another experiment in which the soda solution was heated and the action more prolonged, a greater quantity, 4·5 per cent., was dissolved. This partial solution of the mercurous oxide in the alkali does not however, appear to be due to the caustic soda, but to the sodium carbonate present in it or formed by exposure to the air during the reaction.

It would of course be possible to express the results of the analysis in terms of silver mercurous oxide and unchanged silver mercurous chloride, or silver mercurous oxychloride and silver mercurous oxide.

Action of Sodium Carbonate.

This reagent appears to act upon silver mercurous chloride rather more readily than if the two chlorides were uncombined. A cold solution changes the salt to an olive-green colour with a little yellow about it, and then to a slate colour. The solution obtained contains mercury and no silver, and dilute nitric acid dissolves out from the residue both silver and mercury, which metals are completely precipitated from the solution by hydrochloric acid, showing that the mercury remains in the mercurous condition. Sodium carbonate solution has scarcely any action upon silver chloride alone.

Action of Hydrochloric Acid.

It is not safe to allow even cold dilute hydrochloric acid to come into contact with silver mercurous chloride, as it leads to a loss of mercury. Strong hydrochloric acid does not darken the salt so readily as the alkaline chlorides do, but on boiling a few times with fresh quantities a globule of metallic mercury is obtained as residue. The results of one operation are given in the following figures, which express the quantities obtained from 100 parts of the salt.

Residue.		Solution.	
Hg.	Ag.	Hg.	Ag.
24·57	0·26	24·85	28·05

The silver was in solution as silver chloride, and the bulk of it was precipitated on cooling and diluting. It is obvious that the mercury is equally divided, that there is a little loss of mercury from both the residue and solution by volatilisation during the boiling, and that practically all the silver dissolves as silver chloride.

The primary reaction is therefore—

$$2AgHgCl_2 = Hg + HgCl_2 + 2AgCl$$

Doubtless the silver in the residue was precipitated from solution by the metallic mercury.

Action of Ferrous Oxalate.

A solution of ferrous oxalate in potassium oxalate readily reduces either mercurous chloride or silver chloride alone, and also silver mercurous chloride, to the metallic state, the whole of the chlorine being removed and the whole of the metals remaining in the residue. Ferrous citrate was found to have no visible effect upon silver mercurous chloride after contact with it for several minutes, but immediately a little potassium oxalate was added reduction began.

Action of Sodium Sulphite.

In the investigation of this reaction, my colleague, Mr. W. Kirman, has worked with me, and I desire here to express my thanks to him for his assistance.

Divers and Shimidzu (C.S.J., XLIX., 544, 569, 572) state that when sodium sulphite solution acts upon mercurous chloride, black "hypomercurosic sulphite," "$Hg(SO_3)_2Hg_3$," is formed, but that this is so rapidly acted upon by the excess of sodium sulphite, forming mercuric sodium sulphite in solution and precipitating half the mercury in the metallic state, that it is hardly possible to do more than just to see that the sulphite has a blackening action. The final change may therefore be written—

$$2HgCl + 2Na_2SO_3 = HgNa_2(SO_3)_2 + Hg + 2NaCl$$

We have confirmed this reaction showing quantitatively that half the mercury passes into solution and half is precipitated as metal, and also that the solution contains mercuric sodium sulphite by precipitating it with a strong solution of sodium sulphite and indentifying it qualitatively.

Concerning the action of sodium sulphite on silver chloride, the latter is dissolved presumably with the formation of a double sulphite of silver and sodium, but we have not been able to fix any formula for this double sulphite; indeed the proportion of sodium sulphite necessary to hold silver in solution appears to be affected by temperature, by dilution, and by the presence of other compounds, such as chlorides. By adding a standard solution of silver nitrate to a solution of sodium sulphite until a permanent precipitate begins to be produced, we find that each atom of silver requires 2·24 molecules of sodium sulphite when this latter is dissolved in water in the proportion of 1 grm. to 80 cc. and the experiment is done at the ordinary temperature. With a stronger or weaker solution, or if the test is done at a higher or lower temperature, the sulphite required for each atom of silver soon rises to 2·85 to 3 molecules. By adding a little sodium chloride to any of these solutions saturated with silver sulphite, silver chloride at once precipitates; therefore by using silver chloride instead of silver nitrate a still greater proportion of sodium sulphite must be necessary, and this we find to be the case. An excess of precipitated silver chloride was digested in the cold for a day or two with a solution of sodium sulphite, and it was found that for each atom of silver dissolved there were 3·97 molecules of sulphite present. In other experiments it was found that digestion for five hours or for six days gave a higher proportion. Three molecules of sodium sulphite were found insufficient to dissolve one molecule of precipitated and washed silver sulphite. Prolonged digestion is not advisable in these experiments, as even at ordinary temperatures there is a tendency for the silver sulphite in these saturated solutions to decompose, depositing its metal.

A cold solution of sodium sulphite at once darkens silver mercurous chloride. By grinding the salt in the solution a turbidity which looks as if it were due to silver chloride makes its appearance; this dissolves and the residue shrinks together as the reaction is completed. One experiment gave the following atomic proportions:—

—	Residue.	Solution.
Silver	1·89	2·11
Mercury	0·98	3·00

The atomic proportion of silver in the residue, taking the mercury as unity, was found in three other reactions to be 2·02, 1·99, 1·90. There is no doubt therefore that the residue consists normally of silver and mercury in the proporion of two atoms to one. The mercury in the solution was proved to be present as mercuric sodium sulphite by precipitating this salt with excess of sodium sulphite, and by the precipitation of mercury when its solution was heated. Therefore the decomposition of the silver mercurous chloride may be represented by the equation—

$$4AgHgCl_2 = Ag_2 + Hg + 2AgCl + 3HgCl_2$$

and as the mercury and silver dissolved are changed into sulphites, as stated above, the full equation may be written—

$$4AgHgCl_2 + 7Na_2SO_3 + xNa_2SO_3 =$$
$$Ag_2 + Hg + Ag_2SO_3, xNa_2SO_3 + 3HgNa_2(SO_3)_2 + 8NaCl$$

the x being equal to about seven.

By mixing the sodium sulphite solution and silver mercurous chloride in a tube that is afterwards sealed and allowed to stand for a few days so that the products of the action have time to react among themselves, we find that the metallic mercury of the residue precipitates silver from the solution, the mercury dissolving. In two experiments the silver in the residue was increased from 14·25 per cent., the amount required for the change as represented above, to 26·4 per cent. and 27·5 per cent. respectively. The mercury dissolving is not equivalent to the silver precipitated, and the proportion of it is very discrepant; indeed, while in two experiments the residual mercury had considerably decreased, in another it had apparently increased. This, irregularity, however, is only what was to have been expected, especially when the sodium sulphite was not in very large excess, because of the well-known tendency of both silver and mercury sulphites to decompose in the presence of water giving sulphuric acid and the metal.

Action of Sodium Thiosulphate.

A 10 per cent. solution of sodium thiosulphate was employed, which had a scarcely perceptible acid reaction. Unless care was taken to add a considerable excess to the silver mercurous chloride, sulphide of mercury was precipitated, and the consequent production of sulphuric acid caused a gradual and considerable precipitation of sulphur. But by arranging so that the salt never comes into contact with less than a sufficient excess of alkaline thiosulphate, the decomposition of the thiosulphates is so far prevented that there is a mere trace of sulphide in the residue, and the acidity of the solution is not great enough to affect litmus paper. An experiment done under these conditions gave the following atomic proportions of the metals :—

——	Residue.	Solution.
Silver	1·18	1·83
Mercury	0·79	2·22

These figures indicate that the primary change of the silver mercurous chloride may be expressed thus :—

$$3HgAgCl_2 = Ag + Hg + 2AgCl + 2HgCl_2$$

and that some of the metallic mercury of the residue then precipitates some of the silver from the solution. I find that mercury readily precipitates silver from a solution of silver chloride in sodium thiosulphate, and that silver has no effect upon a solution of mercuric chloride mixed with excess of sodium thiosulphate. It will be noticed that the excess of metallic silver in the residue falls short of the amount equivalent to the excess of mercury in the solution. This, I think, is probably due to the solution of some of the silver in the thiosulphate solution, the silver perhaps becoming soluble by aerial oxidation. The full equation, showing the action of sodium thiosulphate, may be written thus :—

$$3HgAgCl_2 + 9Na_2S_2O_3 = Ag + Hg + Ag_2S_2O_3, 2Na_2S_2O_3 +$$
$$2[HgS_2O_3, 2Na_2S_2O_3] + 6NaCl$$

It is necessary to observe that the composition of the double thiosulphate of mercury and sodium does not appear to have been determined, and the above formula is given because it appears to be the rule for sodium thiosulphate to combine with heavy metal thiosulphates in this proportion when soluble compounds are formed.

It is stated by some authorities that sodium thiosulphate dissolves mercurous chloride, but I do not find that anomalous action to take place. It appears that half the mercury dissolves and that the other half remains as metal if enough thiosulphate is used to prevent secondary reactions.

Conclusion.

We may summarily compare the primary effects of the reagents examined upon silver mercurous chloride by stating that hydrochloric acid, ferrous oxalate, caustic soda, and sodium carbonate act as we should expect them to do if the silver chloride and mercurous chloride were separate from and independent of each other. Hydrochloric acid dissolves the silver chloride and breaks up the mercurous chloride into mercuric chloride and mercury, ferrous oxalate gives complete reduction to the metallic state, and the alkalis act by partially exchanging chlorine for oxygen. But the reactions produced with the other substances are not merely the added changes they would give with the two separate chlorides. Ammonium chloride, potassium chloride, potassium cyanide, and sodium thio-sulphate act similarly in leaving one-third of each metal as residue in the metallic state and dissolving the remainder. Sodium sulphite leaves half the silver and one-third of the mercury as metals, dissolving the rest, and potassium silver cyanide leaves all the silver as metal. Ammonia produces substituted ammonium salts containing both mercury and silver.

Of the four reagents that act as they would if the silver and mercurous chloride were not combined but only mixed, it is obvious that ferrous oxalate giving complete reduction must do so, and this leaves only the action of the acid and the alkali upon which to found an argument against the suggestion that the body is a double chloride and not a mere mixture. I think, therefore, it must be admitted, as formulæ only express reactions, or at least must do this before they can do anything else, that the product of the action of mercuric chloride upon metallic silver is most advantageously considered to be a double chloride.

It is not difficult to write down the possible ways in which silver mercurous chloride may break up, leaving metals and fully saturated chlorides only :—

$$\begin{aligned}
HgAgCl_2 &= Ag + \quad\;\; + \qquad\quad\; + HgCl_2\\
2HgAgCl_2 &= \quad\;\; + Hg + 2AgCl + HgCl_2\\
3HgAgCl_2 &= Ag + Hg + 2AgCl + 2HgCl_2\\
4HgAgCl_2 &= 2Ag + Hg + 2AgCl + 3HgCl_2\\
5HgAgCl_2 &= Ag + 2Hg + 4AgCl + 3HgCl_2\\
&\text{or } 3Ag + Hg + 2AgCl + 4HgCl_2\\
6HgAgCl_2 &= 4Ag + Hg + 2AgCl + 5HgCl_2
\end{aligned}$$

and by taking seven molecules we can add three equations; by taking eight, two more; and so on.

It is interesting to note that of these changes the first is realised by silver potassium cyanide, the second by hydrochloric acid, the third by the alkaline chlorides, potassium cyanide, and sodium thiosulphate, and the fourth by sodium sulphite. I have not found any reagent that induces the decomposition indicated by the equations where five or more molecules of silver mercurous cyanide are necessary to react together.

Mercuric chloride readily reacts upon the mixed (or combined ?) metals left as residues, and it is so possible to produce double chlorides, or mixtures of the two chlorides containing mercury and silver in other ratios than an equal number of atoms. If, for instance, we take the mercury and silver left by the action of ferrous oxalate upon silver mercurous chloride and treat it with mercuric chloride, we should expect to get—

$$HgAg + 2HgCl_2 = Hg_3AgCl_4$$

and I have established the fact that mercuric chloride does act upon some of these metallic residues in this manner. Whether this product, taken as an example, would be merely a mixture of silver mercurous chloride and mercurous chloride, $AgHgCl_2 + 2HgCl$, is a question that I hope to be able to answer in due time.

When mercuric chloride acts upon such metallic residues, and also, I believe, when it acts upon silver itself, a black compound appears to be first produced. This also needs investigation.

NOTE ON THE COPPER MINES OF SINGHBHOOM, INDIA.

BY HAROLD HARRIS.

It is not generally known that in Singhbhoom, Chota-Nagpore, Bengal, there is a large belt of copper-bearing country extending over a distance of 80 miles in length. Having the opportunity to visit this district in the early part of 1892, I spent some two months examining that part of the country. The geological formation is sub-metamorphic, consisting principally of micaceous, chloritic schists, quartzites, and steatite, otherwise known as pot stone or soap stone, the whole formation resting on gneiss granite. All along this tract of country there are large heaps of slag and numerous old workings, some of them very extensive in length and width, clearly showing that the ancients who worked in these mines thoroughly understood the art of copper mining, and also of smelting from the oxidised ore. As to whether they understood the manipulation of sulphides is uncertain, but everything seems to indicate that they did not, as none of the old workings are down deep enough to strike the pyritic ore. At the present time a company is opening up a new mine to the depth of the old workings at Rajdoha. It has sunk two vertical shafts, each 14 feet diameter, one at Rajdoha and one at Rakka, some eight miles apart. The shaft at Rakka is down to a depth of 247 feet, having passed through copper-bearing ground from the surface. During the sinking, two valuable beds of copper ore were passed through. Crosscuts have been driven from the bottom of the shaft, and intersected these beds again in as healthy a state as in the shaft. The ore is all sulphide, and a bulk of 10 tons of undressed ore, from the richest portion of the lode, was sent to Liverpool and sold on a dry assay of $13\frac{3}{8}$ of copper. An analysis by the author, in the laboratory at Mason College, Birmingham, of a sample of this ore, gave the following results:—

	Per Cent.
Copper (Cu)	15·50
Iron (Fe)	26·25
Silica (SiO_2)	21·00
Sulphur (S)	21·50
Alumina (Al_2O_3)	2·60
Phosphorus pentoxide (P_2O_5)	3·25
Lime (CaO)	3·50
Magnesia (MgO)	2·00
Nickel and cobalt (Ni + Co)	1·20
Silver (Ag)	0·004
Water at 100° C.	1·35
	98·154

Probably existing as:—

	Per Cent.
CuS	23·33
FeS	37·67
Fe_2O_3	3·20
SiO_2	21·00
Al_2O_5	2·60
P_2O_5	3·20
CaO	3·50
MgO	2·00
NiO + CoO	2·00
Ag	0·004
H_2O	1·35
	99·854

A good feature in this ore is the entire absence of arsenic, which was carefully sought for, but not found. The percentage of phosphorus is unusually high. The presence of nickel and cobalt, although only in such small quantities, is a very interesting feature. Until lately this tract of country was practically inaccessible for commercial purposes. It consists principally of jungle and forests. Within the last three or four years, the Bengal-Nagpur Railway, from Asansol, on the East Indian Railway, to Nagpore in the central provinces, on the Great Indian Peninsular Railway, has passed through the country and opened it up. I have no doubt that the future of this copper-bearing country will be a very important one as its wealth in copper becomes known.

THE MOST RECENT DEVELOPMENT IN ARTIFICIAL INDIGO.

BY WATSON SMITH.

Our friend Mr. Levinstein, in opening the proceedings of the Manchester Section on November 3rd (this Journal, 1893, 908), described a new development in artificial indigo, introduced by the firm of one of our foreign members, Dr. W. Kalle, of Biebrich, which I also had before me, but which circumstances prevented my bringing before you at our opening meeting for the session. I shall now have much pleasure in demonstrating before you the use of this new indigo compound for printing upon cotton, or for dyeing. The first success attained by Baeyer in the synthesis of indigo was in the preparation of orthonitrophenylpropiolic acid. This acid, was, however, too expensive to threaten the natural indigo with any serious competition. More recently Baeyer and Drewson (1882) prepared indigo by the action of an alkali upon a mixture of orthonitrobenzaldehyde and acetone. The difficulty here was, however, the manufacture of the *o*-nitrobenzaldehyde, which could only be obtained by using *o*-nitrocinnamic acid as the starting point.

In their investigations, Baeyer and Drewson discovered *o*-nitrophenyllactone as an intermediate product, formed by the action of alkalis upon *o*-nitrobenzaldehyde and acetone. But this *o*-nitrophenyllactone could not be applied to the printing of textiles or to dyeing, because it was so little soluble in water, and no method was then known of making it soluble. Now, however, the firm of Kalle and Co., of Biebrich, have accomplished this desirable object by starting from *o*-nitrobenzylchloride, and preparing from this, by an improved and cheaper method, *o*-nitrobenzaldehyde, and then transforming the *o*-nitrophenyllactone into a sodium bisulphite compound, which is soluble in water. This soluble bisulphite is introduced into commerce as "indigo salt," and its formula is—

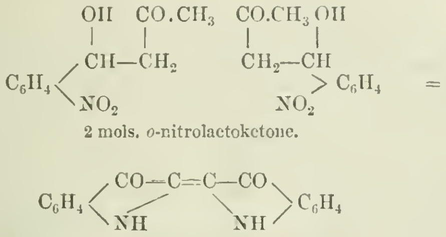
$$C_6H_4NO_2(CH.OH)(CH_2)(CO).CH_3 + NaHSO_3 + 3H_2O.$$

As you will see by an examination of the sample before us, it consists of a pasty crystalline mass smelling of sulphurous acid. Gently heated, this paste melts and becomes a clear liquid. At a temperature of 52°—53° C. the liquid becomes turbid and deposits the free lactoketone. Cooled down again, at the ordinary temperature the lactoketone reassumes its original condition. Dilute aqueous solutions of the paste deposit the lactoketone even at 40° C. Re-solution is then only effected after addition of bisulphite of soda. The bisulphite of soda should not contain free sulphurous acid, as the lactoketone is precipitated by sulphurous acid from its bisulphite solution.

If the lactoketone solution contain free sulphurous acid, it is necessary to add sodium carbonate until a slight permanent precipitate is produced, and then redissolve this precipitate by adding cautiously some bisulphite of soda.

M. Ullrich, the manager of the dyeing department at Kalle's factory, has made a series of investigations on the employment of indigo in calico-printing, the results of which will shortly appear in print.

To dye with the salt, the goods are simply dipped into its aqueous solution, wrung out, and then passed through a caustic soda solution of about 20° B. Indigo can be printed on cotton after first thickening with "British gum." The prepared piece is then developed in an alkaline bath of caustic soda at 20° B. The chemical change which takes place by the action of the caustic soda may be simply illustrated as follows:—



2 mols. *o*-nitrolactoketone.

Indigo blue.

Cotton printed by means of "Indigo salt."

It has been stated that now would probably commence the death blow to the natural indigo, upon which so much of our Indian revenue depends. But may I with all diffidence point out that whilst from Germany comes this practical threat, from Germany also comes much consolation and encouragement in the shape of new, powerful, and cheap antiseptics, and the best ways of employing them in the vats in which the indigo plant is extracted. Our hitherto rule of thumb and wasteful methods have largely ignored excesses of fermentation, whereby indigo once formed is further destroyed again in those vats. Who therefore can predict what our total yields of the natural product may yet be increased to, through the adoption of thoroughly scientific methods both in growth and extraction, and consequently what price our Indian planters and makers can yet afford to accept under such improved conditions?

Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

Chairman: E. Carey.
Vice-Chairman: H. Brunner.
Committee:

P. Bateson.
J. Campbell Brown.
V. C. Driffield.
Jos. C. Gamble.
F. Hurter.
W. Norris Jones.
G. Schack-Sommer.
E. Scott.
A. Smetham.
Frank Tate.
H. Tate, jun.

Hon. Treasurer: W. P. Thompson.
Hon. Local Secretary:
Dr. Chas. A. Kohn, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893-94.

Jan. 10th:—
Mr. E. H. Saniter. "A Review of some of the Methods in general use for the Estimation of Manganese in Minerals and Metals."
"Discussion on the State of the Patent Law." To be opened by Mr. W. P. Thompson.

Feb. 7th:—
Professor E. Divers, F.R.S. "The Manufacture of Calomel in Japan."
Mr. J. Beveridge. "The Manufacture of Straw Pulp."

March 7th:—
Mr. F. H. Tate. "Methods for the Rectification of Vitriol."

Meeting held Wednesday, December 6th, 1893.

MR. EUSTACE CAREY IN THE CHAIR.

THE COMPARATIVE EFFICIENCY OF ABSORBING APPARATUS.

A REPLY TO PROFESSOR LUNGE BY DR. F. HURTER.

Since the appearance of my last contribution to our knowledge of the principles which govern the action of absorbing apparatus, a criticism has appeared, written by my friend Professor Lunge, and I take this first opportunity offered to me to make a short reply.

I judge from the style of this criticism that Professor Lunge took my paper to be an attack on his invention—the plate-tower. I am very sorry indeed to have conveyed such an impression. I said nothing in my paper in any way calculated to detract from the value of this invention. I described it as an ingenious design, beautifully carried out by Mr. Rohrmann. I brought specimens of the plates and the distributors. The only sentence in my paper which, by misconstruction, could at all be held to detract from the value of the plate tower, is this one:—"It is difficult to see by what process of strictly accurate reasoning one can arrive at the conclusion that 7·3 sq. ft. of the smooth surface of pottery will do ten times as much work as a minimum of 10·8 sq. ft. of rough coke surface, which in reality may amount to 20 sq. ft. It could only be so if on every square inch of the pottery surface there were 15 times as many molecules impinging every second, than on a square inch of coke area. This would presuppose the equivalent of a pressure of 15 atmospheres."

Professor Lunge has not favoured us with any strictly accurate reasoning process to explain this difficulty. He points to the "infinitely" better sub-division of the gas in the plate-tower as the possible reason, but he does not seem to have realised the fact that this "infinitely" better division is really already noticed in the mode of comparison I have adopted, and to which I drew particular attention; I mean the formula—

$$\frac{\text{Surface} \times \text{time}}{\text{Quantity of gas}}$$

and of which Professor Lunge says: Everyone will have taken these conditions for granted, as being dictated by the common-sense way of looking at the matter.

Instead of the strictly accurate reasoning process, Professor Lunge gives us valuable practical examples of the performances of several plate-towers. I take no exception to any one of his examples—there is nothing marvellous in them; above all, there is not a single experiment quoted with such details as would permit accurate comparison with the work of a coke-tower of the same size.

When I wrote my last paper I had to admit that I had no experience with coke-towers so small as a plate-tower. But since that time I have gained this experience, and I am quite satisfied that a trial, side by side, of a plate-tower and a coke-tower, under similar conditions, will not show the plate-tower to be of ten times the efficiency of the coke-tower. But I do not mean to say that therefore the plate-tower may not have its special advantages in special cases, though it is a very expensive apparatus.

I must say a word on the experiments made by Mr. A. Carey and myself on the distribution of a single jet of water by the coke. The diagram, to which Professor Lunge objects, is perfectly accurately drawn to scale. The engraver misunderstood the shading of the stream, which was made darkest in the centre to indicate the greater quantity of water flowing there. But, apart from this and the omission of the bars supporting the coke, the diagram is perfectly correct.

Professor Lunge is quite wrong in his construction of the results. The tower was open at the bottom so that the distribution could be seen as well as measured.

The alteration Professor Lunge suggests in the mode of measurement is one which is easily conceived behind the desk, but which cannot so readily be carried out in the works. A column of 14 feet, and more, of coke needs support, and the bars, which were shown in my drawing but omitted in the engraving, would render wholly worthless the arrangement proposed by Professor Lunge.

We have applied in practice the results obtained by these experiments; we have in small condensers abandoned the numerous small holes for the admission of the absorbing liquid, and have restricted them to five or six judiciously placed. Hitherto we have had no reason to regret the change.

The most important point in Professor Lunge's criticism is, however, his objection to the principle I have tried to prove in my paper, viz., that the contact obtained per unit of work is as much greater, when the gas is sub-divided, than when the liquid is sub-divided, as the *mean velocity* of falling drops is greater than that of rising bubbles.

The objection Professor Lunge makes to my derivation of this principle, is that I made use of the formulæ for the descent of drops *in vacuô*, whilst they really fall in air, and that this air may have a velocity. Professor Lunge overlooked the fact that I only made use of it for the purpose of giving an elementary proof of the principle, in order to avoid higher mathematics. The friction in air, and the velocity of the ascending gas, if it happens to have such a velocity, are quite easily dealt with, but unfortunately the mathematics would not have been much use to a great number of chemists, hence I avoided them. But when the principle is once stated anyone gifted with the universal commodity "common sense" can see that it must be true whatever the respective velocities are, whether the friction be great or small. If the velocity of the drops is less than that of the bubbles, the case is of course reversed. But all that is of course contained in the algebraical statement of the principle in my paper.

As this "common-sense view" of the matter may not strike every reader, I give the following additional elementary proof, which does not involve the laws of gravitation.

I have shown that the contact of V volumes of gas subdivided into bubbles of the radius r, when ascending through a height H of liquid, is $\frac{3\,\mathrm{VH}}{r}$, and the work done in obtaining this contact is VH × 62·5 foot-lbs. if the liquid is water. The contact per unit of work is therefore $\frac{3}{62{\cdot}5 \times r}$.

Let the unit volume of liquid be divided into drops of radius r, and let these drops fall through a height H, whilst a current of gas is moving in the opposite direction.

Let the time which a drop takes to reach the bottom of the apparatus be t, then the mean velocity of the drop is $\frac{\mathrm{H}}{t}$. The surface of the drops is $\frac{3}{r}$, the time of fall is t, hence the value of the contact is $\frac{3\,t}{r}$. The work done is that of lifting unit volume of the water to the height H, viz., H × 62·5 foot-lbs. Hence the contact obtained per unit of work is $\frac{3\,t}{r \times \mathrm{H} \times 62{\cdot}5}$.

Comparing this with the contact of bubbles we find the ratios—

$$\frac{3}{r \times 62{\cdot}5} : \frac{3\,t}{r \times \mathrm{H} \times 62{\cdot}5} = \frac{\mathrm{H}}{t}$$

i.e., the contact obtained by dividing the gas is $\frac{\mathrm{H}}{t}$ times greater than that obtained by subdividing the liquid.

But $\frac{\mathrm{H}}{t}$ is the mean velocity of the drops.

Hence the contact obtained per unit of work, *cæteris paribus*, is as much greater when subdividing the gas than when subdividing the liquid, as the mean velocity of the drops is greater than the mean velocity of the bubbles, whether there be much or little friction, and whether the gas be at rest or in motion.

But, says Professor Lunge, "it is known to every child that the extremely minute drops of a fog sink down with extreme slowness." That is perfectly true, and it is precisely the reason why a fog would be absolutely useless for manufacturing purposes, even if every child knew how to produce such a fog. What use would the fog be if we had to wait days before it dropped again, or had to construct huge scrubbers to collect it. My experience is that once a fog is produced it is so difficult to deal with, that fog may be left out of the question.

It is different with spray. It is possible to produce spray, but it is only possible to produce it with a very great expenditure of mechanical energy, the liquid having to issue from the jet under great pressure if it is to be finely divided. Now my formulæ take no notice at all of the cost of pumping the liquid against such pressures. Professor Lunge also forgets that the liquid in this case issues with an initial velocity much greater than that which any drops ever assume falling through such heights usually to be found in apparatus of chemical works. The initial velocity of the jets made by Körtings are 30 to 40 feet per second, and this velocity is reduced by friction against the air to a velocity which nevertheless far exceeds that of rising bubbles.

Again, Professor Lunge is entirely wrong in thinking that the "diameter of drops is most easily brought down, not merely to $\frac{1}{10}$, but to a much smaller fraction of the diameter of the smallest gas bubbles producible by ordinary technical means." He only thinks so; he has not tried it. It is perfectly easy to produce gas bubbles of 5 mm. diameter. It is extremely difficult to produce drops of 1 mm. diameter, each of which would weigh only 0·5 mgrm. if they were drops of water.

I have disregarded spray also for good reasons. Whilst with pure filtered water the spray may sometimes perhaps be useful, for any other liquids it is not applicable, at least not generally.

The problem of ascertaining the actual velocity of drops of different sizes falling through air is extremely simple, and can be solved with a great degree of accuracy by means of an ordinary Mariotte's bottle and a good watch. It is not my intention to enter any further into this matter beyond saying that the actual mean velocity of a small drop falling through a height of 30 feet differs from the theoretical mean velocity by about 16 per cent.

In apparatus which permits continuous work, and for the comparison of which I have taken the trouble to find a theoretical basis consistent with my experience—in such apparatus it is much easier to obtain fine bubbles than fine drops. The principles which I had the honour to bring before you are the outcome of my experience in the first instance, and, to use Professor Lunge's words, of "absolutely reliable mathematical demonstration, as true as the kinetic theory of the gases."

I do not flatter myself that my work is perfect; on the contrary, I expect that such a beginning in establishing scientific principles of chemical engineering must and will necessarily be subject to corrections.

It is much to be regretted that there are so many chemists of high reputation who are unable to read what Professor Kirchhoff declared to be the most concise and most accurate description of our experience—a mathematical formula.

Discussion.

The Chairman remarked that no matter how ignorant they might be of mathematics, they would all appreciate the one axiom which Dr. Hurter had laid down—that the utility or otherwise of an apparatus for condensing gas appeared to resolve itself into a question of surface and of the time during which that surface and the gases were brought into contact. That appeared to him to be common sense as well as capable of support by mathematical proof.

Mr. A. E. Fletcher said that the point under discussion was the relative merits of the coke-tower as against the more compact plate-tower. The great advantage of the coke-tower had always seemed to him that it was not only an excellent surface condenser, but that it retained a large quantity of water. It contained so large a stock of water that although the supply of the gas to be absorbed was intermittent, yet the solution went on without break. A large coke-tower held many tons of water; the gas from the salt-cake furnace poured in at first in large quantity, and gained upon the water. If now they could test the tower foot by foot upwards they would find that the acid was rapidly gaining upon the water. Before half an hour had passed the great stress of gas would cease, and the water being constant now in its turn would gain upon the acid. Thus there was carried on in the tower a system of giving and taking so helpful in all practical undertakings. That the coke presented a very extended surface was obvious; it was not only rough, but each of those little cavities was a holder of water, a space where the gases might linger and deposit their acid.

He had not had an opportunity of making a trial of the plate-tower in comparison with the coke-tower, but knew it was used effectively in many cases. Each apparatus would no doubt be used in the cases which were fitted for it. One need not, he thought, force a close comparison between the two; each would have its merits. Regarding sprays in a chamber, he had had experience in conjunction with the late Dr. Angus Smith. Mr. Alfred Fryer, of Nottingham, constructed a chamber with a distributing apparatus in it; water was admitted near the spindle of revolving discs, and they threw off an admirable spray into a chamber of something like 6 ft. high and 4 ft. in diameter. Various fumes were passed through this chamber, materials which were readily soluble in water, such as sulphuric acid evaporated rapidly from a hot surface, common salt, hydrochloric acid, and the great surprise was how very little was taken up by the water. The amount of the fume was hardly diminished; it came through almost unchanged. There seemed another element brought in—each drop of water appeared to be repugnant to the finely-divided matter in the air. May we not consider it to be owing to the effect of surface tension? Each globule of water had its determination to remain globular, and refused contact with the substance to be dissolved. When the gas came in contact with the surface of the moistened coke, surface tension seemed to interfere less with the solvent action. Certainly there appeared to be more solution carried on in the same space. Perhaps Dr. Hurter would be able to explain the reason of the repulsion, and how much surface tension had to do with it. There was a decided disinclination for the two substances to come into chemical contact.

Mr. A. Carey said, with regard to Dr. Hurter's remark about the difficulty of condensing a fog of vapour, he had recently had some experience of this difficulty. He had been watching the trial of one of Professor Lunge's plate-towers as an auxiliary chamber in a vitriol plant. Dilute acid was run down the tower and the chamber gases passed through it. These gases contained on entering the tower about 30 grains per cub. ft. total acid expressed as SO_3, of which about 16 grains per cub. ft. was already H_2SO_4. The gases on leaving the tower were found to have lost only about 2 grains per cub. ft.

With regard to the remark of Mr. Fletcher as to the large quantity of water held in the coke of a coke-tower, he was able to supply figures. A condenser 7 ft. square and 50 ft. high, containing about 2,400 cub. ft. of coke, would hold enough water to completely condense at 30° Tw. all the hydrochloric acid given off from a salt-cake pot and roaster during three charges of 16 cwt. salt each. The steadying effect of this large and permanent supply of water in working such an apparatus was obvious.

Dr. Hurter, in reply, said the point he wanted to show clearly, and he had hoped he had succeeded in showing, was that whatever the apparatus, it must be judged by the amount of surface it exposed, and by the length of time which that surface was in contact with a given volume of gas, and those two factors together determined the value of an apparatus. With reference to Mr. Fletcher's point regarding the failure of the spray and its connection with the surface tension, he had not thought over it. He could only assure him that he was greatly surprised when he calculated the amount of contact which was to be got out of the drops in Lunge's plate-tower as compared with the contact of the plates themselves. It amounted to only half a per cent. of the total contact. There was very little to be got out of drops. He had not made the calculation for such an instance as Mr. Fletcher mentioned; probably in that case the surface of a very fine spray would be very large, but the time which those drops took in falling down so small a height was so short that they had hardly time to take anything out.

Manchester Section.

Chemical Theatre, Owens College.

Chairman: Ivan Levinstein.
Vice-Chairman: Edw. Schunck.

Committee:

G. H. Bailey.
F. H. Bowman.
R. F. Carpenter.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
P. Hart.
J. M. Irving.
E. Knecht.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
C. Truby.

Hon. Local Secretary:
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1893–94.

Jan. 5, 1894.—Dr. C. Otto Weber. "The Vulcanisation of India-Rubber."

Meeting held Friday, December 1st, 1893.

DR. SCHUNCK, F.R.S., IN THE CHAIR.

DISCUSSION ON THE FLASHING POINT OF MINERAL OILS.

Mr. J. Carter Bell stated that he had received the following notes from Mr. D. R. Steuart. The dangers of petroleum were of two kinds, those in connection with storage and those in connection with burning in lamps. The danger-point for storage was a degree or two under the Abel flash-point. This was easily proved by making an imitation of the Abel apparatus nine inches wide instead of two inches. With this apparatus oils not only flashed but kept burning permanently 2° below their Abel flash-point. With wider surfaces, such as tanks, barrels, or a large spill on the floor, the firing-point and point of danger would be a little lower still. In stores, then, and even in tin cans, the flash-point was the point of danger. With lamps there was the danger of explosion in the lamp, or of fire when the lamp was overturned. The Abel flash-cup was an imitation of a lamp, and gave the point where a slight explosion could take place in a lamp. The point where a violent explosion was possible varied with the structure of the oil. With low-flashing oil generally he found that a violent explosion took place 5° above the Abel flash-point, and with high-flashing oils (above 100° Abel) the interval was greater. But there was some real danger at the Abel flash-point. When a lamp had burned for some time the oil got heated with the combustion, 10°, 20°, or more, according to the nature of the lamp. When oil was heated 5° above its flash-point, and the lamp overturned, the oil as a general rule did not catch fire. At 10° above the flash-point the oil, if of low flash, might catch fire or not, according to the structure of the oil, but high-flashing oils did not generally catch fire unless heated more than 15° above the flash-point. But lamps might be overturned on combustible matter, and the point of danger even with this kind of accident was then the Abel flash-point. All the facts went to prove that high-flashing oil was safer than low-flashing far more than in proportion to the difference of flash. Our standard of safety in this country, horrible to relate, was 73° Abel. As London had a temperature of over 90° for a long time last summer, the absurdity of this was apparent. The dangerous oil flashing at 73° could be stored in any quantity in the middle of cities anywhere. Our Government, instead of attempting to protect people, had by special legislation shut itself out from the power of interfering. Before the Abel test was adopted in 1879 Professor Abel was asked by the Government to report as to whether 100° F. (or its equivalent in any modified method of testing) was, in his opinion, calculated to afford adequate protection to the public without unduly interfering with or restricting the trade; if not, what alterations should be made. He answered that there were not, in his judgment, any well-established grounds for considering that the present flashing-point was not calculated to afford adequate protection to the public, and he recommended its equivalent in the new test, which proved to be 73°. It lay with Sir Frederick Abel to protect them all by giving them experimental grounds for forming an opinion that could never be overturned, but he did not recognise this. He did not even give his opinion on the point asked, but merely founded his report on the fact that in his opinion there were no well established grounds for alteration. His (Mr. Bell's) opinions were not the unsubstantiated results of an interested party; they were those of the scientific world. In 1891 the the Inflammable Liquids Bill proposed to raise the safety point to 150°, leaving 73° between naphtha and burning oil. This made the mistake of leaving the oil which was practically perfectly safe, flashing between 73° and 100°, and putting all under a strict Government surveillance that the trade could not put up with. The objection was so universal that it was withdrawn. To raise the safety point to 100° was a medium course that would practically put an end to lamp explosions and leave the trade unhampered, and could be brought about without adding anything in the least degree burdensome to the price to the poor. Our own Government acknowledged the necessity for a high flash-point by getting oil of 105° for the soldiers, and 145° for lighthouses. A consignment of oil for the soldiers, although it was 105° when tried in Scotland, yet because it turned out 104° as tested by the Government expert, was returned, so that certain advisers of the Government were alive to the facts of the case. The question was a simple one of common sense to anyone with an elementary knowledge of chemistry and physics, and it should not be left to men connected with the trade, but scientific men should speak out clearly, and not allow the unscientific public to be in any doubt. The standard should not have been lowered in 1879 from 100° to 73°, for the whole test was false by that interval. Let the Society unite in saying so. Instead of the present slaughter being continued from year to year, let it be stopped at once by raising the standard to 100°, and then the matter could be investigated at leisure. If the matter still required investigation the slaughter should be stopped until the investigations were finished. If the trade could see their true advantage it would support them. But whether or not, as scientific men, they could say, without fear or being controverted, that in our climate oil of less than 100° flash was dangerous, and as practical men they might state as confidently that to raise the flashing-point was quite practicable without adding much to the price. Professor Kedzie, of Michigan College, states that the people of Michigan demanded a test equal to 120° F. flash test in close cups. The oil companies in the States exerted a powerful influence in favour of a low test for the oil, but public safety withstood their efforts, and the tendency on the part of sanitarians and the people was towards a higher test. He (Mr. Bell) had also received some figures with regard to the fires in London in the years 1890—2. From those it appeared that in 1890, out of 2,555 fires, 271 were due to lamp explosions; there were 51 lamp explosions due to accidents to lamps; and the total number of deaths was 61, of which 15 were due to lamp accidents. In 1891 there were 290 fires due to lamp explosions, 46 lamp explosions caused by accidents to lamps, and 12 deaths due to lamp accidents. In 1892 there were 275 fires due to lamp accidents, 82 of which were due to explosions caused by accidents to lamps, and 16 deaths resulted.

Mr. D. R. Steuart wrote that in *Fire and Water* reports were given from the different fire brigades. From these reports since March 1892 he had made out the following table of total fires to which the brigades were called, and the proportion of them that were caused by lamp accidents. The figures were for a year each :—

City.	Year.	Total Fires.	Fires from Lamp Accidents.
Liverpool....................	1891	565	58
Birmingham.................	„	382	24
„	1892	388	31
Brighton	1891	77	9
„	1892	71	6
Aston........................	1891	41	6
Tunbridge Wells	„	10	1
„	1892	9	2
Reading	1891	13	2
York	1891-2	26	3
Salford	„	65	4
Middlesbrough..............	1892	16	1
Bootle	1892-3	69	5
Newport (Mon.)	„	17	1
Bury....	„	42	3
Glasgow......................	1891	539	12
„	1892	591	7
Edinburgh	1891-2	315	12
„	1892-3	320	4
Dublin	1891	147	12
„	1892	114	6
Chicago......................	1891	3,353	141
„	1892	3,549	464

City.	Year.	Total Fires.	Fires from Lamp Accidents.
New York	1891	3,938	397
Paris	„	975	233
„	1892	1,070	256
Berlin	1891	1,193	{178 {195
„	1892	1,381	277
Toronto	1891	370	30
Melbourne..................	1892	357	10
Sydney..................	1891	262	11

Of 1,791 English fires, 156, or 8·71 per cent., were from lamps. Of 1,765 Scotch fires 35, or 1·98 per cent., were from lamps. Of 261 fires in Dublin, 18 were from lamps, or 6·89 per cent.

Of 10,840 fires in New York and Chicago, 1,002 were from lamps, or 9·24 per cent. The percentage in Toronto was 8·10. The percentage in Paris was 23·91, but included more than lamp accidents.

In Berlin, out of 2,574 fires, 650 were caused by lamps, or 25·25 per cent. In Germany the standard was as low as in England, but they took surveillance of all burning oils, counting them all dangerous as far as storage was concerned, and sought safely in the home by safety lamps. The danger of the low standard and the fatality of safety lamps was shown by this high percentage.

In some of the States of the Union the laws were defective. In others there were good laws and efficient inspection; in others, again, good laws, but seemingly no inspection, and the whole matter left to the insurance offices; and he feared this was the general rule.

There was a report on petroleum and its products, by S. F. Peckham, published by the American Government, 1885, from which he would give the following one short paragraph:—

"I am informed that the demand for high-test oils is not equal to the amount that can be made from the petroleum manufactured. Manufacturers the world over can only make what they can sell, and the ignorant and reckless buy the cheapest oil, regardless of all other considerations, encouraging the production of these cheap oils. It is here that intelligent legislation is required, to protect the ignorant purchaser on the one hand, and the honest manufacturer from unprincipled opposition on the other, as well as the innocent public, especially prominent as women and children, from the consequences that follow the use of dangerous oils, not safe even with 'safety lamps.' As Dr. Chandler said ten years ago:—

"'*It is not possible to make gasolin, naphtha, or benzine safe by any additions that can be made to it. Nor is any oil safe that can be set on fire at the ordinary temperature of the air.* . . . Even when the safety lamp has an ally in the form of a "safety can" it still fails to make naphtha safe. It is an axiom that *no lamp is safe with dangerous oil, and every lamp is safe with safe oil* . . . What we want is *safe oil; with it all lamps will be safe.*'"

And Mr. Peckham added: "This axiom expresses a permanent truth." He goes on to say: "It therefore appears to me that if legislation strictly required all oil to be brought to a *flash point* of 100° F., the general public would be fairly protected in the legitimate use of such oils, so far as mere legislation alone can afford protection. Such legislation should rigidly exclude all forms of naphtha from use in households, in lamps, or in stores of any pattern whatever, as always, under all circumstances and under whatever name or guise, more dangerous than gunpowder.

Mr. George E. Davis said he well remembered with what fear and trembling more than one household made the change from colza to paraffin oil. It was generally surmised that some oils were safer than others, and by those who could afford it a long price was often paid, with the idea of procuring a non explosive kind. At the present day the Government (Abel) test was not so well understood as it should be by the consumers of petroleum oils, and he thought that the law should require that vendors of petroleum should be compelled to affix a label to all sales, setting forth what the flash point (and consequently the dangerous point) really was. It by no means followed that because a high price had been paid for a lamp oil, that a high-test oil was always supplied. Some oil burned by him in 1879 in a lamp with a glass reservoir, and at the rate of 13 ounces in six hours, left a residue in the lamp at a temperature of 74° F., and when some years after, the glass reservoir had been replaced with one of copper the temperature of the residual oil after burning six hours was found to average 85° F. The oil burned in 1879 had a sp. gr. of 0·794, and as it differed somewhat from the oils of to-day, as analysed by D. R. Steuart (this Journal, 1892, 885–893), the following particulars might be interesting:—

First Drop Distilled at 140° C.

8 per cent. at	170° C.	25 per cent. at	210° C.
11 „ „	180° C.	32 „ „	230° C.
16 „ „	190° C.	37 „ „	240° C.
21 „ „	200° C.	44 „ „	250° C.

It had a flash-point of 112° F. in the "Abel" apparatus. Since that date he had always carefully selected an oil flashing considerably above 100° F., as he thought a margin of 15° over the temperature actually reached in the lamp was not an extravagant allowance.

At first sight it might appear that the raising of the legal "flash point" from its present 73° F. limit, below which no lamp oil should be sold, would be equivalent to raising its price to the working man consumer, but he had collected some statistics which proved this was not so. For the purposes of this discussion, he had endeavoured to get a fair estimate of the quality of lamp oil sold in Manchester and Salford, and a lad had been sent in the ordinary way to various shops mostly in the "slums," and he asked the name of the brand in each case. In this way 16 samples were collected, of which the following were the details:—

Locality.	Brand.	Specific Gravity.	Flash Point.	Price per Quart.
			°	*d.*
Ordsall Lane.......	Petroline	0·800	122	2
Red Bank.........	Snowflake	0·790	108	2
King Street	Strange's A 1.....	0·787	105	4½
Great Cheetham Street.	White Rose	0·787	104	3
St. Stephen Street.	Crystal Safety....	0·827	88	1½
Gt. Ancoats Street.	Unknown........	0·825	88	1½
Oldfield Road	Pearl	0·825	87	1½
St. Mary's Gate ...	"Swans Down"..	0·824	86	3
Cannel Street	Luminous........	0·825	86	1½
†Chapel Street	Unknown........	0·826	86	1½
Gartside Street....	Russian..........	0·826	85	1½
Oldfield Road.....	Beacon	0·811	84	1½
Great Bridgwater Street.	Stoddarts	0·823	84	1½
„ „ „	White Rose......	0·824	84	1½
Greengate	Royal Daylight...	0·795	76	1½
†Chapel Street	Unknown........	0·825	61	1½

A glance at the table showed that the lamp oil ordinarily consumed in the lamps of the poorer classes was in most cases much above the legal flash-point, so that there was not so much danger as was generally supposed, it being very improbable that a higher temperature than 84° F. was ever reached in a lamp burning under ordinary conditions in a cottage house. But, on the other hand, what would happen if all makers of lamp-oil reduced the flash-point to that limit legally allowed them? He ventured to suggest that 12 months of such a *regime* would give most appalling results. The reason there were not more lamp accidents was because a large bulk of the oil sold to the poorer classes had a flash-point varying from 84° to 88° F. It might be asked why manufacturers produced an oil of 88° flash-point while the law only compelled them to produce 73° F. Was it from motives of philanthropy, or had they an inkling that a light over an oil flashing at 73° F. was very much akin to a lighted match over a barrel of gunpowder?

Referring to the last line of the table, this sample, flashing at 61° F. (the temperature of the air), was supplied in the ordinary course. Thinking that something was wrong, another quart was purchased from the same shop, and this second lot tested 86° F., showing that some mistake had been made in the first sale by the shop assistant. May not such incidents as these account for many lamp accidents? The table showed clearly enough that no hardship would be wrought upon makers of lamp-oil if the flash-point were raised to 90° F.; but, even then, oil flashing over 100° F. would no doubt be preferred by most consumers.

Mr. A. E. Powell said during the past six weeks he had obtained numerous samples of burning oils from small shopkeepers in Ashton, Oldham, Stalybridge, Stockport, and that district. He found that about 80 per cent. was supplied by American firms either direct or through agents and brokers, from tank waggons or in casks. About 70 per cent. of this oil flashed at 74° F., Abel test, and burnt away at 120° F. without further assistance.

His attention was drawn to this subject by an explosion in his own house, which occurred while his servant was turning down a lamp in which this oil was being used. To confirm his previous tests he obtained from reliable sources 15 samples of standard oils (four American, three Russian, and eight Scotch), which he carefully tested in a legally standardised apparatus, with the following results:—

		° F. Abel.
American,	No. 1	74
„	No. 2	75
„	No. 3	103
„	No. 4	108
Russian,	No. 5	97
„	No. 6	82
„	No. 7	85
Scotch,	No. 8	121
„	No. 9	120
„	No. 10	115
„	No. 11	123
„	No. 12	128
„	No. 13	113
„	No. 14	124
„	No. 15	138

A comparison would show that the lowest Scotch (paraffin) oil was perfectly safe at the temperature at which ordinary American (petroleum) oil actually fired. He would point out that the so-called (average) "paraffin lamp accidents" had nothing whatever to do with paraffin oil, but were caused generally by the inferior petroleum oils before mentioned.

The higher grades of American and Russian oil were all that could be desired with regard to safety and illuminating power, but the lower grades (principally sold) were not fit to be used as at present supplied to the general public, who were told that the test was 120° F., and which they believed to be the point of safety, instead of, as was really the case, that of danger. He trusted that this matter would be taken up by consumers and others, with a view of getting the legal flash-point raised to 100° F., Abel test. This would not greatly increase the cost (if at all) to users.

Mr. Carpenter thought it would be very interesting to have some information about the flash-point being lower with a 9-in. cup, as the conditions were in much closer relation to those prevailing in an ordinary lamp.

Mr. Powell moved and Mr. Hodgson seconded the following resolution:—

"That in the opinion of this meeting the legal flashing-point of burning oil sold in this country is considerably too low, and that it should be increased to a standard of not less than 100° F., Abel standard."

The resolution was carried.

DISCUSSION ON THE USE OF OIL AS FUEL.

Mr. George E. Davis, in opening the discussion, said that the coal strike being now over, it might be assumed that the immediate necessity for using oil as fuel had passed away. Still the situation just passed through would have taught lessons of economy that might prove useful at some future time. A very large number of oil burners had been in use in the Manchester district during the past two months, and their sudden disappearance now that the coal strike was over, proved, more than any argument of the speaker's, that oil must be less advantageous than solid fuel.

The oils usually employed as fuel were gas-tar, crude petroleum, astatki, blast-furnace oils, coke-oven oils, and creosote. These products did not vary so much in their composition as was generally supposed, their cleanliness and viscosity being of more importance than their chemical composition.

Gas tar contained 85 per cent. carbon, 5 per cent. hydrogen; astatki, 85 per cent. carbon and 12 per cent. hydrogen; while blast-furnace oils and coke-oven oils contained about 83 per cent. carbon and 10 per cent. hydrogen.

In practice various methods had been adopted for the combustion of liquid fuel—(1) burning on a porous bed; (2) in a trough or gutter or on an inclined bed; (3) as a spray, produced by steam or compressed air; and (4) as gas.

The first and fourth methods had scarcely been found satisfactory. The second was perhaps the best for viscous oils, such as gas-tar; while the third or the spray system had adherents everywhere.

In order to gauge the value of liquid fuels one must have a standard for comparison, and the most generally accepted one would be, no doubt, ordinary boiler coal or "burgy." Even at the outset one met with a difficulty—what was to be the standard of evaporation even for ordinary good quality "burgy"? He thought that the average evaporation in a steam boiler working to 60 lb. was, taking the whole country through, about 7 lb. of water per lb. of fuel, and this might well be adopted as a standard.

In some experiments published by Thwaite, astatki with natural draught evaporated 15 lb. of water from 212° F., and with forced draught 14·2 lb.; and Carpenter, at the Vauxhall Gasworks, made 30 galls. of tar do the same work as 5·7 cwt. of coke, or a comparative value of 18 to 10. The speaker's experiments were carried out when creosote was selling for 5*s.* 8*d.* per gallon, and the comparisons between coal, coke, gas, gas-tar, and creosote were carried out, not by any theoretical heat units, but by actual work done in furnaces. There were many precautions to be taken in burning liquid fuel, which could not be learned in a day; but the chief difficulty, especially with viscid liquids, was in regulating the quantity, which was so extremely small. The quantity of oil necessary to heat an oven of six gas retorts was barely 3 galls. per hour, and such a small orifice was very liable to become choked. His own experiments, carried out very carefully, with air supplies adjusted by means of the carbonic acid content of the waste gases, showed me that the following quantities gave equal heating values :—

Coal....................	1,453 lb.
Coke....................	1,624 ,,
Gas (debenzolised)	25,000 cubic feet.
Creosote................	77 galls. or 831 lb., at 1,080 sp. gr.

The regulation of the draught in using spray burners was a very important item to be considered.

The following table would show approximately the money value of oil for fuel against coal of various prices :—

Coal per Ton.	Oil per Ton.	Coal per Ton.	Oil per Ton.
s. d.	s. d.	s. d.	s. d.
3 6	6 6	7 6	13 11
4 0	7 5	8 0	14 10
4 6	8 4	8 6	15 9
5 0	9 3	9 0	16 8
5 6	10 2	9 6	17 7
6 0	11 2	10 0	18 7
6 6	12 1	10 6	19 6
7 0	13 0	11 0	20 5

Roughly, there were 226 gallons of blast-furnace oil or coke-oven oil to the ton, and 210 gallons of creosote, so that creosote at 1*d*. per gallon was practically equal to coal at 9*s*. 6*d*. per ton.

His own impression, formed from the results of many experiments, was that the correct way to burn liquid fuel was by means of compressed air. In order to show how easily this could be accomplished, he had brought for inspection the new "Primus" stove, which burnt petroleum without a wick, and might be found useful in those industrial establishments and laboratories where there was no gas supply. The "Primus" lamp would boil two litres of water in five minutes when burning at the rate of 17 fluid ounces, or 500 cc., of petroleum oil per hour.

Dr. Carl Otto Weber said: In the use of liquid fuel Russia appeared to be in advance of all other countries. During the coal strike many Manchester firms had recourse to petroleum as a fuel, but the results in every instance seemed to have been discouraging. In Russia it was only the heavy petroleum residues (astatki) which was used for boilers, railway engines, and similar purposes. Astatki on combustion produced 11,000 cal., as against about 8,000 cal. obtained from first-class steam coal. It appeared, therefore, that in this respect 62 lb. of astatki were equal to 100 lb. of coal. By working side by side two boilers of the same type, firing the one with coal, the other with astatki, it was found that 1 lb. of coal evaporated 8 lb. of water, and 1 lb. of astatki 13 lb. of water. The relation between the volume of air passing into the furnace and the quantity of water evaporated was also important; and it was found that for 1,000 cubic feet of air consumed, coal evaporates 1·5 and astatki 2 lb. of water. Consequently, besides a smaller weight of fuel, also about 20 per cent. less heating surface was required for astatki fires. This was apart from the cost of the fuel, an item of considerable importance for marine boilers, as it would allow to reduce their volume very considerably without lessening their steam-producing capacity.

The works in and around Moscow used in 1890 about 100,000 tons of astatki at a saving of about 30 per cent. as compared with coal. The price of the residue at Moscow is 5*l*. per ton; at Baku no more than 10*s*.

Mr. G. E. Davis said that Dr. Weber had mentioned the question of air supply. He found that a pound of creosote oil required 165 cubic feet of air at least to keep a chimney smokeless.

Dr. Weber said he had omitted to mention that liquid fuel was very difficult to use in boilers of the Galloway or Lancashire type.

Mr. Grimshaw did not think there should be any difficulty in burning oils in many ways, either by steam or compressed air. After burning oil under his boiler for two or three months he adopted a principle of his own, and he had had very little difficulty with it since then. The whole question rested on the price of coal as compared with the price at which these burning oils could be purchased. It was very improbable that they could produce crude oils in this country in sufficient quantities to seriously affect the price of coal, and it was a question whether they could be imported from other countries at a sufficiently low price to be used in place of coal.

Mr. Irvine did not anticipate serious competition between coal and oil as fuel for boilers. It was only when there was limited boiler space that any advantage could be gained by burning oil.

Dr. Dreyfus said he had been burning creosote oil for the last 18 years constantly, and had tried it with the injection both of steam and air, and the results by the injection of steam had been much more satisfactory than by air. With a proper burner and perfect arrangements one could produce water-gas and obtain higher figures than those quoted by Mr. Davis.

* * *

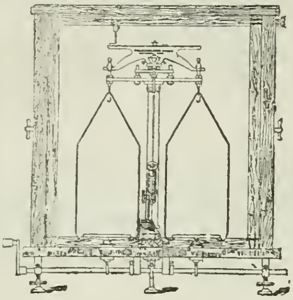
ON KUHLMANN'S NEW MODEL TECHNICAL BALANCE.

BY DR. B. W. GERLAND.

The balance to which I wish to call your attention bears great likeness to the well-known Bunge balances, and is, on the whole, constructed on similar principles. The glass of the case is ample, affording clear views of the instrument from all sides. The front and back are each formed of one piece of plate glass in wooden frames, which lift up and are retained in the elevated position by checks on the right. The sides are glass doors, and for the bottom plate Kuhlmann uses a marble or glass slab. Below this plate the shaft is fixed, which carries the three eccentrics working the two piers for the supports of the pans and the central pin for lifting the beam. The handle for this shaft can be slipped on either the left or right end. By a turn of the same of about 20° the pans are set free and are steadied by short movements backward and forward. A further turn liberates the stirrup suspension of the pans, and lastly the beam is set free. The beam is made of phosphor-bronze strongly gilt, the pans and wires of nickel silver, and the three knife edges and their supporting planes are of agate. For the convenient use of the rider the beam finishes at the top in a straight line, and is divided over the whole length into 100 parts marked 0 at the left and 100 at the right end. These divisions are cut out in V-shape, offering safe resting places for the rider, which is made of aluminium wire, and weighs 0·05 grm. The arrangement for moving the rider is most satisfactory, so that with ordinary care a mishap to the rider is almost impossible.

The knife edges are carefully placed parallel to each other and effectively fixed by an ingenious method of Kuhlmann, and then polished so that the strain of the fixing screw does not interfere with the straight line of the agate knife edge. All three knife edges are arranged in a straight line. The centre of gravity is regulated by a bob moving on a screw at the back of the beam, and in connection with this screw is a horizontal screw carrying a bob for putting the balance into equilibrium. This is done with the rider placed in the first nick on the left of the beam. The centre of gravity is held very low, so that an oscillation takes only from 6 to 12 seconds according to the balance being empty or weighted with 200 grms. in each pan.

As the knife edges are arranged in a straight line the deviation of the balance is in proportion to the overweight on one side or the other, and not influenced by the greater or less weight in the pans. The balance is regulated so that the deviation for 0·001 amounts to 2°, and this moves the pointer 2 mm. A little ivory scale, in front of which the pointer moves, has to both sides of the centre line 2 mm. marked off and divided into 10 parts. As these parts are for most eyes too small to observe, a diminutive telescope is attached to the front frame, which, properly focussed, makes the counting of the number of parts passed by the pointer easy. As 0·001 grm. causes a deviation of 10 parts, for every single part 0·0001 grm. has to be allowed.



The rider weighing 0·05 grms. will represent 0·1 grm. when moved from one extreme of the beam to the other, and every one of the 100 divisions : 0·001. The rider thus gives centi- and milligrammes, the decimilligrammes are read off (and fractions of these may be judged) the scale behind the pointer, and of weights none smaller than decigrammes are used. This saves some trouble, and the correctness of the weighing I have repeatedly proved by using centigramme weights and centigramme rider.

The balance when released turns the right way at once even with overweight as low as fractions of a milligramme. I have worked with this instrument two months, and am more and more pleased with it the more familiar I get with it. It has proved correct and satisfactory in every respect, it allows weighings to be taken in a very short time, and the price is remarkably moderate. I trust I am doing a service to my brother chemists by introducing this new model balance to their notice.

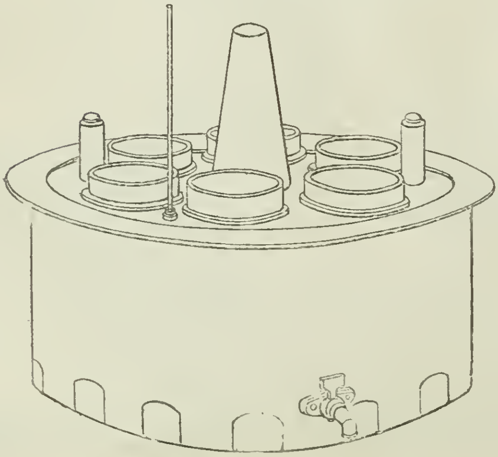
Meeting held Friday, 3rd November 1893.

MR. IVAN LEVINSTEIN IN THE CHAIR.

A NEW DYE-BATH ARRANGEMENT FOR EXPERIMENTAL DYEING.

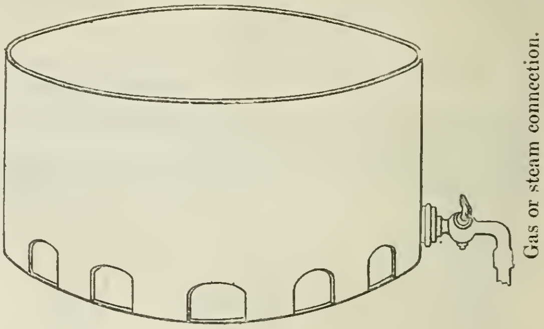
BY WM. MARSHALL, F.I.C.

(This Journal, November 30, 1892, p. 909.)

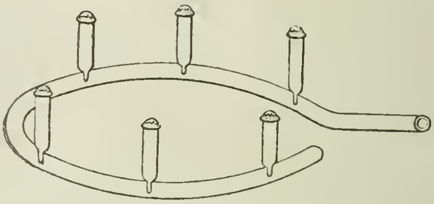


Dye-bath Complete.

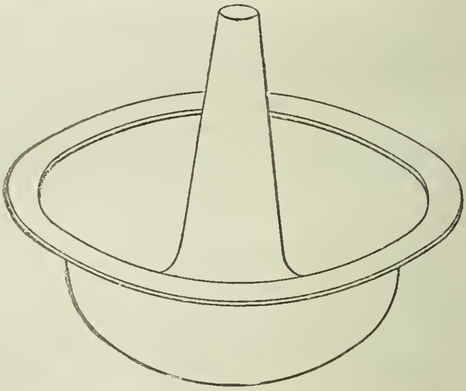
A.

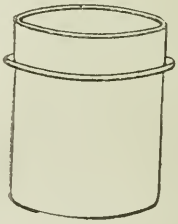


B.



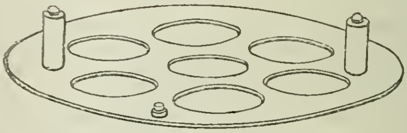
C.





Dye-pot.

D.



Note.—When steam is used for heating, a coil can be inserted at the bottom of the bath.

Yorkshire Section.

Chairman: A. Smithells.
Vice-Chairman: T. Fairley.
Committee:

J. E. Bedford.
F. Branson.
J. B Cohen.
J. J. Hummel.
J. Lewkowitsch.
W. McD. Mackey.
C. Rawson.
F. W. Richardson.
Jas. Sharp.
G. W. Slatter.
G. Ward.
T. B. Wilkinson.

Hon. Local Secretary:
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications should be addressed to the Hon. Local Secretary.

SESSION 1893-94.

There will be no meeting in January.

Feb. 5th:—
Messrs. Liechti and Hummel. "The Mordanting of Wool with Chromium." Part III.
Dr. C. Otto Weber. "Substantive Dyes and Substantive Dyeing."

March 5th.—Dr. C. Otto Weber. "The Tinctorial Properties of some Indian Dyestuffs." Part I.

Meeting held Monday, December 4th, at the Yorkshire College, Leeds.

PROF. SMITHELLS IN THE CHAIR.

ON THE TREATMENT AND UTILISATION OF TOWN REFUSE.

BY CHRISTOPHER RAWSON, F.I.C., AND CHRISTOPHER SMITHSON.

The refuse of a town or city may be broadly divided into two classes:—(1) that which is carried away by water, including house sewage and the waste liquids from works and factories; (2) that which is removed and disposed of in the solid state. In the present instance it is our purpose to deal with the treatment of the solid matter only. The solid matter is obtained principally from ashpits, dustbins, and middens. It consists of coal, coke, and ashes; night-soil, vegetable refuse, rags, paper, glass, crockery, bones, iron, and all kinds of house rubbish. It is this heterogeneous mass which is commonly known as town refuse.

Naturally the composition of town refuse varies widely; partly, according to the season of the year in each particular locality, but more especially according to the means adopted of disposing of excreta. In other words, whether the town furnishing the refuse is a "midden" town or a "water-closet" town. Of course there are many places where both systems are in vogue. It has long been generally recognised that by the water-carriage system—advantageous as it may be—the country sustains an immense loss in the shape of valuable manure. In many "midden" towns the night-soil along with the contents of the ashpits is burnt in destructors and also lost. The excrements of animals contain all that which is necessary for fertilising the soil, and there can be no doubt but that these products were intended by the law of nature for that very purpose.

The late Dr. Voelcker, F.R.S., in a paper read before the Society of Arts on the "Agricultural and Commercial Value of Prepared Night-soil Manures" (Jour. of Soc. Arts, 1877, 622), stated that the fertilising value of human excreta was greater than that of the excrements of horses, cows, pigs, and sheep. He pointed out that the main difficulty in disposing of human excreta was due to the circumstance that at the very least either three-fourths of useless matter (water) had to be carted into the country, or some of the water had to be absorbed by porous materials, or somehow or other to be got rid of before the expense of collection and cartage could possibly be recouped. In the same paper an analysis of fæces is given by Way. We reproduce the figures here, together with the results calculated on the dry matter:—

TABLE I.

—	In Natural Condition.	Calculated on the Dry.
Water	75·00	..
*Organic matter	22·13	88·52
Insoluble siliceous matter	0·37	1·48
Sulphuric acid	0·06	0·24
Phosphoric acid	1·07	4·28
Oxide of iron	0·13	0·52
Lime	0·43	1·72
Magnesia	0·38	1·52
Potash	0·30	1·20
Soda and sodium chloride	0·13	0·52
	100·00	100·00
*Containing nitrogen	1·50	6·00
Equal to ammonia	1·82	7·28

Naturally the composition of human excrement varies considerably, but several analyses point to an average of about 75 per cent. of water. Porter found the ash to consist of:—

TABLE II.

	Per Cent.
Sulphuric acid	3·13
Phosphoric acid	36·03
Carbonic acid	5·07
Oxide of iron	2·50
Lime	26·43
Magnesia	10·54
Potash	6·10
Soda	5·07
Sodium chloride	1·33
Undetermined	3·77
	100·00

The chief difference between this analysis and that of Way is that the former contains much more lime and rather less potash.

Provided the material could be presented to the farmer in the state of a concentrated powdery manure. Dr. Voelcker estimated (in 1877) the fertilising value of human excreta to be 30*s.* per ton, which is equal to 6*l.* per ton calculated on the dry matter. If we calculate on the basis of ammonia having a value of 11*s.* per unit, phosphoric acid 1*s.* 6*d.* per unit, and potash 3*s.* per unit, a ton of human excreta, according to the above analysis, would be worth 4*l.* 10*s.* In Watt's Dictionary of Chemistry, on the authority of Wehsarg, it is stated that a full-grown man discharges on the average, in 24 hours, 131 grms. of fæces containing 26·7 per cent. of solid matter, therefore 35 grms. (about 1 oz.) of solid matter. Supposing we take half of this amount per head for the entire population, the United Kingdom would produce 237,500 tons of dry solid matter per annum, worth, at 4*l.* 10*s.* per ton, no less a sum than 1,068,750*l.*

In order to compensate for the mineral and nitrogenous matters which are taken from the soil and subsequently washed down our drains or otherwise destroyed, England imports artificial manures to the value of from 2,000,000*l.* to 2,500,000*l.* per annum.

In China nothing is allowed to go to waste which is useful to the soil. Notwithstanding its vast population, China is entirely independent of all other nations, not only for its food supplies, but for the fertilising materials required by the soil. Since England imports immense quantities of wheat, flour, and other foodstuffs, if the whole of the excrement were returned to the land, it naturally follows that the soil instead of becoming impoverished would yearly become richer without the importation and application of any foreign manure. It must not be thought for a moment that we are advocating the methods employed in China for disposing of refuse, but that country undoubtedly shows, on a very large scale, the value of excrement as a fertiliser.

In his presidential address (this Journal, 1891, 600) at Dublin, Mr. E. Rider Cook expressed the view "That no good will be done in the direction of sewage utilisation while the present water-carriage system continues." In order to deal successfully with the problem, he mentions the following requirements:—

"(*a.*) The finding of a chemical or chemicals, the use of which shall immediately deodorise excreta, and which shall arrest decomposition for some days.

"(*b.*) The construction of an apparatus, with or without the means of separating the solid from the liquid excreta, for the application of these chemicals, which while quickly removing the contents to a receptacle, shall be simple and cleanly in its action.

"(*c.*) The provision of a receptacle in each house which shall be readily accessible to the public authority, and which can be conveniently emptied."

Several methods have been proposed for dealing with this question, but up to the present we may safely say that the above requirements have not been satisfactorily fulfilled. We do not propose to discuss this problem, however, but to deal with the town refuse as it exists at present. We might consider for a moment what has been done in the past and what is now being done with this refuse. Much has been used for filling up old quarries and making roads. It has been tipped on to any vacant available land, upon which after a comparatively short time dwelling-houses have been erected. The evils arising from such procedure have been pointed out so frequently by many eminent authorities in sanitary science that further comment here is unnecessary. As long ago as 1878 a bye-law of the Metropolitan Board of Works was passed:—

"That no house, building, or other erection shall be erected upon any site, or portion of any site, which shall have been filled up or covered with any material impregnated or mixed with any fæcal, animal, or vegetable matter, or which shall have been filled up or covered with dust, or slop, or other refuse, or in or upon which any such matter or refuse shall have been deposited, unless and until such matter or refuse shall have been properly removed, by excavation or otherwise, from such site. Any holes caused by such excavation must, if not used for a basement or cellar, be filled in with hard brick or dry rubbish."

Outside the metropolis, however, houses have been built, within quite recent times, upon foundations of town refuse of a very objectionable character.

In "midden" towns part of the mixture of nightsoil and ashes has been put upon land as manure, but the labour involved thereby is so great that it can only be considered a very clumsy and costly way of dealing with the material. At the same time, a great nuisance is created in the neighbourhood by the noxious smell which is evolved. After the refuse, in large quantities, has been spread on the land for some months, that which remains—forming a very high percentage of the whole—is raked off and tipped at any convenient spot. In some places, however—especially in South Lancashire towns—the night-soil is collected separately in pails or tubs, the contents being sprinkled with gypsum, and the whole mixed with about 1 per cent. of sulphuric acid to fix the ammonia, and dried. In a paper read before the Society of Arts in 1877 on the "Treatment and Utilisation of Night-soil, and Conversion into a Concentrated Manure by Milburn's Drying Machinery" (Journal of the Society of Arts, Vol. XXV. (1876—77), 630), an analysis by Dr. Voelcker is given of such a product, as follows:—

TABLE III.

	Per cent.
Moisture	10·49
*Organic matter	59·69
Phosphate of lime	5·12
Oxide of iron and alumina	5·72
Sulphate of lime	9·19
Carbonate of lime	2·01
Alkaline salts and magnesia	1·93
Insoluble siliceous matter	5·85
	100·00
*Containing nitrogen	6·48
Equal to ammonia	7·87

The manure is said to have a market value of about 6*l.* per ton. On the basis previusly adopted, the above analysis shows a theoretical value of 4*l.* 10*s.* per ton. This figure, however, does not take the potash into account, since potash does not occur as a separate item in the analysis.

In many large towns, the refuse (from ash-pits and middens) is now burnt in furnaces commonly known as "destructors," of which there are various kinds. In some places, where the contents of the middens are burnt, many complaints have been made in respect to the noxious smells arising from the destructors, but in recent years, since the so-called "Fume cremators" have been adopted, the operation has been satisfactorily accomplished without creating a nuisance. But the expenses connected with the operation are very great. The original cost of a destructor containing from 12 to 14 cells is about 10,000*l.*, and the cost for labour in burning the refuse varies from 8*d.* to 2*s.* 6*d.* per ton. The fertilising properties of the night soil are entirely destroyed, and the value of the steam produced from the burning of the refuse is comparatively very small. The power which is thus obtained is usually utilised in grinding the clinker with lime into mortar. The following table shows the amount of refuse destroyed in a few towns in 1891, with the net cost per ton of burning it.

TABLE IV.

Town.	Tons Burnt.	Cost per Ton, inclusive of repayment of Capital and Interest.		Value of Steam, &c. per Ton of Refuse Burnt.
		s.	*d.*	*d.*
Leeds	130,000	1	2	—
Bradford	68,450	1	7	2
Battersea	24,640	3	0¾	10¼
Newcastle-on-Tyne	15,198	1	1¼	1
Leicester	10,000	1	6	3

Leaving Battersea out of the question, where the expenses seem to be abnormally high, the mean cost in the other four towns, after deducting the value of steam, &c. is 1*s.* 2½*d.* per ton.

In some parts of London, Chelsea for instance, the refuse (containing no night soil however) is passed through sieves of various degrees of fineness, and at each stage pieces of metal, bones, crockery, bottles, rags, glass, &c. are picked out by boys. In this way 1,000 tons of refuse have yielded on an average:—

TABLE V.

	Tons.
Coal and coke over 1½ in. pieces	8
Coal and coke, 1½ in. and under	799
Rags, paper, string, &c.	76
Vegetable matter	44
Tins, 7; iron, 2	9
Bones	5
Crockery	5
Glass	2

And about 5,000 unbroken bottles.

In dealing with the disposal of town refuse we have three principal factors to take into consideration:—

(1.) To treat it in such a manner that no nuisance shall be created.

(2.) To separate the combustible matter or fuel which it contains, and utilise it to the best advantage for the production of steam.

(3.) To separate the fine portion in such a manner that it can be advantageously applied to the land as a fertiliser.

In the apparatus which we have now to describe, the invention of Mr. Sam Smithson, these requirements have been carefully studied, and the results of experiments carried out on the large scale have been highly satisfactory. All the operations are carried out by mechanical means, there being no handling of the refuse whatever. Briefly, the crude refuse is passed through a revolving cage, which separates large and bulky materials, such as tins, pots, bottles, &c. The main portion is then carried through a revolving iron cylinder, which practically forms part of a flue leading from the boiler furnaces to the chimney. The heated gases passing through the cylinder drive off the moisture, and the dry material is conveyed to a second revolving cage having a fine mesh. In this manner the dried refuse is divided into what we shall afterwards describe as coarse portion or fuel, and fine portion or manure.

In the accompanying diagrams, Fig. 1 is a front elevation, Fig. 2 an end elevation, Fig 3 a part section and end elevation, Fig. 4 a plan, and Fig 5 a section of the drying cylinder showing the feeding arrangement.

Fig. 1.

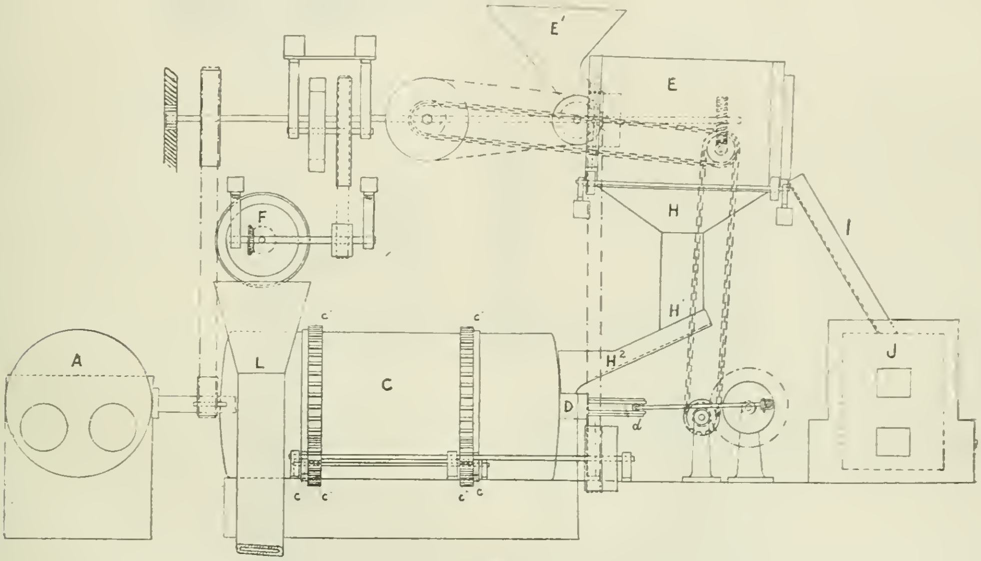


Fig. 2.

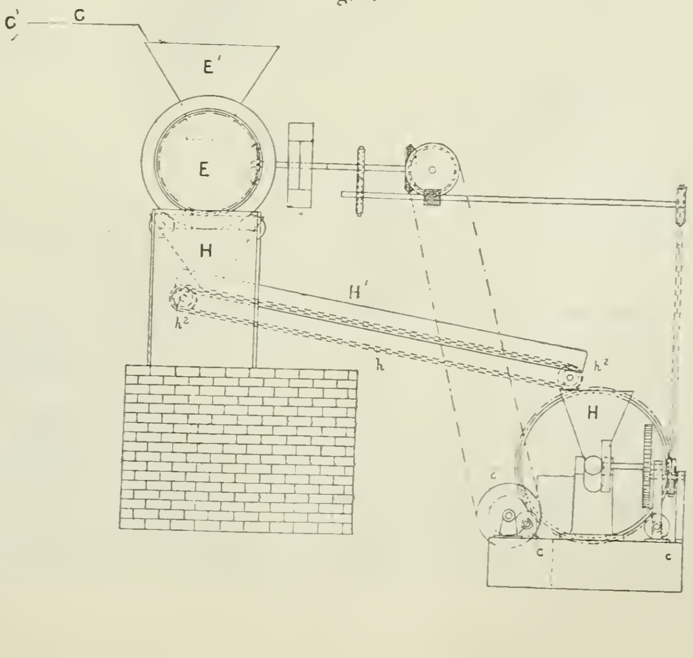


Fig. 3.

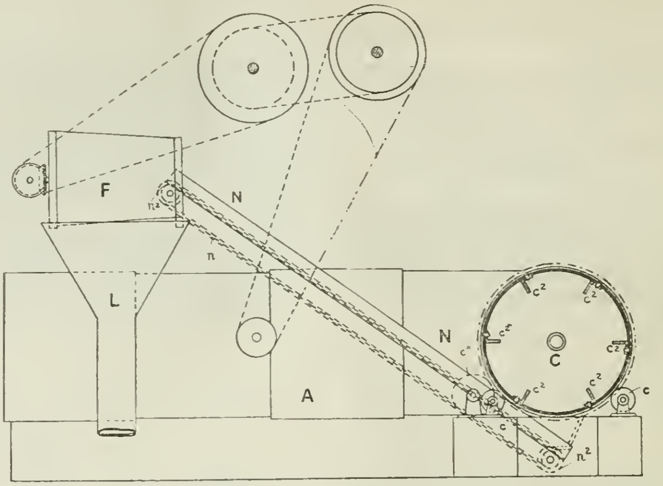


Fig. 4.

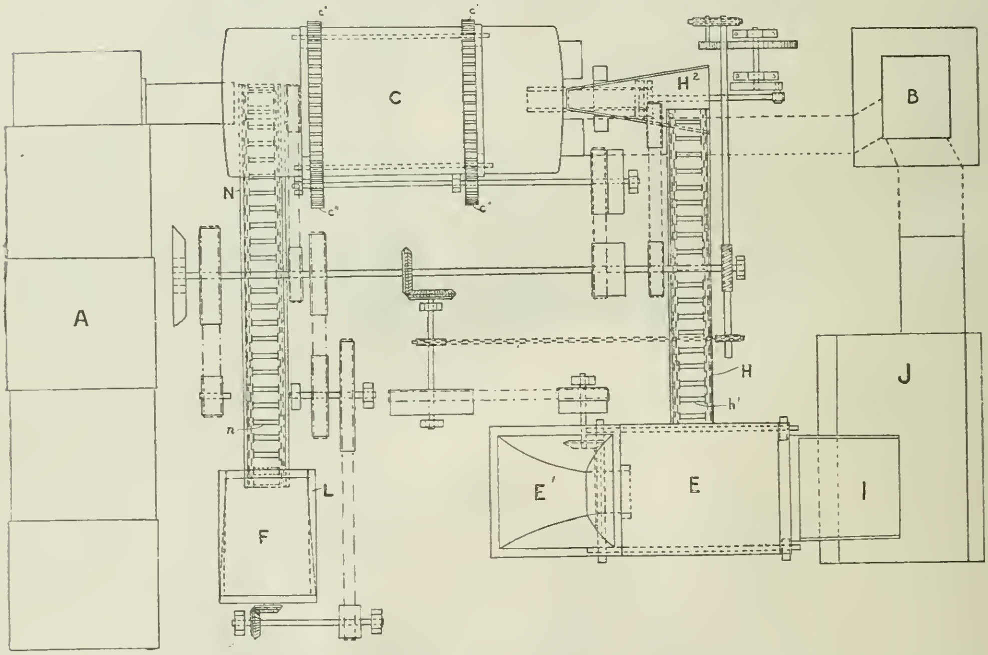
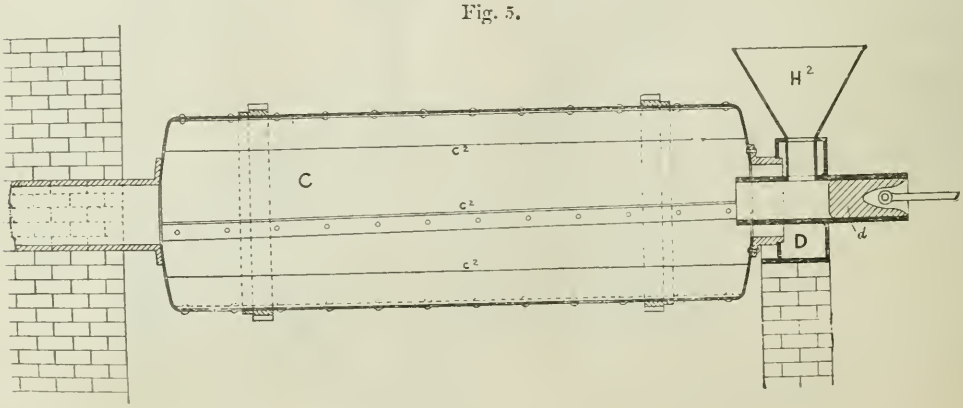


Fig. 5.



A is a Cornish or Lancashire boiler, shown in outline, of the usual construction and set in brickwork in the ordinary manner, so that its flue or flues may communicate either directly with the chimney B, when the plant is not in use, or the heated gases may be diverted by means of one or more dampers, so as to pass through the revolving drying cylinder C. This iron cylinder, resembling the shell of a Cornish boiler with the ends removed, is mounted on wheels or pulleys *c* carried on suitable foundations a little above the floor level, and caused to rotate by means of spur gearing c' c''. The cylinder is armed internally with six angular blades or shelves c^2. These blades or shelves extend the full length of the cylinder, and are fixed at a slight angle longitudinally (about 1 in 12). The box-like framework D at the end of the cylinder furthest from the boiler is made of metal. It communicates above with a hopper H^2, and at the end with a ram *d*, which is made to reciprocate for feeding the refuse into the cylinder. E and F are two revolving sieves or screens mounted in bearings upon suitable standards. The screen E, whose meshes are coarse (about 1½ in.), is mounted on an incline. The top of the hopper E′, which is attached to the screen E, is arranged below the level of a platform G.

This platform, which may be at a height of about 10 ft. from the ground, is approached by an incline G^1, in order that a cart may be drawn upon it, and its contents tipped direct into the hopper. The screen F is made to taper, and its meshes are much finer than those of the screen E. H^1 and N are elevator chutes, which consist of U-troughs with open tops, in which endless chains *h*, *n*, armed with scrapers h^1 n^1, are arranged to pass over the pulleys h^2 n^2 for preventing the material lodging in the chutes. J is a furnace, the flues of which are arranged to communicate with the chimney B.

The refuse is operated upon in the following manner:—The machinery being set in motion, the crude material is tipped from the platform G into the hopper E^1, from which it passes into the revolving inclined screen E. Tin cans, broken crockery, bottles, rags, paper, and other large and bulky material pass out at the lower end of the screen, down the chute I, to furnace J. The whole mass of coarse material is either burnt in this furnace or treated as will be subsequently described. The finer portion, constituting the bulk of the crude refuse, passes into hopper H, thence into elevator chute H^1, from which it is conveyed into hopper H^2 connected with the drying cylinder C. The material is then forced at regular intervals into the drying cylinder by means of the reciprocating motion of the ram or piston *d*. By means of the angle blades or shelves c^2 the refuse is carried up to near the top of the revolving cylinder, when it falls to the bottom, to be carried up again by the next advancing blade. At the same time the screw-like curvature of the blades causes the material to pass slowly forward towards the opposite end of the cylinder, when it falls out from ports (which open and shut automatically) into the elevator chute N. The refuse in the cylinder being continuously in motion offers a great surface to the hot flue gases passing through, and consequently the moisture which it contains is readily carried off. But the temperature is not sufficiently high to char the material or cause destructive distillation of any of its constituents. The elevator chute N conveys the dried refuse into the interior of the screen F at its smaller end. The finer portion passes through into hopper L, and may be collected in bags or any other convenient receptacle. The coarser portion passes out at the larger end of the screen, and, by means of a chute (not shown in the figures), is delivered in front of the boiler furnaces to be used as fuel.

[Samples of the two dried products (coarse and fine) were exhibited.]

We have now to bring before you the results of our experiments with town refuse and the analyses of the products obtained.

Several tons of refuse from Ravensthorpe (Yorkshire) were passed through the machine in August, but the quantities were not weighed. Samples taken from the coarse and fine portions respectively gave on analysis the following figures:—

TABLE VI.

——	Coarse.	Fine.
	Per Cent.	Per Cent.
Water	7·20	5·54
*Organic matter	45·91	24·78
Sand, silica, and insoluble silicates	28·47	38·38
Sulphuric acid (SO_3)	1·95	2·51
†Phosphoric acid (P_2O_5)	0·45	0·84
Oxide of iron and alumina	11·50	22·52
Lime	2·38	2·94
Magnesia	0·50	0·63
‡Potash	0·47	0·58
Soda, carbonic acid, &c. (by diff.)	1·17	1·29
	100·00	100·00
*Containing nitrogen	1·04	0·82
Equal to ammonia	1·27	1·00
†Equal to phosphate of lime	0·98	1·83
‡Equal to sulphate of potash	0·87	1·07
Calorific power of the dry samples:— Heat units (° C.)	2710	1312
Evaporative power from 100° C. at 100° C.	4·86	2·50

On the 26th Sept. 20 tons of Ravensthorpe refuse were passed through the apparatus, and the following quantities were obtained:—

TABLE VII.

——	Lb.	Per Cent.
Coarse portion (fuel)	15,456	34·50
Fine portion (manure)	11,536	25·75
Tin cans, pots, rags, &c.	1,680	3·75
Water evaporated in cylinder	16,128	36·00
	44,800	100·00

It will be seen in this case that about one-third of fuel and one-fourth of manure were obtained, whilst rather more than one-third of water was evaporated.

On analysis the coarse and fine portions respectively gave the following results:—

TABLE VIII.

——	Coarse.	Fine.
	Per Cent.	Per Cent.
Water	6·40	5·80
*Organic matter	42·91	29·08
Sand, silica, and insoluble silicates	23·55	35·27
Sulphuric acid (SO_3)	2·16	2·18
†Phosphoric acid (P_2O_5)	0·43	0·61

——	Coarse.	Fine.
Oxide of iron and alumina	13·75	21·55
Lime	1·56	2·43
Magnesia	0·50	0·58
‡Potash	0·40	0·49
Soda, carbonic acid, &c. (by diff.)	2·34	1·98
	100·00	100·00
*Containing nitrogen	0·84	0·90
Equal to ammonia	1·02	1·09
†Equal to phosphate of lime	0·84	1·33
‡Equal to sulphate of potash	0·74	0·90
Calorific power of the dry samples:— Heat units (°C)	24·43	19·33
Evaporative power from 100° C. at 100° C.	4·55	3·60

On the 3rd October the coarse portion (15,456 lb.) was burnt under two Lancashire boilers, which were fitted with steam jets to produce a forced draught. At each clearing out of the fires a little coal was thrown on to prevent the steam getting too low. The total amount of coal used in this way was 1,708 lb. The whole evaporated 40,684 lb. of water at an average steam pressure of 52 lb.; the temperature of the feed-water being 10° C. Seven hours were occupied in burning the material, during which time the steam worked a large engine used for grinding myrabolam mills, &c. In a subsequent experiment, 1,708 lb. of coal evaporated under the same conditions 11,648 lb. of water. Therefore the water evaporated by the prepared refuse alone amounted to 29,036 lb. This allowance for the coal is no doubt too high, since in all probability it did not perform so much work in conjunction with the refuse as when used alone. In the former case a considerable amount of heat is lost in the extra cleaning out of the fires which is involved. However, making the full allowance, 1 lb. of the prepared refuse evaporated 1·88 lb. of water from 10° C. at a pressure of 52 lb., equal to 2·23 lb. at 100° from 100°. Calculating on the dry material, this is equal to an evaporative power of 2·46 lb. So that 54 per cent. of the theoretical heating power, as found by the calorimeter, was directly utilised.

The clinker and ashes formed from the prepared refuse (15,456 lb.), allowing for the ash of the coal used, weighed 7,056 lb., equal to 45·65 per cent., or to 15·75 per cent. calculated on the gross weight of refuse treated.

On the 25th October, in conjunction with Mr. George Wilkinson, consulting engineer, we made a series of tests with a truck-load of refuse from Harrogate. The gross weight of material treated was 13,860 lb. It gave the following results:—

TABLE IX.

——	Lb.	Per Cent.
Coarse portion (fuel)	5,579	40·25
Fine portion (manure)	3,509	25·32
Rags, paper, &c.	784	5·65
Glass, pot, &c.	130	0·94
Iron, tin cans, &c.	15	0·11
Water evaporated in cylinder	3,843	27·73
	13,860	100·00

Simultaneously with the drying of this refuse, the coarse portion (5,555 lb.) was burnt under a Lancashire boiler, the waste gases of which furnished the heat for drying. No other fuel was used, and in order to provide a sufficient supply for the boiler the material had to be fed into the machine more quickly than it could be thoroughly dried, as will be seen from the analysis given below. Previous to commencing this test, refuse only (of a similar character) had been used for firing the boiler for some hours. The 5,555 lb. of prepared refuse evaporated 14,241 lb. of water from a temperature of 10° C. at a steam pressure of 57 lb. One pound therefore evaporated 2·57 lb. of water, equal to 3·06 lb. at 100°, from 100°. Calculating on the dry material this is equivalent to an evaporative power of 3·96 lb., or 72 per cent. of the theoretical heating power shown by the calorimeter. The operation lasted $5\frac{1}{2}$ hours, during which time the steam worked several small engines and was also used for heating purposes in the chemical works. Taking 20 lb. of steam as the weight of steam consumed for the work done in an engine cylinder per horse-power per hour, the steam produced by the combustion of of the prepared refuse may be represented as equivalent to 130 horse-power.

In addition to the work done in the boiler, we should also take into consideration that the waste gases of the furnace further evaporated 3,843 lb. of water in the revolving cylinder. Calculated on the dry fuel, this is equal to 0·84 lb. per lb., which brings the total amount of water evaporated in the boiler and in the revolving flue to 4·8 lb. per lb. of dry prepared refuse burnt.

The mean temperature of the flue gases before passing into the revolving drying cylinder was 229° C. After passing through the cylinder the temperature was reduced to 139° C. The clinker and ashes formed from the burning of this refuse weighed 1,988 lb., equal to 35·78 per cent., or to 14·40 per cent., calculated on the gross weight of refuse treated.

An analysis of the coarse and fine portions, respectively, of the Harrogate refuse gave the following results:—

TABLE X.

——	Coarse.	Fine.
	Per Cent.	Per Cent.
Water	18·20	15·96
*Organic matter	42·56	25·67
Sand, silica, and insoluble silicates	22·25	34·46
Sulphuric acid (SO_3)	2·19	2·65
†Phosphoric acid (P_2O_5)	·42	·64
Oxide of iron and alumina	8·15	14·86
Lime	3·80	3·90
Magnesia	·60	·50
‡Potash	·29	·38
Soda, carbonic acid, &c. (by diff.)	1·54	·98
	100·00	100·00
*Containing nitrogen	·63	·57
Equal to ammonia	·77	·69
†Equal to phosphate of lime	·91	1·39
‡Equal to sulphate of potash	·53	·72
Calorific power of the dry samples:— Heat units (°C)	2953	1880
Evaporative power from 100° at 100° C.	5·50	3·50

On the 30th October another truck load of refuse from Harrogate was treated. The gross weight was 8 tons 13 cwts. and 2 qrs. It gave the following results:—

TABLE XI.

——	Lb.	Per Cent.
Coarse portion (fuel)	6,738	34·67
Fine portion (manure)	5,340	27·48
Rags, paper, &c.	1,120	5·76
Glass, pot, &c.	112	0·57
Iron, tin cans, &c.	28	0·14
Bones	26	0·13
Water evaporated in cylinder	6,068	31·25
	19,432	100·00

The following figures represent the composition of the coarse and fine portions respectively:—

TABLE XII.

——	Coarse.	Fine.
	Per Cent.	Per Cent.
Water	12·35	7·70
*Organic matter	47·36	22·66
Sand, silica, and insoluble silicates	22·37	47·04
Sulphuric acid (SO_3)	2·08	2·32
†Phosphoric acid (P_2O_5)	0·43	0·48
Oxide of iron and alumina	9·15	12·50
Lime	2·44	3·86
Magnesia	0·83	1·06
‡Potash	0·34	0·39
Soda, carbonic acid, &c. (by diff.)	2·65	1·99
	100·00	100·00
*Containing nitrogen	0·65	0·52
Equal to ammonia	0·79	0·64
†Equal to phosphate of lime	0·94	1·05
‡Equal to sulphate of potash	0·63	0·72
Calorific power of the dry samples:— Heat units (°C)	3,007	1,557
Evaporative power from 100° C. at 100° C.	5·60	2·90

Part of the coarse portion (6,082 lb.) was burnt under a boiler at Halifax, and evaporated 17,410 lb. of water from a temperature of 7° C. at a steam pressure of 48 lb. 1 lb. of the prepared refuse therefore evaporated 2·86 lb. of water, equal to 3·41 lb. from 100° C. at 100° C. Calculating as before on the dry material, the evaporative power was 4·04; 72 per cent. of the total heating power of the fuel was therefore utilised. This figure, curiously enough, is exactly the same as that obtained in burning the fuel at Ravensthorpe.

The clinker and ashes in this experiment weighed 2,060 lb., corresponding to 33·87 per cent., equal to 11·74 per cent. of the gross weight of refuse operated upon.

It will be observed in all these cases that the percentage of clinker and ashes is somewhat less than the percentage of mineral matter shown in the analysis of the samples. The difference is no doubt accounted for by a portion of the mineral matter passing forward into the flues as flue-dust.

As the Ravensthorpe refuse burnt on the 3rd October gave so much lower results than the Harrogate refuse, and the experiment was, moreover, complicated by the use of coal, it was decided to make a further test, using the prepared refuse only. Accordingly on the 25th November, 3 tons of refuse were burnt under a Lancashire boiler as before. The water evaporated at a steam pressure of 50 lb. amounted to 7 tons 1 cwt. 3 qrs. (15,876 lb.); the temperature of the feed water was 9° C. One pound of refuse evaporated, therefore, under these conditions, 2·36 lb. of water, equal to 2·81 lb. from 100° C. at 100° C. The prepared refuse contained 10 per cent. of water, consequently the dry material possessed an evaporative power of 3·23, equal to 70 per cent. of the total heating power shown by the calorimeter.

The 3 tons of refuse occupied five hours in burning, so that 3,175 lb. of water were evaporated per hour, corresponding to a horse-power of 158.

These several experiments undoubtedly show that town refuse contains a very considerable quantity of combustible matter which, by proper treatment may be rendered available for the production of steam with great facility. The power thus obtained could be utilised by town authorities in various ways, but no doubt the most important application would be the working of dynamos for electric lighting. The electric light is admittedly the light of the near future, and every town and village in the country has within its reach a store of fuel in its refuse, which would go a long way towards furnishing the necessary power. Let us see what could probably be done with the refuse of a city like Leeds, which furnishes about 130,000 tons per annum. The mean results of our experiments on the large scale show the prepared refuse (coarse portion) to have an evaporative power of 2·88 lb. per lb. One pound of the crude refuse, therefore, as it is taken from the ash-pits is capable of evaporating 1·05 lb. of water. This figure, of course, leaves out of consideration the fine portion (about 25 per cent.) which also has a considerable heating value. The refuse of Leeds—say 360 tons per day—presuming it to have a composition similar to that of the refuse already treated, should be capable of evaporating 378 tons of water in 24 hours, or 35,280 lb. per hour. Taking 20 lb. of steam per horse-power, we obtain an amount of steam equivalent to 1,764 horse-power continuously. Looking at the matter from another point of view, the 130,000 tons of refuse should produce as much steam as 17,000 tons of good average coal. In like manner the refuse from Bradford (about 70,000 tons) should produce steam equivalent to a continuous horse-power of 948. We should point out that in firing with this prepared refuse, on account of the high percentage of mineral matter present, steam is not raised so quickly as with a corresponding quantity of coal. Consequently, more boiler space is required to produce a given quantity of steam. Probably three boilers fired with the refuse would produce about the same amount of steam as two fired with coal, but this must only be taken as a rough estimate. More work would no doubt be done by having the boiler furnaces fitted with moveable grate-bars so as to avoid the frequent cleaning out of the clinker.

If we compare the work done by the refuse in the apparatus described with that obtained in destructors we shall observe a striking difference. As a mean of four experiments, we have obtained rather more than 1 lb. of water evaporated per lb. of crude refuse without taking the fine portion into consideration. In destructors where the whole mass is burnt the amount of refuse consumed per lb. of water evaporated varies from 3·3 at Oldham (which is exceptionally good) to 9·7 at Eastbourne. Taking the mean results of six towns we find that about 6½ lb. of refuse are required to evaporate 1 lb. of water.

Regarding the value of the fine portion as manure, the only constituents which we need consider are nitrogen, phosphoric acid, and potash. On reference to the tables of analysis, it will be observed that the refuse from Ravensthorpe (which is a "midden" town) is considerably richer than that from Harrogate, where the water-carriage system is principally in vogue. Taking the mean of the two series of analyses we obtain the following figures :—

—	Fine Portion from Ravensthorpe Refuse.	Fine Portion from Harrogate Refuse.
	Per cent.	Per cent.
Phosphoric acid	0·72	0·56
Potash	0·53	0·38
Nitrogen as ammonia	1·04	0·66

Calculated on the basis previously given, the fine portion from Ravensthorpe has a theoretical fertilising value of 14*s.* 1*d.* per ton, and that from Harrogate of 9*s.* 2*d.* per ton. The nitrogen is the most important constituent; it exists principally as organic nitrogen, only a comparatively small percentage being present as salts of ammonia. A sample of the fine portion from Ravensthorpe, which gave 1·09 per cent. of ammonia by the soda-lime process, yielded only 0·21 per cent. on treatment with a boiling solution of caustic soda. A corresponding sample from the Harrogate refuse, which contained 0·69 per cent. total nitrogen, as ammonia gave only 0·08 per cent. of ammonia on boiling with a solution of caustic soda. It might be expected that in passing through the drying cylinder, a considerable proportion of ammonia would be carried away by the hot flue gases, but this does not appear to be the case if the machine is fed so that the material is not thoroughly dried. Ravensthorpe refuse was passed through the machine at different velocities, so that in one case the fine portion contained 5 per cent. of water and in the other 15 per cent. The nitrogen was estimated in both samples, but the difference was found to be inappreciable. A weighed portion of the sample containing 15 per cent. of water was dried for a period of two hours in an air-bath at a temperature of 120° C., and then tested for ammonia. It was found that under these conditions the sample had lost one-tenth per cent. of ammonia. In order to test the effect of drying further, a large sample of the crude refuse was ground up and the ammonia estimated in it. The total nitrogen by soda-lime was found to be 0·89 per cent. as ammonia, whilst 0·18 per cent. of ammonia (present as ammonium salts) was obtained. Weighed portions dried at 110° C. for an hour, afterwards yielded on analysis 0·81 per cent. of ammonia by soda-lime and 0·08 per cent. of ammonia by boiling with caustic soda. The sample of crude refuse contained 23 per cent. of water.

No doubt the sulphurous gases from the furnace tend in some degree to fix any free ammonia which may be present. However, in certain cases where the refuse to be treated contains much night soil, it would probably be found advantageous to mix it with a small proportion of sulphuric acid before drying it.

The percentage of ammonia (1·04) in the dried refuse of a "midden town" may appear to be rather low, but it should be observed that the material only contains 27 per cent. of organic matter, and some of this will consist of coke and unburnt coal. Calculated on the organic matter present, the percentage of ammonia is 3·88, rather more than half the amount found by Way in dry *fæces*. If the portions of the crude refuse, consisting principally of night soil, were treated separately, the manurial value of the product would be very greatly enhanced. In water-closet towns, where the fine powder has little manurial value, it might, with special arrangements, be used for heating purposes, since its calorific power is not inconsiderable. On the other hand, in agricultural districts, where steam may not be much required, the coarse portion (or part of it), together with the fine, might be ground up for manure. Its fertilising value deduced from its chemical composition is about the same as that of the fine portion, but in practice it would probably be found less valuable. Although the average percentage of ammonia found in the coarse portion is rather higher than that in the fine, if calculated on the organic matter present it is considerably less, viz., 2·5 per cent.

With regard to the disposal of the rags, paper, metal, glass, &c., collected in the rough revolving cage, amounting to about 6 per cent. of the crude refuse, we need say but little. They could, if desired, be destroyed in a small furnace, but a better method would be to wash the whole with a stream of water in a revolving cage. The recovery of the rags and other fibrous material would more than repay the cost of the operation, and the paper would be washed away in the form of pulp. The old iron and tin cans could be dissolved in crude oil of vitriol and converted into "copperas." In this way not only is an unsightly mass of rubbish got rid of, but a useful compound is formed which can be employed as a disinfectant, or in the sewage works of a town.

One word more as regards the manure. It has already been applied to grass and to garden produce, with such results as to show that the value we have placed upon it is by no means a fictitious one. Next year, however, we hope to make careful experiments upon various crops, comparing the prepared manure with several well-known fertilisers.

Discussion.

Mr. A. H. **Allen** said that the paper was a thoughtful and interesting one, but the numerous statistics could scarcely be grasped in an evening, and criticism was therefore difficult. As to the problem of the disposal of town refuse, chemists had had their try at it in times past and had failed, and since then it had been left to the engineers, and the only chemical process really much used was treatment with lime. A series of experiments had, indeed, been made recently at Salford with liquid sewage, but whatever results had been obtained, it appeared that the experiments were about to be recommenced. Destructors might be satisfactory to engineers, but they certainly were not to chemists; a chemist required utilisation, not mere destruction of the town refuse. The problem was not hopeless, for he remembered that a process, described by Mr. C. G. Moore, at the Cardiff meeting of the British Association, had been tried on the large scale, and only failed through certain mechanical difficulties that were probably not insuperable. Mr. Moore had found that the lime sludge derived from the treatment of sewage with lime contained enough organic matter to make it combustible, and that under the influence of the lime present, much ammonia was produced in this combustion.

But, although the prospect was hopeful, he thought the authors of the paper too sanguine in expecting to light towns electrically by means of the refuse. In any case, the subject was well worthy of the careful attention they had given it.

Dr. J. **Lewkowitsch** said that chemists over-estimated the possibility of utilising town refuse; disposal was the first and pressing question, utilisation only of secondary importance. Æsthetic considerations, too, were concerned, and he did not believe that any consideration of the possible utility of human excrement would induce a civilised nation to give up the convenience of its water-closets. As for the much-vaunted superiority of China and Japan in their utilisation of town refuse, that had been Liebig's pet idea, but it must be considered as exploded since we had ammonia and nitrate phosphates, Thomas meal, and potassium salts at reasonable figures supplied to us. Certainly it was more than irony of fate that Holrecht, the designer of the Berlin sewage irrigation works, had been invited to Japan to superintend similar works there. The whole question of disposal of refuse, &c. was, therefore, one of cost. The value ascribed to the products obtained from town refuse was, in his opinion, purely fictitious; these products could all be obtained better and cheaper from other sources. The value of the "manure," for example, would be nil; no farmer would buy it at the price which the cost of transport would necessitate. The evaporating power of the "fuel" obtained was also very small; if steam was wanted it would be much cheaper to buy coal. To ascribe value to all these products seemed to him very much like that proceeding so common in calculations of "costs of the process," which usually conclude their list of the supposed sources of profit with

"Recovery of the calcium sulphate, or refuse, for making cement." He would, therefore, like to know the actual cost of the author's process. The above criticisms seemed to him well founded, but he wished the authors, nevertheless, that he might be driven, by the successful working of their process, to withdraw them at a subsequent meeting.

Mr. H. R. Procter thought that the temperature in the flue was not high enough to deodorise the gases, although it might probably sterilise.

Mr. G. W. Slatter said that the analysis of its refuse seemed to show that Ravensthorpe was in that respect richer than other towns; it was certainly richer in possessing the inventor of the apparatus described that evening. That apparatus was, in spite of what had been said, vastly better than the ordinary destructor, as much better as was a modern rifle than an old flint-lock. For the destructor destroyed everything, a little heat being alone gained, whereas Mr. Smithson's apparatus undoubtedly produced plant foods of great value, if the analyses that had been given could be trusted, as he knew they could, having regard to the well-known skill of the person who executed them. He then proceeded to show, from principles familiar to all botanists, that the "manure" contained just those constituents which plants need, but are unable to assimilate, except from the soil. Referring to the heat-producing power of the substances prepared by the machine, the speaker said it seemed only reasonable to expect that mankind would soon be able to get the electric light from matter he had hitherto despised and thrown away.

Mr. J. E. Stead said that the question discussed that evening was one that pressed for solution, and he was glad to see that men of such talent as the authors of the paper devoting their best energies to the task. He was of opinion that the value of the "manure" was over-estimated; some of the phosphoric acid, and probably also of the potash, would be present in a not very soluble form, as a part of the nitrogen would be combined in the coke or coal present, and would not be readily assimilated. Mr. Rawson had spoken of "free" ammonia instead of "combined"; it was doubtless a slip, but one that might be misleading to laymen.

Mr. R. C. Forster asked what was the temperature of the gases in the cylinder, and whether it was higher with a forced draught?

Mr. H. Broadbent said that the paper dealt with a most important subject, and he was sorry that neither the medical officer of health nor any member of the city sanitary committee was present. The criticism of the paper had been distinctly discouraging, but he hoped the authors would persevere with their experiments. He would like to have a detailed analysis of the refuse before treatment, in order to see the effect of the apparatus in drying it; he was of opinion that the refuse would prove valuable if it could be dried cheaply.

Mr. Rawson, in reply, drew attention to the fact that he had already stated that the prime necessity was to dispose of the refuse without creating a nuisance, but contended that it was, nevertheless, important to make as much use as possible of the valuable constituents present. He had distinctly stated that he had not the slightest intention of advocating Chinese methods, but had alluded to them merely to prove, what farmers often deny, that town refuse has a high manurial value. The value he had placed upon the manure was that calculated from its chemical composition; no doubt the market value, as is usually the case with manures of comparatively low quality, would be less. It was a matter for experiment. The phosphoric acid and potash, especially the former, were very probably present in the manure in a somewhat insoluble form, but the nitrogen was much the most important constituent present. It had been pointed out that the nitrogen was probably combined, as in coal or coke, and therefore could have little fertilising value. This, however, could not be the case, since the percentage of nitrogen calculated on the organic matter rose to about 4, whereas in coal and coke it is very much less than that figure. He was unable to enter into details regarding the cost of the apparatus, but it would be very small indeed in comparison with destructors. The extra cost in labour involved in firing the boilers (as compared with coal) would be far more than compensated by the value of the steam obtained. The experiments which had been made were not merely laboratory experiments. Hundreds of tons of refuse had been treated, and for several weeks large engines had been constantly kept running from the burning of the "fuel" obtained. The heating value of the "fuel," as shown by the figures submitted, was equivalent to one-third to one-half of that of good average coal. It was never intended that the fuel should be sold to manufacturers and other users of steam in place of coal. There was sufficient use for the material as fuel wherever the refuse had to be treated. The temperature of the flue gases in drying the refuse was high enough to prevent any odour being noticeable in the neighbourhood; in one experiment, extending over six hours, the mean temperature of the gases on entering the cylinder was 229° C, and on leaving it at 129° C. The effect of a forced draught was not known, for a forced draught had been used in all the experiments. The crude refuse had not been analysed, except to determine the total nitrogen and the nitrogen present as ammonia.

Glasgow and Scottish Section.

Chairman: C. A. Fawsitt.
Vice-Chairman: E. J. Mills.
Committee:
G. Beilby.
W. J. Chrystal.
J. Clark.
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R. A. Inglis.
R. Irvine.
J. Falconer King.
W. I. Macadam.
J. S. Macarthur.
T. L. Patterson.
J. Pattison.
J. B. Readman.
E. C. C. Stanford.
D. R. Steuart.
R. R. Tatlock.
Hon. Secretary and Treasurer:
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

Members who desire to read Papers, exhibit Apparatus, &c., or introduce Discussions during Session 1893—94 are requested to give early notice to the Hon Local Secretary in order that the programme may be arranged.

SESSION 1893-94.

Glasgow:—
January 9th.—Discussion on the State of the Patent Law.
March 6th:—
Mr. James F. Tocher. "Oil Gas."
Prof. E. J. Mills and Mr. W. Macfarlane. "On the Oxidation of Aniline."
May 1st.—Prof. E. J. Mills and Mr. Saweis. "On the Action of Alums on Gelatin.

Edinburgh:—
February 6th.—Vacant.
April 3rd.—Vacant.

Meeting held Tuesday, December 5th, in the Philosophical Institution, 4, Queen Street, Edinburgh.

MR. E. C. C. STANFORD IN THE CHAIR.

MOISTURE IN PAPER PULPS.

BY J. B. READMAN, D.SC., F.R.S.E., AND
G. H. GEMMELL, F.I.C., F.C.S.

There has been in the past so many different opinions as to the quantity of atmospheric moisture contained in the various pulps used in the manufacture of paper, and as a consequence, disputes have frequently occurred. We thought it might not be uninteresting to certain members of this Society to have the results of a series of experiments on a variety of pulps given in detail. If by so doing we contribute in any way to a better understanding of the matter, our work will not have been in vain.

The experiments were carried on during the last six or seven weeks, and we operated upon 14 different samples of pulp, many of which are lying on the table. The pulps used were—

1. Swedish sulphite wood pulp.
2. Swedish sulphate wood pulp.
3. Swedish soda wood pulp, unbleached.
4. German sulphite wood pulp.
5. Mechanical wood pulp, cold process.
6. Mechanical wood pulp, hot process.
7. German sulphate straw pulp, bleached.
8. Swedish sulphite wood pulp, bleached.

Before we received the above samples they had all been lying for some time in an office in Edinburgh, and when they were handed to us on the 18th October last, they were in a comparatively dry condition.

9. Swedish sulphite wood pulp (another sample). Was received on the 26th October in a wet condition, and was allowed to dry spread out on a table in the laboratory for 24 hours, and was then treated along with the other samples.

10. Swedish sulphite wood pulp.
11. German sulphite wood pulp.

Had been in the laboratory some time; they had been sent as samples for moisture estimation, and had in consequence been at one time made bone dry and had also been torn to small pieces.

12. Swedish sulphite wood pulp (bleached).
13. Norwegian sulphite wood pulp (unbleached).
14. Norwegian mechanical wood pulp (cold process).

These three pulps were weighed when received, and were at once put into a steam steriliser until thoroughly saturated. They had originally been wet samples.

From the 18th to the 23rd October the windows of the room where the pulps were placed were open, but as the increase in the weights was so slight, the windows were closed, and on the 24th to 27th a pan of water was kept boiling in the centre of the room in order to saturate the atmosphere with moisture. All the samples gained considerably in weight. After this, on the 28th October, they were placed in a steam steriliser, and steamed for three hours; then they were allowed to cool, and weighed rapidly. The weight now we assumed to be the maximum that could be obtained by pulps in an atmosphere highly charged with moisture. To confirm this, three of the samples were steamed a second time for three hours, but they did not materially increase in weight.

All the pulps were again exposed in the room with windows open, and weighed at intervals on the dates given in the table.

In all cases the pulps were exposed to the air standing on their edges so as to present as large a drying surface as possible.

On the 6th and 7th November the pulps were exposed for 24 hours in a warm room with much moisture present and on the 8th November all the samples were made bone-dry. Their weights were ascertained and the samples were again exposed to atmospheric influence in the ordinary temperature of a room for three weeks.

With only four days' exposure (after being made bone-dry) to the ordinary temperature of a room in the month of November almost all the pulps had absorbed the maximum amount of atmospheric moisture they are capable of taking up, under normal conditions, from the air of a room, the temperature of which varies from 38° during the night to 60° during the day, and generally the the result of the investigation goes to show that, with the exception of the mechanical wood pulp, which absorbed from 10·03 per cent. to 11·58 per cent. of moisture, nearly all the other pulps absorbed less than 10 per cent. From this it is evident that for sulphite, sulphate, and soda wood pulps, and also for straw pulps, atmospheric moisture may fairly be reckoned at 10 per cent., which is a limit over, rather than under, what they may be expected to absorb.

It is usual for the paper manufacturers of this country to receive from the pulp-makers abroad wood pulps containing from 50 per cent. to 60 per cent. of total moisture, and the custom of the trade is to base the price on what is known as "50 per cent. air-dried pulp." The amount of moisture air-dried pulp is further assumed to contain varies from 10 per cent. to 12 per cent., depending on the terms arranged between buyer and seller, but this matter often gives rise to much difference of opinion and is the source of a good deal of misunderstanding. Would it not be more accurate, much more satisfactory, and be less liable to dispute if the price of all pulps was based on the *absolutely* dry substance? If such a basis as this was adopted it appears to us that all possible differences of opinion would vanish; assuming, of course, that the sample selected for the moisture estimation was a true and genuine representative of the bulk as received by the paper manufacturer.

Take one example: Suppose 20*l.* per ton was the price agreed upon for *absolutely* dry pulp, and that the latter, after careful sampling and estimating the moisture, was found to contain:—

	Per Cent.
Dry pulp	40
Moisture	60
	100

By simple rule of three the price would come out at 8*l.* per ton. At present the system adopted is (as those engaged in the industry are well aware) much more complicated. One example will make this apparent. If the price arranged for pulp, containing 50 per cent. of air-dried pulp, is, say, 10*l.* per ton, and if it is further agreed that air-dried pulp shall be assumed to contain 10 per cent. of moisture, we have the following calculations to make, after ascertaining the total moisture, thus:—

	Per Cent.
Dry pulp (as above)	40
Moisture	60
	100

Assuming air-dried pulp contains 10 per cent. moisture, the above result is expressed as under:—

	Per Cent.
Air-dried pulp	44·44
Moisture	55·56
	100·00

The price fixed was 10*l.* per ton for 50 per cent. air-dried, and as the analysis shows only 44·44 per cent., the price is proportionately less, or 8*l.* 17*s.* 7*d.* per ton.

You will observe on the table on which our results are recorded, that we took the readings on a dry and wet bulb hygrometer, the former, *i.e.* the dry bulb thermometer, gives the temperature of the air; the other gives a reading several degrees below the air temperature, but when air is saturated the readings are alike.

The dew point was obtained from Glaiser's formula.

As the sampling of the pulp to get a genuine specimen of what accurately represents the bulk lying at the mills of the paper manufacturer, is a somewhat difficult matter, and as inaccurate results are very likely to result if the pieces selected for moisture estimation are much handled or exposed even for a short time to atmospheric influences, we have now adopted the system of taking large samples, placing them, immediately they are removed from the bales and without tearing up to small pieces, in a tared copper cylinder, which is closed with an air-tight lid. On reaching the laboratory the gross weight of the cylinder is accurately taken, and the entire sample is dried in a large water-oven constructed for the purpose.

Lately, the disputes that have arisen in regard to the moisture allowance in air-dried pulp have caused the Norwegian and Swedish Cellulose Pulp Association to fix upon 12 per cent., that is, that 100 kilos. of air-dry cellulose shall contain 88 kilos. absolutely dry pulp and 12 kilos. water (see Chem. Tr. J., 22nd July 1893, 51). May we

Date when Weighed, &c.	Condition of some of the Samples as Received, and Treatment.	Temperature on Dry Bulb, Wet Bulb, when Pulps were Weighed.		Dew Point.	Relative Humidity Dry Air Saturated = 100°.	Grains of Water Per Cubic Foot of Air.	I. Swedish Sulphite Wood Pulp.		II. Swedish Sulphate Wood Pulp.		III. Swedish Soda Wood Pulp (Unbleached).		IV. German Sulphite Wood Pulp.		V. Mechanical Wood Pulp (Cold Process).		VI. Mechanical Wood Pulp (Hot Process).	
		°	°	°	°		Grains.	Moist. °	Grains.	Moist. °	Grains.	Moist. °	Grains.	Moist. °	Grains.	Moist. °	Grains.	Moist. °
1893. Oct. 18	The eight samples had been kept in stock and were tolerably dry, they were at once exposed in the laboratory along with the rest as they arrived. Windows open until 23rd, windows closed and a pan of water was kept boiling in room to saturate the atmosphere from 24th to 27°.	..	..	..	..	..	2,301	8·12	1,642	7·8	396	7·8	2,127	7·9	3,261	9·54	459	10·0
„ 19		58	..	..	..	..	2,327	9·16	1,656	8·58	400	8·75	2,152	8·97	3,303	10·69	463	10·80
„ 20		57	54	51	81·3	3·83	2,331	9·31	1,658	8·69	400	8·75	2,157	9·18	3,309	10·85	464	10·99
„ 23		53	49	45	75·6	3·23	2,332	9·35	1,657	8·64	400	8·75	2,159	9·27	3,312	10·93	465	11·09
„ 24	„ „ „	57	54	51	81·3	4·15	2,351	10·09	1,670	9·31	403	10·10	2,175	9·93	3,341	11·71	466	11·38
„ 25	„ „ „	51	48	45	81·1	3·46	2,353	10·16	1,670	9·34	404	9·66	2,180	10·14	3,338	11·63	466	11·38
„ 26	„ „ „	59	59	59	100	5·73	2,370	10·81	1,704	11·16	411	11·84	2,222	11·84	3,360	12·21	467	11·57
„ 27	„ „ ..	61	61	61	100	5·97	2,480	14·76	1,760	13·95	434	17·75	2,312	15·27	3,530	16·41	494	16·40
„ 28	*All samples placed in a steam sterilizer for three hours.*	*Maximum Moisture.*					2,710	*22·00*	1,828	*17·48*	452	*19·25*	2,664	*26·47*	4,544	*35·08*	522	*20·88*
„ 30	All samples exposed in room with windows open.	47	44	40·5	77·5	2·86	2,491	15·24	1,786	15·23	432	15·51	2,326	15·78	4,063	26·31	492	16·06
„ 31	.. ..	48	45	41·5	77·7	2·97	2,404	12·07	1,693	10·58	411	11·19	2,250	12·94	3,921	24·77	480	13·96
Nov. 2	.. ..	46	43	39·5	78·6	2·80	2,386	11·10	1,688	10·31	410	10·98	2,196	10·79	3,416	13·65	477	13·42
„ 3	.. ..	46	44	42	86·5	3·08	2,382	11·26	1,686	10·21	411	11·19	2,192	10·63	3,396	13·14	477	13·42
„ 4	.. ..	44	39	33	67·1	2·23	2,359	10·39	1,677	9·67	408	10·54	2,176	9·98	3,373	12·55	474	12·87
„ 6	Exposed for 24 hours in room with much moisture.	46	42	37·5	73·0	2·60	2,358	10·35	1,674	9·56	408	10·54	2,173	9·85	3,368	12·37	474	12·87
„ 7	„ „ „	59	57	55	87·2	4·87	2,424	12·79	1,700	10·95	410	10·98	2,212	11·44	3,407	13·42	480	13·96
„ 8	*All samples made bone dry and weighed...*	*Anhydrous Pulp.*					2,114	*None*	1,514	*None*	365	*None*	1,959	*None*	2,950	*None*	415	*None*
„ 9	Exposed again to air of laboratory	60	56	53·5	78·8	4·55	2,312	8·57	1,644	7·91	400	8·75	2,131	8·08	3,266	9·68	454	9·04
„ 10	.. ..	51	48	45·0	81·1	3·44	2,331	9·31	1,656	8·58	404	9·66	2,149	8·85	3,295	10·47	457	9·63
„ 13	*At this date nearly all the pulps had taken up their maximum amount of moisture.	49	46	43·0	80·8	3·20	2,332	9·35*	1,657	8·63*	404	9·66*	2,150	8·89*	3,300	10·61*	458	9·83*
„ 15	.. ..	50	47	44	80·9	3·32	2,331	9·31	1,657	8·63	404	9·66	2,149	8·85	3,300	10·61	459	10·03*
„ 17	.. ..	60	55	50·5	71	4·10	2,308	8·41	1,643	7·81	401	8·98	2,130	8·03	3,268	9·73	455	9·23
„ 20	.. ..	45	43	41·5	86·3	2·97	2,332	9·35	1,655	8·52	404	9·66	2,149	8·84	3,298	10·56	458	9·83
„ 22	.. ..	42	39	35·3	77·8	2·40	2,332	9·35	1,655	8·52	404	9·66	2,147	8·76	3,301	10·64	459	10·03
„ 24	Removed on this date and kept till 29th in a damp room, the weather being very damp at the time.	55	50	45·2	70·7	3·46	2,318	8·81	1,642	7·80	400	8·75	2,137	8·33	3,276	9·96	456	9·13
„ 29	.. ..	53	50	47·0	81·1	3·69	2,352	10·12	1,669	9·29	407	10·32	2,168	9·64	3,332	11·17	463	10·80

Date when Weighed, &c.	Condition of some of the Samples as Received, and Treatment.	VII. German Sulphate Straw Pulp (Bleached).		VIII. Swedish Sulphite Wood Pulp (Bleached).		IX. Swedish Sulphite Wood Pulp.		X. Swedish Sulphite Wood Pulp.		XI. German Sulphite Wood Pulp.		XII. Swedish Sulphite Wood Pulp (Bleached).		XIII. Norwegian Sulphite Wood Pulp (Unbleached).		XIV. Norwegian Mechanical Wood Pulp (Cold Process).	
		Grains.	% Moist.	Grains.	% Moist.	Grains.	% Moist.	Grains.	% Moist.	Grains.	%	Grains.	%	Grains.	%	Grains.	%
1893. Oct. 18	The eight samples had been kept in stock and were tolerably dry, they were at once exposed in the laboratory along with the rest as they arrived. Windows open until 23rd. Windows closed and a pan of water was kept boiling in room to saturate the atmosphere from 24th to 27°.	1,523	9·3	2,064	8·87	..	..	..	..	..	..	..	..	..	..	..	..
„ 19		1,531	9·8	2,072	9·17	..	..	..	..	..	..	..	..	..	..	..	..
„ 20		1,532	9·86	2,074	9·26	..	..	..	..	..	..	..	..	..	..	..	..
„ 23		1,532	9·86	2,075	9·30	..	..	..	..	..	..	..	..	..	..	..	..
„ 24	„ „ „	1,542	10·45	2,087	9·83	..	..	..	..	.	..	..	..	..	..	..	..
„ 25	„ „ „	1,543	10·50	2,089	9·91	..	..	..	..	..	..	..	..	..	..	..	..
„ 26	„ „ „	1,554	11·14	2,100	10·38	3,390	57·85†	1,500	11·2	1,500	9·46	..	..	..	..	..	..
„ 27	„ „ „	1,628	15·18	2,156	12·71	1,844	21·43	1,566	14·9	1,548	12·2	1,914	9·1	1,862	10·53	1,252	12·15
„ 28	*All samples placed in a steam sterilizer for three hours.*	1,714	*24·43*	2,243	*16·1*	1,942	*26·42*	1,568	*15·05*	1,668	*18·5*	2,020	*13·6*	1,960	*15·00*	1,530	*28·11*
„ 30	All samples exposed in room with windows open.	1,616	18·45	2,198	14·38	1,778	19·63	1,546	13·8	1,587	15·06	1,984	12·3	1,917	13·10	1,352	18·64
„ 31	.. ..	1,587	12·99	2,154	12·63	1,661	13·97	1,537	13·3	1,552	12·5	1,965	11·5	1,897	12·18	1,317	16·48
Nov. 2	.. ..	1,566	11·82	2,130	11·65	1,638	12·76	1,529	12·8	1,543	11·9	1,945	10·5	1,882	11·48	1,280	14·07
„ 3	.. ..	1,562	11·59	2,126	11·48	1,634	12·55	1,528	12·8	1,538	11·7	1,943	10·4	1,868	10·82	1,279	14·00
„ 4	.. ..	1,544	10·56	2,120	11·23	1,624	12·01	1,521	12·42	1,533	11·41	1,939	10·3	1,863	10·6	1,271	13·46
„ 6	Exposed for 24 hours in room with much moisture.	1,541	10·38	2,112	10·89	1,622	11·90	1,518	12·25	1,525	10·9	1,939	10·3	1,856	10·24	1,270	13·39
.. 7	„ „ „	1,5	13·20	2,117	11·11	1,638	12·76	1,533	13·11	1,537	11·6	1,946	10·6′	1,872	11·01	1,280	14·07
„ 8	*All samples made bone dry and weighed...*	1,381	*None*	1,882	*None*	1,429	*None*	1,332	*None*	1,358	*None*	1,739	*None*	1,666	*None*	1,100	*None*
„ 9	Exposed again to air of laboratory..........	1,522	9·27	2,034	7·48	1,583	9·73	1,476	9·75	1,482	8·3	1,886	7·7	1,800	7·12	1,224	10·14
„ 10	.. ..	1,528	9·62	2,054	8·38	1,591	10·19	1,489	10·5	1,498	9·3	1,902	8·3	1,818	8·37	1,239	11·22
„ 13	*At this date nearly all the pulps had taken up their maximum amount of moisture.	1,528	9·62*	2,060	8·65*	1,596	10·47*	1,490	10·6*	1,501	9·52*	1,905	8·7*	1,823	8·6*	1,244	11·58*
„ 15	.. ..	1,529	9·68*	2,059	8·6	1,593	10·30	1,488	10·5	1,499	9·4	1,905	8·7	1,822	8·5	1,244	11·58
„ 17	.. ..	1,517	8·97	2,050	8·2	1,583	9·73	1,482	10·1	1,493	9·05	1,897	8·33	1,809	7·91	1,235	10·89
„ 20	.. ..	1,529	9·68	2,059	8·6	1,595	10·41	1,490	10·6	1,498	9·3	1,905	8·72	1,823	8·6	1,244	11·58
„ 22	.. ..	1,527	9·56	2,063	8·70*	1,596	10·47*	1,492	10·7*	1,502	9·5	1,907	8·81	1,826	8·77	1,241	11·58
„ 24	Removed on this date and kept till 29th in a damp room, the weather being very damp at the time.	1,519	9·09	2,041	7·79	1,579	9·5	1,476	9·75	1,489	8·7	1,892	8·09	1,805	8·26	1,227	10·36
„ 29	.. ..	1,539	10·27	2,079	9·48	1,614	11·47	1,504	11·4	1,513	10·2	1,925	9·67	1,846	9·7	1,258	12·56

† Specimen of a 50 per cent. pulp.

not rather look forward to the time when, as we indicated before, the pulp maker will fix a price based on the dry cellulose present.

Discussion.

Mr. G. T. Beilby pointed out that the amount of atmospheric moisture varied from day to day, and asked what was the limit of variation in the absorbing power of the pulp.

Dr. J. B. Readman: At the most 2 per cent.

Mr. R. Irvine cited an instance in his own experience of a large cargo of rags which had been damaged by sea-water. He found, on testing them, that they contained 10 to 11 per cent. of moisture. He at first had assumed that this moisture was alone due to the sea-water accidentally introduced during the voyage. The question had become a serious one, as the paper-maker had concluded to deduct 10 per cent. from the price of the rags. In blank experiments, however, conducted on rags which had not been subjected to the damaging action of sea-water, he was surprised to find that the moisture differed by only half a per cent. from that in the damaged samples.

Mr. W. Ivison Macadam said he had lately experimented on tweeds, both pure and with cotton present, and he had found the average proportion of water absorbed by these fibres to be from 8 to 13 per cent. In both classes of tweeds there was the usual oil present.

Mr. Irvine remarked that a coating of oil had therefore apparently no effect on the amount of moisture absorbed.

The Chairman considered that in estimating the amount of moisture, the absolutely dry material should be taken as the standard.

Dr. J. B. Readman, in reply, emphasised the necessity of promptly securing samples. In an instance within his knowledge, the material had lost 0·2 per cent. after being exposed for 15 minutes to the air of an ordinary room. 0·2 per cent. was too large an amount to neglect in cargoes of 500 to 1,000 tons. Every precaution ought to be taken in order to obtain a large representative sample, and no time should be lost in securing it in a hermetically-sealed vessel such as that which he exhibited.

MANUFACTURE OF OIL-GAS.

BY JOHN LAING, F.I.C., ETC.

There are three convenient methods by which mineral oil can be readily decomposed, viz., by repeated distillation into self—by radiant heat—and by distilling under pressure. In the system which I now bring before your notice for the manufacture of oil-gas, I employ a combination of these three methods working in harmony together. Mineral oil-gas making is nothing more than the "cracking" operation carried on to extreme. The apparatus consists of an oil still charged with a quantity of oil consistent with the number of cubic feet of gas it is desired to be made. This oil is vaporised by heat either direct from a furnace for itself, or by using the surplus heat from coal retorts, where they are in use. The oil vapours, as they leave the still, pass into a condenser so arranged that the more condensible portion on being liquefied returns immediately to the still for *re-distillation* and condensation; the lighter portion passes over and down into a superheater, and then, coming into close contact with the *radiant heat* found there, is further decomposed and rendered into permanent gas of very high illuminating value. The back *pressure* on the still, from the gas-holders, raises the boiling point of the oil in the still, and thus assists in its decomposition.

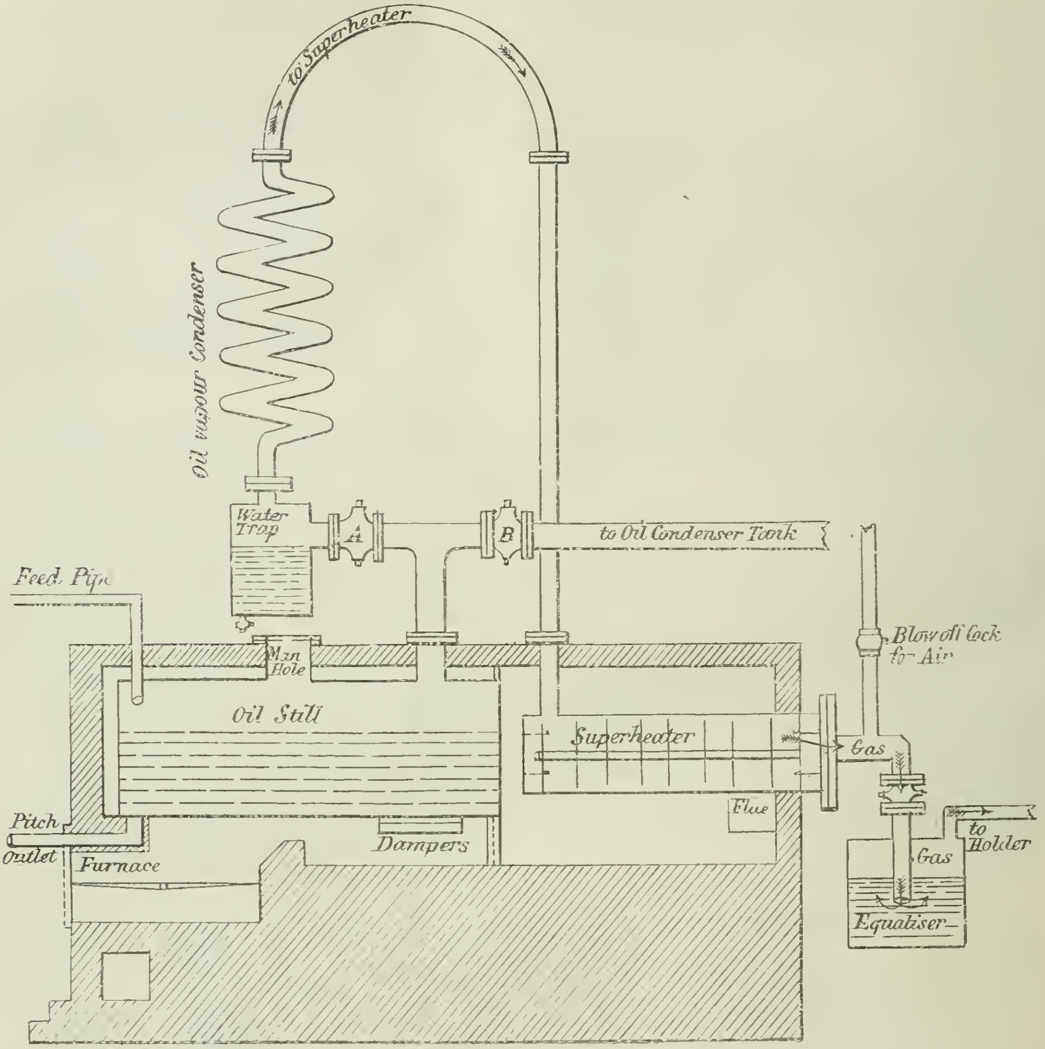
Between the still and the condenser I place an arrangement which acts as a water trap, so that should any water happen to get into the still with the oil it will be removed without any trouble or fear of accident. If this water trap was not employed, then the steam from the still would condense in the condenser overhead, and this water, returning to the still (which is now at a higher temperature), would suddenly burst into steam, and might prove dangerous.

This trap catches all the condensed material from the condenser, and should water be present it will fall to the bottom because it is heavier than oil; the overflow of oil from the surface returns to the still perfectly free from water, and during the remainder of the distillation there is no possibility of further trouble or anxiety on account of water in the still. This trap is fitted with a cock at bottom, and when you turn it on and find oil, you may rest assured that no water is present to be dealt with. Sometimes it happens that water is present in the oil tanks from which the oil is barrelled, and if the tank is well run down some water may have got into the barrels along with the oil unperceived. In this way water may find its way into a still when being charged from the barrels or tank, but with the arrangement I have here mentioned no harm can result from its presence.

In the form of superheater I am using at present I have a number of discs with holes punched through one half of its surface, and the edges of the discs are vandyked or nicked. These discs are fitted on to an iron rod at regular intervals from each other; the end disc has its holes downwards, the next one has its holes upwards, and so on to the end, thus giving the gas a zig-zag travel, and making it come in closer contact with the radiant heat in the superheater. My reason for giving the gas this zig-zag travel is to ensure a uniform quality of gas being made. If you merely pass the gas through an empty superheater direct, then that portion of it which is nearest the sides of the vessel is decomposed the most; the central portion is of a heavier nature, and I am strongly of opinion that this mechanical mixture of the molecules (if I may use such an expression) is one great cause why some makes of oil-gas smoke so badly on being consumed in the burners. If the hydrocarbon molecules are of a uniform character, then you will have a gas which will give satisfactory results on being consumed. I am quite aware that a proper size of burner should be employed for consuming very rich gases, but what I mean to convey is that using two makes of oil-gas, and consuming them side by side under the same conditions in every respect as to burners, pressure, &c., you will find that the gas which has been the result of uniform decomposition will give more satisfactory results than the gas which is not so uniform in its composition, and being more a mechanical mixture of its component parts than a chemical one. Oil-gas of uniform composition blends immediately with coal-gas, and I believe has no tendency to layering in large holders, and accordingly you should have no variation of illuminating value from different heights of the gas-holder. Some people seem to think that oil-gas does not store well, and that it loses a deal of its illuminating power if it has to travel far. Now this is quite a misconception, for really the fact is that if oil-gas is properly made it will store better, and travel better, and stand cold better than coal-gas will, for coal-gas depends more on condensible vapours for its illuminating power than oil-gas does.

The lower temperature at which you can make permanent oil-gas the better results you obtain. You get a higher illuminating gas, less deposit of carbon, and you get a larger quantity of gas from your oil than if you are decomposing your oils at higher temperatures.

By my process, all the dirt is left in the still, and in time produces a pitch of first-class quality; this pitch being liquid whilst hot, is readily run from the still by an arrangement provided for that purpose, and leaves behind practically a clean still ready for the next charge. Before running down the still bottom it should be sampled first, and if the condition is too soft when cold, that indicates that you can yet take more oil from it, and by leaving it longer under heat you will obtain all the more gas and a better pitch. If for any reason you prefer to have coke to pitch then just carry on the distillation to dryness, and coke will be the residue instead of pitch. The samples which I now send round are pitch and coke from the same oil. The coke is merely the result of continued distilling heat on the pitch. The best prices for this coke range to about 21s. per ton. This pitch has been valued about 37s. per ton, and had it been taken off a little later from the still, and accordingly been harder, its price would have been higher by a few shillings per ton.



It takes a higher temperature to produce coke, and I prefer to work to pitch for several reasons, viz.:—

1. It is not so hurtful to the plant.
2. If you are using a furnace instead of surplus heat from coal retorts, then it takes less fuel, and thus is cheaper to make.
3. It saves a deal of cleaning of stills.
4. It can be stored anywhere and for any length of time without deterioration.
5. It is of higher commercial value.

If you take a red-hot still and trickle in slowly, say one gallon of oil, and allow the vapours to escape through a sealed condenser of three inches water, you will have a larger amount of coke formed than if you distilled down the same quantity of oil from a charged still with oil under the same conditions. You will thus see that the quantity of pitch obtained by my method of oil-gas manufacture is less in proportion to the amount of coke formed by other high temperature processes. Coke is a worse conductor of heat than pitch is by a long degree. It is no uncommon thing to see a still bottom bright red-hot with a layer of coke at the bottom and several inches of pitch on its upper surface, and yet the pitch was not strongly giving off vapours.

I may here mention that I have arranged a special pitch cock which will save a deal of trouble by its being easily kept free from plugging up. In the ordinary cocks at present in use, the box or hole in the plug of the cock often retains some of the pitch, and as it cannot escape when the barrel is turned off, it remains and hardens there, and, before another run down can be made, time must be allowed for the hot pitch behind the cock to melt out the plug in the cock-barrel. This is sometimes rather difficult to get over, and a steam jet has to play on it for some time before it will clear. To get over all this I got a cock specially made with a "pap" cast on the one side of it; a hole was bored through this into the plug box, so that when the plug was turned off a hot wire can easily be passed into the hole and all the pitch cleared out. A screw plug fits into this hole. It might, perhaps, even be further improved by having a "pap" cast on both sides and a hole in it so that a hot wire could pass right through and through, and thus clear the cock with the greatest ease. This method is extremely simple and most effective, and far better than the present system of running a red-hot rod up the pipe in line with the cock and melting out the plug. Sometimes the obstruction gives way with a burst, and there is great danger of the person so operating being seriously scalded with the hot pitch from behind coming quicker than he can get the rod removed.

In other processes for oil-gas making the oil is injected or run in a stream into the heated retorts or stills; in this way the oil is at once flashed into vapour. What has been rendered permanent goes to the holders, and what condenses again into oil is returned to the still. By this method you obtain an immediate deposit of coke which goes on increasing in thickness as long as the feed continues to supply the oil. As this coke-deposit increases you must have more heat to enter your still so as to vaporise your oil, and I rather fear that this coke acting as a foreign body in the still will soon set up inflammation and burn it through. By my method I never require a higher temperature than a very little over the distilling point of the oil in use.

If you prefer to use a large size still then you may work on a large body of oil and distil down as many inches as you require, then draw off the heat by opening the damper to the chimney, and leave the still and its contents as it is till next making time. Nothing leaves the still but vapours, the condensible portion of which continuously washes down the condenser coil and other pipes connected to the still, and keeps them clean and free from deposit, all the dirt remains in the still, and according as the oil you use is crude or partly refined so you have a greater or less amount of pitch formed in the still. At present I prefer to use the ·840 or ·865 unwashed home oils, as the gas made from it requires no lime or other purifying treatment. If you use an oil too near the crude state you would be the better to pass the gas made through the purifiers to remove all traces of sulphur and ammoniacal compounds which are apt to be present at that stage.

Where oil-gas is being consumed, it should be burnt in a smaller size burner than that used for ordinary low power coal gas, you should have a burner which will just prevent smoking; if you use burners much below this point you get a very much poorer light, owing to the cooling of the flame.

I understand it has been shown that a Bray No. 0, showing 50 candles for 5 cubic feet burnt and giving a good smokeless flame, if the same gas, under the same conditions, was burnt in a No. 000 burner, it would show a loss of 35 candles for the same amount of gas consumed.

I find a burner passing 1¾ foot per hour will answer very well for general requirements. By my arrangement large or small works are equally served and no duplicating of plant is necessary for large works; you only require to have a larger or smaller still and condenser in proportion consistent with the amount of gas required. Any kind or quality of oil can be employed with absolute confidence. No skilled labour is required. Keeping up a distilling temperature is all that is necessary to give special attention to. The cost of the plant is not great. I would venture to say that a plant capable of yielding 20,000 cubic feet of oil-gas for 24 hours should cost within 100*l*., and such a plant could be fitted up on a ground space of not more than 8 feet square.

There is nothing to go out of order, there being no mechanical parts requiring attention. The whole thing works automatically.

The attendant never requires to soil his person or dress as in a coal-gasworks, and the atmosphere is not polluted with offensive smells from lime-purifiers, &c. By arranging a ${}^{a}\mathrm{T}^{b}$ piece outlet on the still, provided with cocks at A and B, you can have a very useful combination of still suitable for gas-making and oil-refining combined. Suppose you have an oil which contains some light material you do not wish to retain, you can readily convert that portion of it into illuminating gas in the manner described, then by shutting off the cock at A and opening B you can convey the remaining vapours of the heavier remaining oil to an ordinary worm condenser and there run them off in the usual way into receiving tanks, at the same time shutting off the heat going to the superheater as it would not be required. Should such a combination be desired, it would be well to have provision made for a furnace to assist the surplus heat from the coal retorts (if such heat is being utilised) because a smarter heat is better for distilling oil than for gas-making for the reason that if your oil-vapours are kept too long in the still in contact with the radiant heat found there, you will have your viscosity greatly ruined, and an oil of lighter specific gravity the result. The smarter heat quickly vaporises the oil and accordingly the vapours are less time under heat in the still. The lower temperature at which you distil mineral oils will yield you the heaviest qualities and the greatest viscosity obtainable from such oils. As to the cost of production of oil-gas, I would just say that if you are using the surplus heat from coal retorts alone for your oil-gas plant, then the cost of the oil-gas is practically the cost of the oil you are using. It is not my intention here to enter upon the subject of advantages claimed for oil-gas; they are well-known and generally accepted.

It may be stated generally that one gallon of mineral oil will yield, off or on, about 100 c. ft. of oil-gas with an enriching power of not less than 90 candles, if properly made.

Suppose you are using a poor splint coal yielding an 18 candle-gas, then by using five parts of this to one part of oil-gas, you would obtain a gas of 30 candle-power. It is a very simple matter to arrange for a gas of almost any candle-power, by merely adding a greater or less proportion of oil-gas to your poor coal-gas. Oil-gas can be burnt by itself with great acceptance, provided you use suitable burners.

In conclusion, I would strongly recommend that all gas companies should have an oil-gas plant in reserve, at least if not in actual use, for should they run short of coal, through miners' strikes or other causes, they can yet prevent, in a great measure, having their towns left in total darkness by the timely use of their oil-gas plant. The space required for storing an enormous quantity of oil-gas, in a latent stage, is not very great.

Note.—Some gas managers prefer to use a proportion of shale mixed with their coal in the retorts so as to get the benefit of the high illuminating power from the oil-gas made from the shale. Judging from my experience with oils, I would be inclined to say that they do not get the full value of this shale oil as an enriching agent, for a large quantity of its vapors will not have been rendered permanent, and I think they will find considerable quantities of oil condensed into the "drips" or "siphons" or run away with the tar.

P.S.—Since reading the above paper I have made an alteration in my apparatus, by interposing a tank between the return pipe from the coil-condenser and the superheater, in order to trap any excess of condensible vapours which, from some cause, should pass over from the coil-condenser. Any oil in this tank finds its way back to the still again by a pipe connected by a siphon-bend near the bottom of the tank, and opening into the still. The siphon-bend remains full of oil, and acts as a seal to the vapours from the still escaping by that opening into the still. Some oils have a tendency to froth or boil over, but with this arrangement any oil which should at any time get over from the condenser would immediately return to the still. Near the top of this tank is an offset pipe, which connects with the superheater, so that gases only are passed through the superheater, and in this way a regular and decomposing temperature is maintained on the superheater and risk of oil getting into the equaliser avoided.

Discussion.

Mr. Robt. Irvine said this process, as he understood it, appeared to be one which consisted essentially of distilling the lighter oils (from mixed light and heavy oils) and carrying the vapour in a *mechanical* condition to the superheater, where it was broken up. Did he understand Mr. Laing to claim that as the speciality in the apparatus he had described?

Mr. W. Ivison Macadam thought that the apparatus was unnecessarily complex, and would not yield as good results on the manufacturing scale as Mr. Laing suggested. Although results, deduced from experiments on the small scale, showed that 100 cubic feet of gas had been obtained from one gallon of oil, yet he thought Mr. Laing need not expect a greater output than from 80 to 85 cubic feet when working on the manufacturing scale. Had he understood Mr. Laing to have obtained 90 candle power from his oil-gas taken by itself? From a series of experiments with oil-gases burned from a No. 3 Bray burner, he (the speaker) could only obtain 11·786 candle power per cubic foot of oil-gas, or practically 59 candle power for five cubic feet. When the oil-gas, however, was mixed with splint gas the light was made equal to 96⅓ candle power. These results were due to the richness in carbon of the oil-gas. When the heating power of the splint gas was exerted on the carbon of the oil-gas a double value was obtained, viz., the heating power of the splint gas and the value of the carbon in the oil-gas. Mr. Laing would find the advantage of using a lime purifier, if for no other reason than to secure thorough mixing. The introduction of the oil through the ascension pipe would probably prevent stoppages, but, he asked, had any stoppages occurred with this apparatus?

Dr. J. B. Readman asked whether Mr. Laing had in his experiments been troubled with coke in the superheater, and what, if he was so troubled, were the means of removing it?

Mr. Laing said there was no such trouble as Dr. Readman suggested in the superheater. All the dirt remained in the still itself.

The Chairman: But is there no coke in the superheater?

Mr. Laing: Practically none. Continuing, he said all his experience was so far purely experimental. The amount of carbon deposited by lighter vapours, which alone passed into the superheater, was insignificant as compared with the carbon deposited on directly treating the mixed light and heavy vapours. The lighter vapours naturally came in contact with radiant heat on the upper part of the still, and so were rendered permanent, and thus a certain amount of permanent gas was formed in the still itself.

Mr. Irvine thought that Mr. Laing had missed the gist of his question and remarks. His point was this: Was there any real difference in the process just described from that at present in use for gas-making by Pintsch and others, where low-gravity mineral oils were slowly trickled into a red-hot retort?

A small experimental apparatus was in use in connection with the Northern Lights at Granton, and there light oil was trickled into the retort, which, in that case, simply stood in place of Mr. Laing's superheater. What, he asked, was the real or essential difference between that and Mr. Laing's process?

Mr. Laing explained that oil, on being trickled into a red-hot still, was immediately flashed into vapour, while a considerably greater deposit of coke was formed than if the vapours were gently distilled off.

Mr. Irvine asked if the same result was not obtained by trickling a light oil into the cooler part of the superheater as by means of the elaborate and costly plant just described. It seemed to him that Mr. Laing only distilled off from an oil, containing light and heavy oils, the lighter portions, and passed these, in a state of vapour, through the superheater. The same result would be obtained by using the lighter oils alone and doing away with the complication of making the process of gas-manufacture a two-fold one—refining heavy oils and making gas.

Mr. Laing replied that where a red-hot still was used, a much higher temperature was required to decompose the oils than in his process, because of the deposit of coke upon the still. In his process, only the lighter portion of the oil vapours was passed into the superheater, and therefore less heat was required for their decomposition.

Mr. Irvine: But why use the heavy oil at all?

The Chairman: Why not buy lighter oil?

Mr. Laing said he was using 8·40 oil at present, but could use oil of any gravity.

Mr. Irvine said he saw the advantage of passing the vapours of the light oil through the superheater, because, in that way, much less carbon would be separated. But still he came back to the question with which he started—Why not use light oil to begin with instead of thus complicating a simple process?

The Chairman inquired if Mr. Laing was using crude oil in the process at present.

Mr. Laing replied that one could either use crude oil or partly refined oil.

The Chairman said: That did not answer Mr. Irvine's question—"Why not buy and use light oil?"

Mr. Laing said whatever oil was most handy could be used in the apparatus.

The Chairman asked, if light oil were cheaper, why not use it at once in the superheater?

Mr. Laing explained that he used 8·40 oil at present, and went on to say that his object was to have as little heat as possible in the superheater, to make gas at as low a temperature as was possible. If a mineral oil was distilled frequently into itself, it broke down. That back-distilling always helped the process of decomposition.

The Chairman: By taking a light oil, as Mr. Irvine suggests, you have only to pass it into your superheater at once.

Mr. Irvine: You cannot simply distil oil vapour into gas; it must first be in a state of vapour when it leaves the still, and as such reach the *retort* or *superheater*. I am using the term superheater in the same sense as the ordinary gas-maker speaks of his retort.

Mr. Laing: This is my retort. (Referring to diagram of oil still.)

Mr. Irvine said that was only the method by which the light oil vapours were conveyed to the retort. The still proper had nothing at all to do with the process of gas-making.

Mr. Laing considered that the still had much to do with gas-making. On distilling the oil for a length of time into itself, it would gradually be converted into gas without the help of a superheater.

Mr. Irvine admitted that, but did not see where the point of advantage in Mr. Laing's method was. That was the question.

Mr. Laing failed to see wherein he had not answered the question.

Mr. Beilby inquired how much of the oil was decomposed or cracked in the pure process of distillation. What percentage of the whole was really permanent gas at the retort stage, and what proportion had to pass on and become permanent gas at a subsequent stage?

The Chairman: Does that not depend on the kind of oil taken in?

Mr. Laing: Certainly; not only on the oil, but on the temperature of the atmosphere itself.

The Chairman: But can you give us, for a certain quality of oil—say 8·40—the figures Mr. Beilby speaks of, approximately at least?

Mr. Laing: The process is not sufficiently advanced to enable me to give these figures yet.

Mr. Laing, continuing, said a good deal depended upon the condensing power in the upper part of the apparatus, for, of course, with high condensing power, less of the heavier vapours would pass on to the superheater for further decomposition. So far as his experiments had gone, he had found no difficulty in causing the gases to blend thoroughly. He had never experienced such stoppages as had been suggested, even when using a small apparatus.

The Chairman had understood Mr. Laing to say that, when a number of oils mixed together were treated, the product was not so good as when a *uniform* oil was used.

Mr. Laing said he had not referred to that. What he had stated was, that on passing the vapours of oil directly through a red-hot high temperature superheater, the portion next the skin of the vessel got more decomposed than the other portions. But if all the vapours came in contact with the radiant heat *uniformly*, then a better result was obtained. It was not his intention to urge that this gas should be burned as oil-gas alone, unless that was found to be absolutely necessary. There was no satisfactory burner for consuming oil-gas alone. About 60 candle power was got from this gas, as indicated by the photometer, but as an enriching agent it indicated, without difficulty, as high as 90 candles. Little or no coke appeared in the superheater, but that would be better tested as the apparatus became further advanced. Coke could be removed from the still by the manhole door.

He could not agree that the apparatus was intricate. So far as he knew, there was no apparatus employed in gas-making simpler or in any degree so simple. So far as he had yet gone, he had not found any oil condensing in the traps, and he did not think there would be, provided a proper heat was kept up in the superheater.

The Chairman said the subject was one of increasing importance, but he doubted whether the best arrangement for the gasification of oil had yet been introduced. Coal-gas companies would be compelled, by the competition of the electric light, to adopt some form of oil-gas plant, in order to manufacture this gas, which formed so good an illuminant when mixed with coal-gas.

Journal and Patent* Literature.

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I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Determination of the Explosion Temperatures of Combustible Mixtures of Gases. V. Meyer and A. Münch. Ber. 1893, **26**, 2421.

See under II., *page* 1017.

PATENTS.

Improvements in Filters. F. S. Arnold, Manchester, and L. Cresswell, Eccleshill, Yorkshire. Eng. Pat. 18,392, October 11, 1892.

The filter is of the ordinary cylindrical form, provided with two perforated filtering trays resting upon rims formed on the earthenware jar. The trays are slightly conical in form, and the water to be filtered is poured into the upper tray, and after percolating through the first layer it is received into the lower tray, being finally delivered into the reservoir below, ready for drawing off at the tap.
—E. G. C.

Improvements in Apparatus for Producing Fresh Water from Salt Water. A. Normandy, Victoria Docks, Essex. Eng. Pat. 22,016, December 1, 1892.

This is an apparatus for producing fresh from salt water by a system of multiple evaporation. Steam is produced from salt water in an ordinary boiler, and led into a condensing chamber surrounded by cold salt water, which is evaporated by taking up heat from the condensing steam. The vapour from this chamber is treated similarly in a second vessel, and the result again in a third; the water vapour from the last operation is finally condensed in an ordinary condenser. The condensed fluids from all the chambers are run together under certain regulations, and the supply of salt water to each chamber and to the boiler is regulated by means of floats, which are governed by the effluent condensed water from each casing; the supply to each casing being regulated by the water issuing from the next condensing vessel.—B.

Improvements in or relating to Apparatus for Treating Solid, Semi-Solid, or Liquid Substances with Gases. J. J. Melville, Northwich, Cheshire. Eng. Pat. 22,157, December 3, 1892.

The object of the present invention is to treat solids, semi-solids, and liquids with gases without much handling. The apparatus consists of an annular disc or trough rotated in any convenient manner and covered by a fixed annular hood, arch-shaped in cross section, the junctions between the hood and disc being effected by annular lutes. At one radius of the annulus a diaphragm is placed, closing the cross-sectional area between the hood and the bed, and on one side of the diaphragm a suitable device for feeding on the material is placed, while on the opposite side is placed the gas inlet pipe. The exits are so arranged that the solids, &c. travel in the opposite directions to the gases. Suitable spreaders, baffle-plates, and scrapers are arranged at the proper points to assist the action of the gas on the solids. A perforated water-pipe is placed just above the hood to prevent the latter becoming heated during the reactions between the gas and the solids, &c. upon the rotating disc; drip channels are fixed on each side of the hood to catch the waste water. The discharge chutes deliver into barrels or other suitable containers, and are closed by plate valves.—E. G. C.

Improved Apparatus for Raising Liquids. J. Mactear, London. Eng. Pat. 22,176, December 3, 1892.

The inventor proposes to raise liquid by injecting air in minute bubbles into the lower part of a column of the liquid kept in free communication with an equal column of the liquid in an undisturbed state. The gravity of the impregnated column of liquid being thereby reduced, causes it to be raised by the greater weight of the liquid in the other column, which is freely supplied from any source. The range of lift is claimed to be further increased by the removal of the air pressure from the top of the ascending column by means of an air-pump, whereby the action of gravity of the descending column is assisted.—B.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

Improvements in Evaporating Brine and other Solutions. Sir Lowthian Bell, Northallerton, Yorkshire. Eng. Pat. 23,297, December 17, 1892.

The invention has reference to improvements in the apparatus described in Eng. Pat. 17,564 of 1888. Beneath the brine pan a chamber is formed, which is deepened at one end to allow of the introduction of waggons containing heated slag from a blast-furnace. Exhaust steam is introduced at a suitable point, and this latter, coming into contact with the slag, becomes heated, and acts as a medium for heating the bottom of the brine pan, and thereby promotes the evaporation of the liquid contained therein. The brine is admitted to the pan at the far end, and the salt is raked out in the usual way.—E. G. C.

Improvements in Apparatus for Producing Fresh Water from Salt Water. A. Normandy, Victoria Docks, Essex. Eng. Pat. 23,821, December 24, 1892.

This apparatus is constructed on the double-effect evaporating principle. Steam from a boiler is admitted into an evaporating chamber immersed in salt water contained in a surrounding casing. As the steam condenses it heats the salt water, the vapour arising from which is led into a second evaporating chamber, where it acts in a similar manner on the salt water surrounding that chamber. The vapour arising from the latter is led into a condenser and cooler, whence the resulting condensed water can be withdrawn for drinking purposes, whilst the product of condensation from the previous vessels can be separately used for boiler feeding or other requirements. There are automatic devices for regulating the supply and density of the salt water in the various vessels, and provision for cleaning the surfaces of the evaporating chambers.—B.

Improvements in and relating to Filter Pumps. W. E. Caddell, London. Eng. Pat. 23,867, December 27, 1892.

The object of the invention is to combine a filter with an ordinary suction pump so that filtered or unfiltered water may be delivered as desired. In the arrangement described, the barrel of the pump is extended and formed into a filter chamber containing blocks of kieselguhr (fossil earth), the chamber being connected by a tap to the spout. By simply turning the tap the flow of water can be diverted from the ordinary channel and compelled to pass through the filtering chamber. The filtering blocks are cleaned by means of brushes encircling them and attached to the pump rod to give them motion.—E. G. C.

Improvements in and relating to Funnels for Fluids. R. Howard, Northam, Hampshire. Eng. Pat. 1159, January 19, 1893.

The improved funnel is intended for pouring liquids into casks and other vessels so as to disturb the contents of the same as little as possible, and thereby prevent the clouding of the liquid. The stem of the improved funnel is bent upwards in a U curve and has a capped perforated end. In a modified form the stem is straight, with a perforated cap screwed to the outer end.—E. G. C.

Improved Apparatus for Concentrating and Distilling Liquids. O. Guttmann, London. Eng. Pat. 9006, May 5, 1893.

This apparatus consists of a series of tubes laid horizontally one above the other and connected alternately at their ends to admit of the distilling or concentrating liquid passing down through them from the inlet above to the outlet below in a serpentine fashion. The set of tubes is inserted in a furnace or heating chamber, and they are each provided with cleaning covers at the ends, whilst longitudinal screw conveyors may be worked through all or through alternate tubes for regulating the passage of the liquid and for removing deposit.—B.

Improvements in Apparatus for Filtering and Purifying or Clarifying Water. J. Y. Johnson, London. From A. Howatson, Neuilly, France. Eng. Pat. 11,443, June 10, 1893.

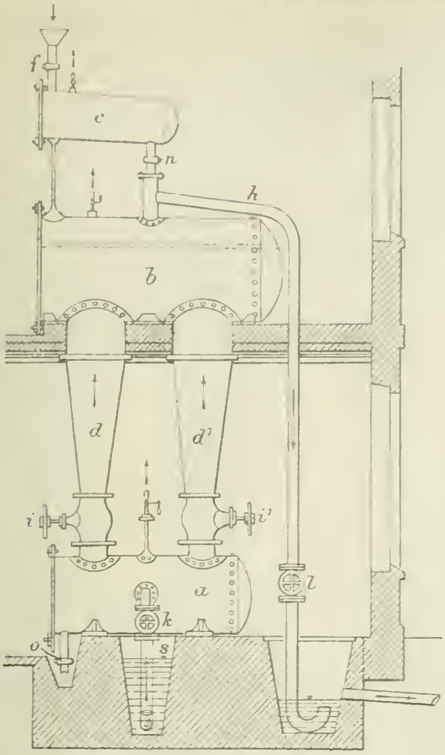
A chamber of suitable dimensions is divided by two or more horizontal partitions or platforms. The drawing annexed to the specification shows two such partitions, one about midway and the other near the bottom. Each consists of a grooved cast-iron plate, upon which is laid a perforated sheet of aluminium, and the bottoms of the grooves are also provided with numerous holes, an arrangement which enables the water to flow in a horizontal direction under the perforated sheet supporting the filtering material. On the top of the chamber is an arrangement for mixing the water to be filtered with a suitable quantity of aluminium sulphate for facilitating the clarification of the water. The filtering material is charcoal powder or dust, or crushed or broken flint or other pulverulent insoluble material. Above the upper partition is an agitator formed by two arms or teeth flattened at the lower extremity and so arranged that when the agitator has described one complete revolution, the whole of the surface of the material deposited on the partition, has been acted upon. The object of this agitator is to assist in cleansing the apparatus, whilst a stream of water is made to flow upwards through the two partitions. The quantity of deposit on the lower partition being small, no agitator is required.—E. G. P. T.

Improvements in Apparatus for Purifying Water. J. Y. Johnson, London. From A. Howatson, Neuilly, France. Eng. Pat. 11,448, June 10, 1893.

The apparatus consists (1) of a tank for the reception of the water to be purified; (2) of a decanting vessel of circular, rectangular, or other form, containing surfaces formed by one or more concentric truncated cones or pyramids, one of such cones or pyramids being of the same height as the vessel, and the others of less height, according to the quantity of matter to be precipitated; (3) of a saturator, in which lime-water is automatically and continuously prepared; (4) of a motor for effecting the agitation of the lime-water; (5) of a vessel in which a solution of sodium carbonate or other suitable reagent is prepared for use when required.—E. G. P. T.

Improvements relating to Clearing and Purifying Apparatus for Liquids. H. Peschges, Potsdam, Germany. Eng. Pat. 16,300, August 29, 1893.

The method of working is upon the siphon principle, the apparatus used being shown by the figure in elevation. Two reservoirs, a and b, are connected by pipes d, d^1; the upper reservoir b contains a filtering arrangement, and also provided with an air chamber c. Valves are placed at all suitable points, and the apparatus is started by closing the valves k, l, o, and opening all the others. The apparatus is then filled with liquid through the funnel f; the valves k, l, and o are then opened and the others closed, excepting the valves i, i^1, and n. The liquid then enters the apparatus by the inlet pipe s, and circulates through the lower vessel a, the connecting pipes d, d^1, and filtering vessel b, finally escaping down the pipe h, which acts as the longer arm of the siphon. Any air contained in the liquid passes into the chamber c, while the grosser impurities are retained in the settling chamber a and filtering chamber b.



Clearing and Purifying Apparatus.

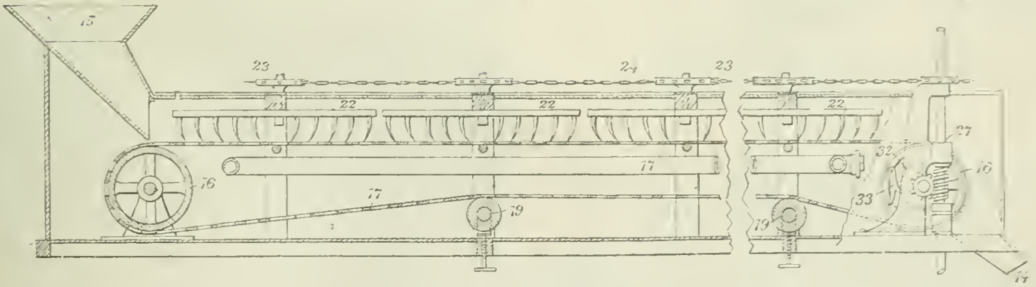
—E. G. C.

Improvements in Antifriction Compositions for Bearings and other Purposes. H. F. Hoveler, London. Eng. Pat. 22,907, September 12, 1893.

For packing rings and segments a mixture is used containing about 30 per cent. of asbestos powder and 70 per cent. pulverised white metal; for bearing-shells, foot-steps, bushes, &c., a similar mixture containing about 30 per cent. asbestos powder, 20 per cent. graphite powder, and 50 per cent. pulverised white metal. When the powders are well intermixed about 10 per cent. of tannic acid is added, and the whole poured into hot glue and well stirred; a tough, sticky cement insoluble in water results, from which any glue or tannic acid present in excess can be removed by washing in hot water; a mouldable paste is thus obtained, which is pressed into the required shape and dried in the open air for some days, finally at about 250° F. for some hours. The rings, &c. thus prepared are as hard as any real metal, and when polished possess a bright metallic lustre; for steam or hydraulic packings they should be prepared from the first mixture and subsequently boiled with tallow so as to fill up the pores completely; the second composition, containing graphite, must be used without oil or water, being self-lubricant; better antifrictional results are said to be obtained with such bearings than with ordinary oiled pillow blocks.—C. R. A. W.

Improvements in Driers for Cocoa and other Grains. J. G. Elizondo, Guayaquil, in the Republic of Ecuador, South America. Eng. Pat. 17,327, September 14, 1893.

In this invention means are described for drying cocoa and such like granular material through the medium of hot water in circulation. A number of compartments are arranged in a building, all of which are heated by pipes from a central hot-water system. The figure shows one of these compartments or drying chambers in sectional elevation. The cocoa or other material is fed through the hopper 15, falling upon an endless belt 17, carried by the drums 16, and kept in constant tension by the movable guide pulleys 19. The cocoa, in its passage through the chamber, is continually agitated by the rakes 22, worked by the spocket wheels 23 and chain 24 from the upright shaft 27, and is subjected to the heating effect of the hot-water pipes 38, being finally discharged in a dry condition through the hopper 14. The driving pulley or drum 16 is driven from the upright shaft 27 by means of worm gearing, and a ratchet and paul arrangement 32 and 33 upon the drums 16 enables the latter to be thrown out of gear and so stop the belt for the purpose of exposing the material for a longer period to the action of the rakes and hot-water pipes. Any convenient hot-water system can be used.—E. G. C.



Drying Chamber.

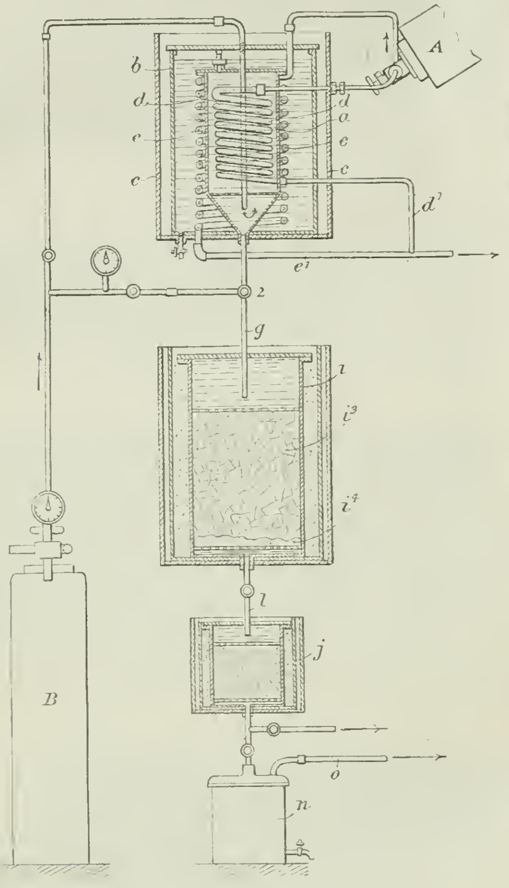
Improvements in the Method of and Apparatus for Filtering Liquids under Pressure. R. Krix, Dresden, Saxony. Eng. Pat. 18,341, September 30, 1893.

The inventor prepares filtering material for the filtration of water, by cutting off unripe reeds and canes close to their roots and splitting them up into pieces of convenient lengths. These he inserts for several months into marshy soil until new and substantial fibres are formed in their tubular net-work, nearly closing it. The pieces are then boiled slowly in a solution containing about 10 per cent. of common salt. After slowly drying they are placed in a solution of from 20 to 25 per cent. of permanganate of potash, which is readily absorbed and penetrates fully, constricting the capillary passages to a large extent. The material, it is claimed, acts destructively upon any organisms and organic matters, which are passed slowly through the interstices. The sticks are packed in tight bundles, and interposed in suitable casings to the passage of the water to be filtered.

—B.

New or Improved Apparatus for Separating Solid or Fluid Substances dissolved in Alcohol, Ether, or Chloroform without Evaporation of the Solvent. C. Weitenkampf, Berlin, Germany. Eng. Pat. 23,399, 1892.

The principle of the invention consists in the application of great cold to the solution to separate the dissolved substance, and afterwards allowing the mixture to run through layers of filtering substance to retain the separated substance, the pure solvent running away. The figure shows the apparatus in sectional elevation, where *a* is the reservoir enveloped by a larger reservoir *b*, which in turn is surrounded by a casing *c*, packed with sawdust or other suitable non-conductor. The reservoir *b* contains a suitable cooling mixture, and both *a* and *b* are traversed by worms *d* and *e*, through which carbonic acid is passed from the holder A, the outlets e^1 and d^1 running away to a cistern. Carbonic acid is passed into the solution in *a* from the holder B until the liquid is saturated, the tap 2 is then opened to permit the saturated liquid to enter the jacketed filtering vessel *i*, containing the filtering medium, which consists of a mass of charcoal i^3 upon a layer of wadding i^4. The purified solution, after passing through the first filter, is led into a second similar filter *j* by the pipe *l* to effect a further purification, the pure solvent being finally received into the holder *n*, while the carbonic acid gas is led away by an outlet pipe *o* for use over again.—E. G. C.



Improved Separating Apparatus.

II.—FUEL, GAS, AND LIGHT.

Fuel Value of Gases. H. L. Payne. J. Anal. and Appl. Chem. 7, 230—235.

As different values for the theoretical heating power of various gases occur widely distributed in chemical literature, and as they frequently give rise to disputes among chemists and gas engineers, the author proposes that the data given by Julius Thomsen in his *Thermo-chemische Untersuchungen* should form the basis of all calculations, since they are probably the most accurate. The amount of heat given out by the complete oxidation of 1 grm. of the combustible gas is expressed by Thomsen in calories. Starting from Thomsen's data the author has calculated the amount of heat in British thermal units, which is evolved by the combustion of one cubic foot of each of the gases, and the results are given in the following table:—

Substance.	Calories per Gram. Thomsen.	B.T.U. per Cub. Ft. calculated by Payne.
H	34,200	345·4
C	8,083	..
CO	2,427	341·2
CH_4	13,245	1.065
C_2H_6	12,350	1,861
C_3H_8	12,028	2,657
C_4H_{10}	11,850	3,441
C_5H_{12}	11,770	4,255
C_6H_{14}	11,620	5,017
C_2H_4	11,910	1,674
C_3H_6	11,900	2,509
C_2H_2	11,925	..
C_6H_6	10,250	4,012
Illuminants	..	2,000

To calculate the heat units of a gas from its analysis, multiply the percentage of each constituent by its number as given in the above table, and the sum of the products will represent the British thermal units evolved by the combustion of one cubic foot of the gas. In ordinary gas analysis it is usual to determine only the H, CO, CH_4 and the "illuminants." If the gas be made from mineral oil, 2,000 is a trustworthy value for the illuminants or gases absorbed by bromine or fuming sulphuric acid; but if the gas is produced by the distillation of coal this value is too low, as coal-gas contains a larger percentage of benzene vapours.

The experimental conditions necessary to give these theoretical results are that the gas is measured at 0° C. and 760 mm. pressure, and is burned with exactly the proper quantity of oxygen, and that the products of combustion are reduced to the initial temperature, the water being all in the liquid state. Of course these conditions cannot actually be observed, but figures which more nearly agree with practice may be obtained if certain conditions are assumed. The temperature for standard gas measurement in this country is 60° F., and this point is usually taken as the initial temperature. 328° F., the temperature of steam at 100 lb. absolute pressure per square inch, a point somewhat lower than the average chimney-flue heat, may be taken as the final temperature. As the combustion takes place in air and not in oxygen, the heat brought in by the gas and air at 60° F. must be added, and the heat carried away by the products of combustion at 328° F. must be subtracted. And since the volume of gas is greater at 60° F. than at 32° F., the result must be corrected by multiplying by the factor $\frac{492}{492 + 28}$.

Under these assumed conditions the values for the four most important constituents of ordinary gases are given in the following table. For "illuminants" fifteen per cent. is taken as a fair loss.

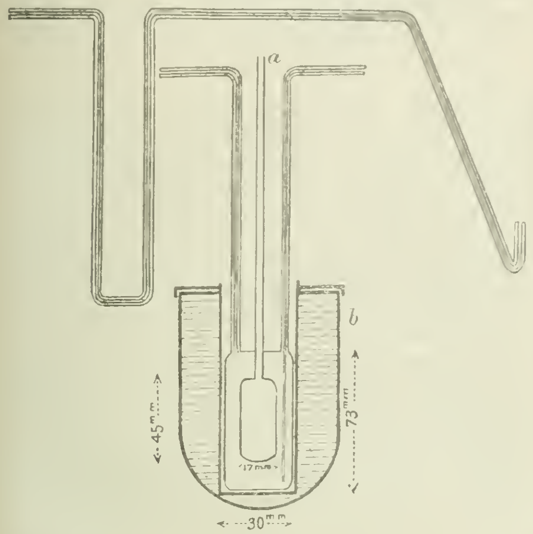
Gas.	B.T.U. per Cubic Foot.		Percentage loss.
	32° initial. 32° final.	60° initial. 328° final.	
H	345·4	263·2	24
CO............	341·2	306·9	10
CH_4...........	1,065·0	853·0	20
Illuminants...	2,000·0	1,700·0	15

Natural gas has been taken as a standard for heating gases, with the arbitrary value 1,000. If it contains 94 per cent. CH_4, which is not far from the average, it will show by the above calculation 1,000 B.T.U. per cubic foot, and hence the numerical result obtained by this method for any fuel gas will also indicate its position in that scale.

—J. S.

Determination of the Explosion Temperatures of Combustible Mixtures of Gases. V. Meyer and A. Münch. Ber. 1893, 26, 2421—2432.

In order to obtain more exact determinations than have hitherto been observed, the apparatus figured in the cut was employed. The explosion chamber was placed inside an air thermometer of difficultly fusible glass, the temperature being deduced from the volume of air driven out by displacement by means of a current of pure hydrochloric acid gas. The whole was heated in a bath, *b*, of molten alloy of equal parts lead and tin, the explosive mixture being introduced through a fine capillary tube inserted through the orifice *a*. Direct experiments showed that the heat evolved during the explosion did not perceptibly affect the results. Electrolytic gas from dilute sulphuric acid (freed from ozone by passing through potassium iodide solution) was employed under varying conditions with the following results :—



Details of Experiment.	Explosion Temperature.
Moist gas supplied at rate of—	
300 bubbles per minute......	From 615° to 686° in 19 observations, with four different apparatus.
150 „ „	613°.
108 „ „	666°.
80 „ „	644°.
Gas dried by calcium chloride...	620°.
Explosion chamber filled with—	
Small splinters of glass........	625°.
Larger number of splinters....	610°.
Ignited purified sea sand......	633°.
Apparatus directly plunged in molten alloy.	632° to 682° (4 experiments).
Explosion chamber of different sizes—	
4·5 mm. diameter.............	661°—722° (4 experiments). In 6 other experiments silent combination only, without explosion.
9·0 „	629°—675° (7 experiments: explosion always took place).
Spongy platinum used in chamber.	No explosion, only silent combination.

On the whole, therefore, the explosion temperature lies between 620° and 680°, averaging near 650°, and is not materially influenced by the rate of supply or the size of the chamber; nor by the presence of moisture, glass splinters, or sand.

The following results were obtained with other gases when mixed with the quantity of oxygen just sufficient for complete combustion :—

Gas.	Temperature.
Carbon monoxide...............	[illegible], 715°, 804° in 3 experiments. In several others, no explosion but only silent combination.
Sulphuretted hydrogen.........	Explosion did not occur.
Marsh gas (from sodium acetate and baryta; purified).	656°, 678°; silent combustion in many cases.
Ethane (from zinc-ethyl and water).	605°, 622°, 622°.
Ethylene.......................	577°, 577°, 596°.
Acetylene (prepared by Gattermann's process; perfectly soluble in ammoniacal cuprous chloride).	509°, 510°, 515°.
Propane (prepared by Kohnlein's method).	545°, 545°, 548°.
Propylene......................	497°, 499°, 511°.
Isobutane (Kohnlein's method).	545°, 549°, 550°.
Isobutylene....................	537°, 546°, 548°.
Illuminating gas (3 vols. oxygen)	647°, 647°, 649°.
„ (mixed with air)	No explosion producible.

It hence results that the explosion temperature of a gaseous paraffin mixed with enough oxygen for complete combustion, is higher than that of the corresponding olefine, at any rate in the case of the lowest members of the series.

Ethane,—average value found = 616°
Ethylene „ „ = 680°
Acetylene „ „ = 511°

Propane „ „ = 547°
Propylene „ „ = 504

Butane „ „ = 548°
Butylene „ „ = 543°

—C. R. A. W.

Regulations for the Use of Water-Gas in Germany. J. für Gasbeleuchtung, 1893, 36, 31—32.

See under XVIII. B., *page* 1052.

Rapid Determination of Phosphorus in Coal and Coke. F. L. Crobaugh. J. Anal. and Appl. Chem. 7, 223.

See under XXIII., *page* 1061.

The Behaviour of Safety Lamps in Explosive Gaseous Mixtures. H. Kämmerer and T. Oppler. Jour. für Gasbeleuchtung, 1893, 36, 101—104 and 121—125.

The authors describe (1) the construction, (2) the behaviour in explosive gaseous mixtures of the following safety lamps :—

1. Friemann and Wolf's petroleum spirit safety lamp, fitted with a percussion cap igniting arrangement. The latter is operated by a ring on the exterior of the spirit reservoir, into which the mechanism is sunk.

2. W. Seippel's petroleum spirit lamp with a similar igniting mechanism to No. 1, but which is operated by a lever fixed to the lower side of the spirit lamp.

3. W. Seippel's oil lamp without any special igniting arrangement. In this lamp the air enters at the top through the gauge.

4. The Bros. Stern's petroleum spirit lamp, with a "match" igniting arrangement, which is actuated by pushing a spindle passing through the reservoir. The flame of the match strikes upwards in an inclined direction against the wick.

5. The Bros. Stern's oil lamp with a similar igniting arrangement as No. 4.

6. J. Pintsch's large lamp, adapted for either rape oil or candles, without any special igniting arrangement.

7. J. Pintsch's small lamp similar to the above, with a flat wick 15 mm. broad.

The authors point out that all the modern safety lamps embody the principle of the original Davy lamp, but show marked improvements upon it in construction and efficiency. With all the inflammable mixtures tried, except that of air and carbon bisulphide, the lamps Nos. 1 to 5 gave the following results:—

(1.) If only a small proportion of the inflammable gas or vapour is present in the mixture, the flame is elongated and becomes more pointed. It was noticed that their elongation was greater, and took place more rapidly, with petroleum spirit than with oil, due no doubt to the greater volatility of the former.

(2.) If larger amounts of vapour or gas are present, the elongation of the flame is greater, and it becomes unsteady, is curved, and gets sooty and coloured red at the top.

(3.) If the mixture is such that the oxygen is just sufficient to effect the combustion of the vapour present (the condition of maximum explosiveness), the phenomena described under (2) occur in rapid succession, then the gaseous mixture entering the lamp through the gauze ignites and forms a luminous cap to the flame, the latter goes out, and the entering mixture continues to burn for some time on the inside of the gauze.

(4.) If there is a deficiency of oxygen the phenomena described under (3) occur, but the luminous cap goes out after a very short time. It was observed, however, that it burnt longer when oil was used than with petroleum spirit, probably because the former makes the gauze hotter than the latter does. When the gaseous mixture consists of air and carbon bisulphide, the results are different. At first the same effects occur, as with the other mixtures, but when the quantity of carbon bisulphide was sufficient to elongate the flame until it touched the cover, or when the luminous cap appeared, the gases *outside* the lamp were ignited. The authors believe that the lamps Nos. 1—4 and No. 6 may be considered true safety lamps with all the inflammable gaseous mixtures they tried, with the exception of a mixture of air and carbon bisulphide.

The results with the latter are further considered, and the authors point out that a lamp that is really safe in this mixture has yet to be made. They refer to the work of L. T. Wright (this Journal, 1888, 542) as an indication of the lines to be worked upon. They also suggest that many accidents in india-rubber factories, in which large quantities of carbon bisulphide are used, have been due to the use of "safety lamps," as it has hitherto been believed that they could be employed with safety in the presence of carbon bisulphide vapours.—R. B. P.

PATENTS.

Improvements in Apparatus for the Manufacture of Gas and of By-Products from Liquid Hydrocarbons. P. Dvorkovitz, London. Eng. Pat. 21,647, November 26, 1892.

This invention relates to apparatus for making gas and recovering by-products from liquid hydrocarbons, in which the fixing chambers are heated internally, and has for its principal objects the reduction of the quantity of fuel required for heating, and the prevention of (1) loss of valuable by-products, and (2) injury to the outlet valve.

Fig. 1 represents a vertical, and Fig. 2 a horizontal section of this apparatus. A is the generator for producing water-gas, B the fixing chamber, and C the gasifier, which may be like that described in P. Dvorkovitz's Eng. Pat. 7983, 1892. A and B are each divided by a partition into two compartments A^2, A^3, and B^2, B^3, respectively.

In working the apparatus the chambers A^2, A^3, are filled with coke and "lighted air" under pressure admitted into one, say A^2, through *k*. The valve a^3 is opened so that the hot products of combustion from A^2 enter the gasifier and heat the vaporising pipes therein. When a sufficient temperature is attained, the supply of air is discontinued and a^3 is closed, and a^4 opened, thus establishing connection between the gasifier and A^3; steam is then admitted into

Fig. 1.

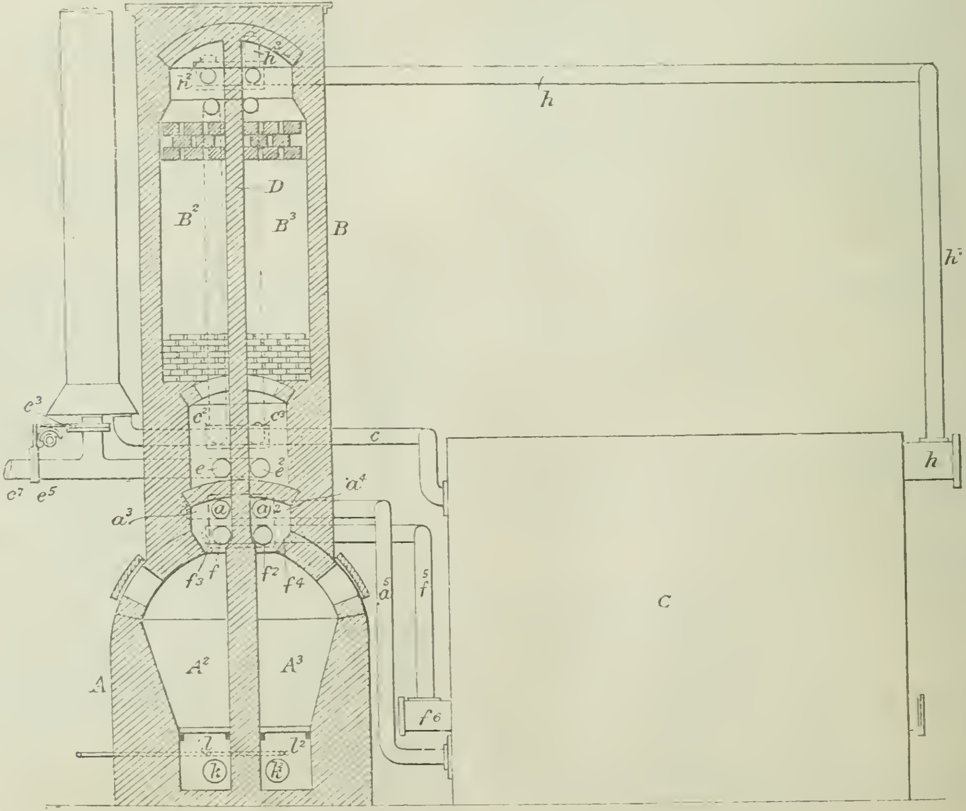
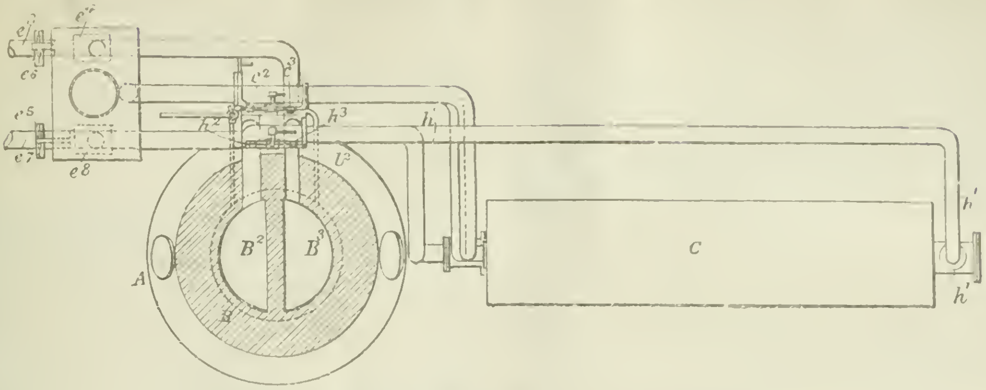


Fig. 2.



Apparatus for Manufacturing Gas and By-Products.

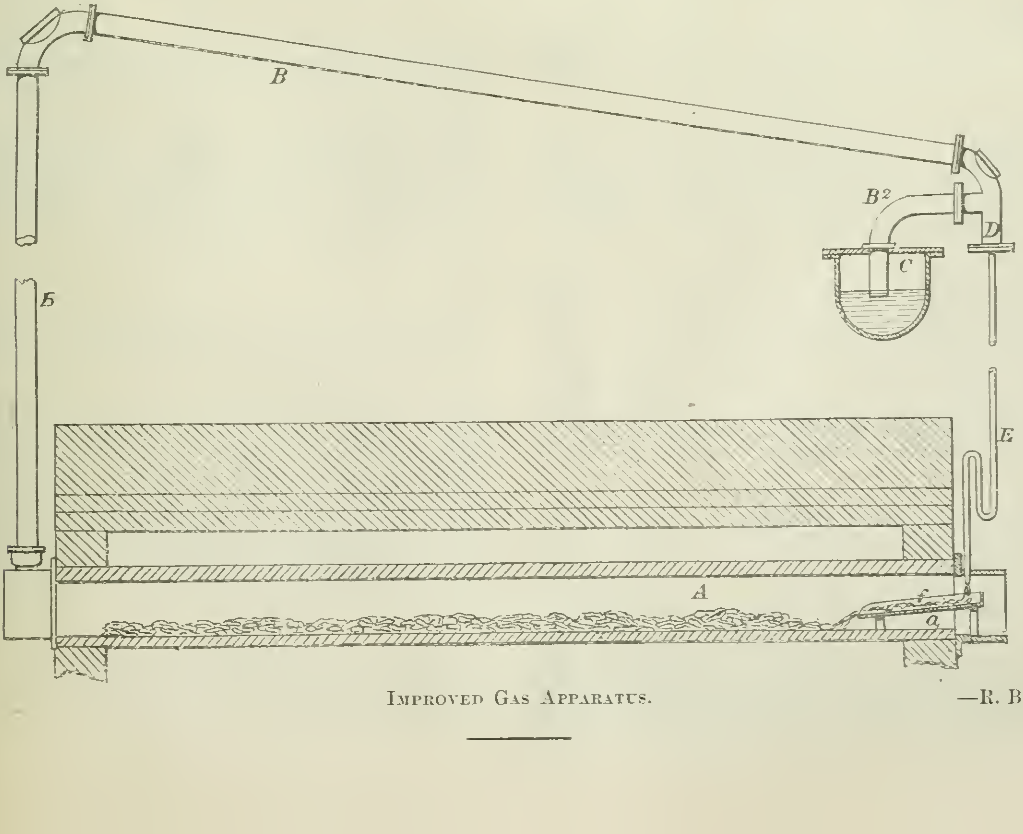
A^2 through l, f^3 opened and liquid hydrocarbon admitted into the tubes of the gasifier. The vapour from this becomes intimately mixed with the water-gas in the carburetting chamber f^6, whilst the heavy tar is deposited and can be withdrawn as required. The carburetted water-gas leaves C at h, is conducted along h^1, h^2, h^3, into the fixing compartment B^2, where those constituents to be converted into illuminating gas are "fixed," whilst valuable by-products, such as benzol, toluol, &c., are deposited and can be drawn off as required. From B^2 the permanent gas passes to the gas-holder or other apparatus. Whilst one compartment of A is being "blown up" the other is producing water-gas; in a like manner the two compartments of the fixing chamber B are used alternately, so that the plant works continuously, the heat being regulated so as not to destroy valuable by-products. When a pure oil-gas is to be made and by-products recovered, the use of water-gas, and, if desired, of the fixing chambers, can be dispensed with, the vapours being passed to suitable condensers direct from the gasifier.—R. B. P.

Improvements in and Apparatus for the Manufacture of Gas for Illuminating or other Purposes. R. O. Paterson, Cheltenham. Eng. Pat. 21,649, November 26, 1892.

To increase the yield of gas from a given quantity of coal, condensable products of distillation are returned to the retort and converted into gas. Attempts have been made before to utilise the gas-exit pipe for returning the condensed products to the retort, but have failed on account of the high temperature of this pipe, which carbonised the products and blocked up the pipe.

According to the present invention a separate pipe is provided, so that the products are returned to the opposite end of the retort to the gas exit, and thus continually circulate until wholly, or nearly so, converted into gas.

The figure shows a suitable arrangement in section. A is the retort, B the gas-exit pipe, which is inclined downwards towards the hydraulic main C, and E the return pipe for condensed products from B. Means of preventing, if desired, the return of ammoniacal liquor to the retort are described.

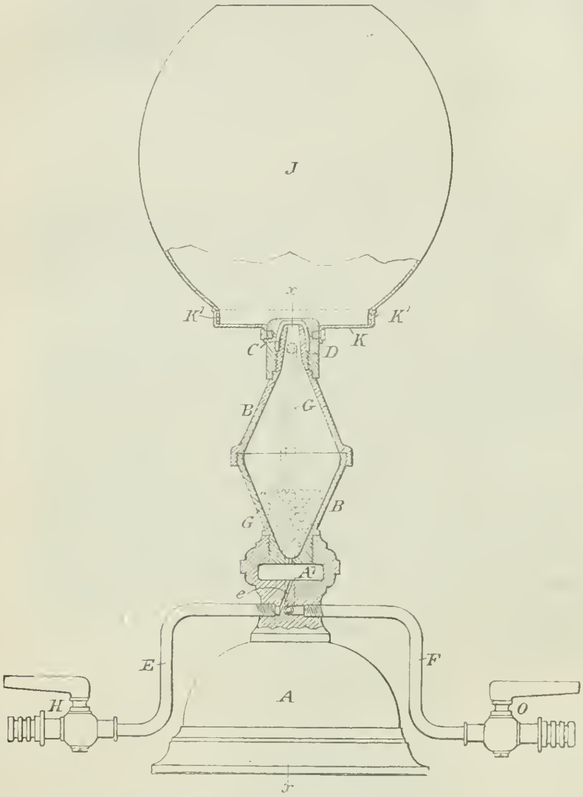


Improved Gas Apparatus. —R. B. P.

Improvements relating to the Production and Use of Light, and to Apparatus therefor. W. Willis, E. J. Humphery, both of London, and W. H. Smith, Penge, Surrey. Eng. Pat. 22,941, December 13, 1892.

This invention relates to the production of light of great actinic power for photographic and other purposes, by burning magnesium, aluminium, or other substances in a flame of hydrogen or other inflammable gas.

The burner consists of two concentric tubes C, D. B is the receptacle for the powdered magnesium. The inflammable gas enters through E and *e*, and passes up through the powdered magnesium, carrying some of it with it in suspension, to the inner tube of the burner C. At the orifice it meets with oxygen supplied to the outer tube D through F, and on being ignited the gas and magnesium powder burn. The lamp, fitted with a lens and chimney, and applied as a "search-light" are described.—R. B. P.



Improved Means for Generating and Utilising Gas or Vapour from Hydrocarbon or other Oils. H. Knieling, London. Eng. Pat. 22,969, December 14, 1892.

This invention relates to the production of gas or vapour from oils by placing a piece of wire gauze over the lighted wick of a burner in such a position that the part of the flame that would have been luminous passes through the gauze as gas or vapour, and may be collected for further use.—R. B. P.

Improvements relating to the Smokeless Combustion of Fuel and to Apparatus for effecting such Combustion. H. H. Lake, London. From E. Clarenbach, Berlin. Eng. Pat. 23,236, December 16, 1892.

This invention relates to furnaces in which the fuel is filled into a shaft or hopper situated over the fire-grate. The air required for combustion is admitted, and the amount regulated at the top of the hopper, and is conducted to the furnace below along an annular flue surrounding the column of fuel. This flue has its inner wall perforated with a number of longitudinal slots through which air can pass into the column of fuel and gases from the fuel into the annular flue. The amount of dry distillation going on gradually increases as the fuel descends towards the fire, and the temperature of the air in the flue, and of the gases driven off from the fuel, gradually gets higher, so that they leave the lower end of the flue and meet the fuel actually burning on the grate in a heated condition, and thus produce a white, smokeless flame.—R. B. P.

Improvements in the Application of an Electric Current in the Boiling or Evaporating of Solutions or Liquids. E. L. C. Schiff, Delft, Holland. Eng. Pat. 24,071, December 30, 1892.

See under XI., *page* 1042.

Improvements in Apparatus for the Manufacture of Illuminating Gas from Mineral Oils and like Bodies, applicable also for Distilling Oils. J. Laing, Edinburgh. Eng. Pat. 35, January 2, 1893.

According to this invention, oil is heated in a still, which is connected by pipes to a superheater. These pipes are of such a length and are kept at such a temperature that all the heavier vapours condense and the resulting oil runs back into the still. By these means only the lighter vapours pass into the superheater for conversion into permanent gas, whereby a saving of heat is effected. Any water present will be condensed with the heavier vapours, and to guard against the sudden evolution of steam that would occur if it was allowed to run back into the still, the liquids formed in the pipes first pass through a "trap," which separates the water. Instead of continuing the distillation until all the oil is "broken down" into light vapours, and only coke remains, the inventor prefers to stop the process when the residue in the still is of such consistency that, when cold, it will form a good pitch. When desired, only a portion of the oil may be converted into gas, and the remainder broken down into lighter oils, by arranging fittings to cut off the superheater and make connection to condensers.—R. B. P.

An Improved System of Increasing the Illuminating Power of Common House Gas by burning the Fumes of Heated Oils in Conjunction with it. C. H. Harrison, London. Eng. Pat. 2376, February 3, 1893.

This invention consists of a metal oil holder, into which ordinary coal-gas enters through a tube, and leaves it through other tubes, passing to the burners. It is so placed that the burner heats the oil and drives off from it vapour, which mixes with the gas before burning. The apparatus is fixed to the pipe or gas fitting.—R. B. P.

Apparatus for Producing an Atmospheric or Bunsen Smokeless Flame from Liquid Hydrocarbons as Fuel. J. Lee, Askrigg, and S. Lancaster, Bainbridge. Eng. Pat. 10,190, May 23, 1893.

This lamp is for burning mineral oils, such as petroleum, having a specific gravity of not less than 0·7. The oil under pressure, which is set up by forcing air into the reservoir by means of a syringe fixed in it, is conducted by suitable tubes to a vaporiser. In this the oil is converted completely into vapour, which, passing through an injector, draws in air, the two passing through a mixing chamber to the burner, consisting of a case covered by a perforated plate, and situated on the top of the mixing chamber.
—R. B. P.

III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

The Manufacture of Ceresin. Edgar von Boyen. Zeit. f. ang. Chem. 1893, 114—120; 148—150; 581—590; 601—607.

The special value of ceresin as compared with other solid hydrocarbons lies in its plasticity; unfortunately, the processes in ordinary use for refining and decolorising ozokerite usually more or less deteriorate the product as regards this property. Thus, sulphuric acid is generally employed to destroy colouring matters, but it also acts on certain hydrocarbon constituents, to the presence of which the plastic nature of this mineral is largely due. When the action of the acid is pushed to the limit, so that no further action is observed with fuming acid, "stable ceresin" results, water-white when molten, fusing at 75° to upwards of 80°, and even less acted on by chemical agents than paraffin wax, from which it also differs in being destitute of crystallinity. Sulphuric acid, however, is not the only possible decolorising agent: chemically precipitated silica is capable of fixing and removing from melted ozokerite the colouring matters contained therein, ultimately yielding a clear white product; the "unstable ceresin" thus produced is much more plastic than "stable ceresin" prepared by means of sulphuric acid, inasmuch as the hydrocarbons attacked by that acid are still present; so that on treatment with acid a vigorous action takes place, accompanied by carbonisation.

Crude ozokerite is comparatively little attacked by sulphuric acid at 80°, the evolution of sulphur dioxide being but slight; at higher temperatures the action is more marked; 160° is the critical temperature for the refining process, inasmuch as at this temperature "separation" takes place, a black asphalt-like product of the action of the acid being formed in a condition capable of separating completely from the pure unattacked hydrocarbon, and subsiding readily on standing; at lower temperatures the formation of this product is incomplete, whilst at higher ones the dark matter does not subside thoroughly, but remains suspended to a greater or lesser extent in the fluid hydrocarbon, and is much less readily removed by subsequent processes. Usually the refining is effected in two stages, sulphuric acid containing 78 per cent. of anhydride being used in the first stage to the extent of 18 to 20 per cent.; after the "acid asphalt" has been formed by heating to 160°, "natural yellow ceresin" results; when white ceresin is required this is again treated with somewhat stronger acid (81 per cent. of anhydride). In order to remove acid products disseminated through the roughly purified hydrocarbon, together with the last traces of coloured impurities, two kinds of "purifying powders" are employed, one (decolorising powders) containing silica or silicates, charcoal from ferrocyanide manufacture, or animal charcoal, &c.; the other (de-acidifying powders) containing simultaneously ingredients that will act as acid neutralisers, and finely-divided carbonaceous matter, so that both chemical and physical actions are called into play during their use. Usually these are more active when employed only air-dry, and consequently containing hygroscopic moisture, than when recently ignited; so that on introduction into the melted hydrocarbon at a temperature of upwards of 100°, a considerable amount of frothing is brought about through the evolution of steam. Some 5 or 6 per cents. of "de-acidifying powder" are usually employed for the first refining, and 3 per cent. for the second; whilst about 2 per cent. of "decolorising powder" is subsequently employed to complete the absorption of coloured impurities.

The operation of refining is one of great simplicity, the points to be attended to being only the admixture of the proper quantity of acid of the right strength at the critical temperature so as to insure the formation of "acid asphalt" in such a solid or semi-solid form as will best effect its removal by subsidence; and the subsequent treatment with purifying powders. The vessels used are made of iron; cast-iron pots are apt to become fissured, whilst wrought iron ones sometimes open at the seams, causing leakage; the latter appear to be preferable, although cast-iron retorts are largely used in the mineral oil industry of Saxon Thuringia, which requires a higher temperature. The pots generally hold some 3,000 kilos. of ozokerite, exclusive of some 0·5 metres or more in depth at the upper part to allow for frothing; they are open at the top, but provided with a hood and exhaust flue to collect and remove the evolved gases. The operation commences by melting down the ozokerite, the heat being sufficient to cause considerable evolution of steam from the moisture in the material, and consequent frothing. In from four to six hours the ozokerite is anhydrous; a wooden cover is then placed on the pot and the fire drawn, so that the mass cools to 115°—120°. The sulphuric acid is then run in in a stream some 3 cm. thick from a leaden measuring vessel until the required amount has been added. In large factories the measuring vessel is conveniently arranged so as to run on an elevated tramway from pot to pot, the acid being fed in as required by means of a movable montejus. During the addition of the acid the whole is well stirred by hand with an iron rod provided with a crook at the end; copious evolution of sulphur dioxide takes place, removed by the exhaust flue. The melting down of the ozokerite is effected conveniently over night, and the addition of the acid made at about 8 o'clock in the morning; the fire is then gradually increased, so that at 10 o'clock the temperature is about 140°. The separation of the "acid asphalt" then begins to take place freely, requiring a second workman to keep up the stirring, so as to prevent the asphalt from sticking to the bottom of the pot and interfering with the heating, as well as damaging the product by becoming burnt; the crook on the stirring rod serves as a scraper. At 12 o'clock the temperature is 160°—165°; by this time the precipitated asphalt has become semi-granular and less liable to stick to the iron and burn, so that the second workman is no longer needed. This temperature is maintained until 3 o'clock, after which it is somewhat raised to 170°—175° until 6 o'clock, the stirring with the crook being still kept up. The whole is then allowed to stand at rest all night; in the morning the temperature has fallen to about 115°. The de-acidifying powder is then added in portions of 5 to 10 kilos. at a time, the whole being stirred with the crook. Copious foaming ensues; when this has subsided the temperature is raised to 130°, about three hours being required for the de-acidification process. Samples are then drawn and filtered through a hot-water funnel; if the liquid filters freely, giving a clear yellow filtrate, the operation is successful so far. The decolorising powder is then added, and the whole well stirred for about an hour or two, after which the mass is ready for pressing and filtration, so as to separate the asphalt and ceresin from one another.

The large amount of labour requisite in this mode of proceeding renders it desirable that mechanical stirring arrangements should be employed whenever possible; accordingly these are being tried and adopted in the more modern and better arranged works. The author describes various forms of experimental apparatus used by him in working out this problem; good results were obtained with certain forms of closed vessels, and by the use of an air-blast as agitator; at the temperature requisite to form asphalt (not exceeding 180°) no injurious effect on ceresin is brought about by contact with air. Closed vessels (provided with an exhaust arrangement for getting rid of sulphur dioxide) possess the further advantage, that the risk of fire is greatly lessened, whilst the saving of labour is very great; moreover, they can readily be discharged montejus-fashion if required.

For pressing and filtration various forms of apparatus are in use, the most satisfactory of which are hydraulic hot presses with some 30 plates and upwards, a pressure up to 200 atmospheres being employed; and a special form of hot filter-press.

In addition to "natural yellow ceresin" prepared by one treatment with acid, and "white ceresin" obtained by subjecting "natural yellow ceresin" to a second treatment with somewhat stronger acid, tinted ceresins are also sent into the market varying from citron-yellow to clear orange-red and dark orange-red; the colouring matters being coal-tar dyestuffs sold under various fancy names for the purpose, *e.g.*, "Sudan," "Lederin," &c. Further, a number of different qualities are distinguished according to the physical texture and fracture, &c., many different varieties from ozokerite of different localities being known. The asphalt press cakes furnish to solvents (*e.g.*, petroleum spirit) considerable quantities of impure ceresin capable of being purified to saleable articles; the insoluble residues, when submitted to dry distillation, yield 10 to 12 per cent. of a yellowish-brown tar, rich in paraffin, and somewhat resembling the paraffin mass similarly obtained from brown coal. "Ceresin compositions" containing paraffin wax or rosin, are also sold.

Various substances have been patented as "decolorising powders" for ceresin. F. Redl finds that by treatment of melted ozokerite with three times its weight of animal charcoal, and then dissolving out the ceresin in an extraction apparatus with petroleum spirit or carbon bisulphide, a nearly white product is obtained, retaining, however, some of the constituents destroyed by sulphuric acid. Precipitated silica, silica, or silicates impregnated with carbon, aluminium silicate, and manganese silicate, have been similarly employed, their power of removing colour from earth wax being greatly superior to that of animal charcoal.—C. R. A. W.

PATENTS.

Improvements in Apparatus for the Manufacture of Gas and of By-products from Liquid Hydrocarbons. P. Dvorkovitz, London. Eng. Pat. 21,647, November 26, 1892.

See under II., *page* 1018.

Improvements in Apparatus for the Manufacture of Sulphate of Ammonia and Liquid Ammonia. R. Dempster, Manchester. Eng. Pat. 22,602, December 9, 1892.

See under VII., *page* 1030.

IV.—COLOURING MATTERS AND DYES.

Valuation of Commercial Indigo. F. Stolba. Chem. Zeit. Rep. 1893, **17**, 66.

See under XXIII., *page* 1064.

Electrolytic Reduction of Nitrobenzene in Sulphuric Acid Solution. A. A. Noyes and A. A. Clement. Technology Quarterly, 1893, **6**, 62.

See under XI., *page* 1041.

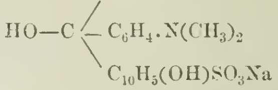
PATENTS.

Improvements in and relating to the Manufacture and Production of Diphenylnaphthylmethane Dyes. H. E. Newton, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 21,139, November 21, 1892.

Dyestuffs of the diphenylnaphthylmethane series are obtained by condensing alkylised diamido benzhydrols with certain α-naphthylamine sulphonic acids, and either oxidising the leuco compounds so obtained, or else sulphonating the compounds and then oxidising the resulting sulphonated leuco derivatives. The α-naphthylamine sulphonic acids specially suitable for the purposes of this invention are those which contain a sulphonic acid group ortho to the amido group, such, for instance, as the acids: α-naphthylamine sulphonic acid [$NH_2 : SO_3H = 1 : 2$], α-naphthylamine disulphonic acid [$NH_2 : (SO_3H)_2 = 1 : 2 : 2'$], or α-naphthylamine trisulphonic acid—

$$[NH_2 : (SO_3H)_3 = 1 : 2 : 4 : 2'].$$

The method employed is, in general, similar to that described in Eng. Pat. 14,728 of 1892. The following example describes the method for carrying out this invention with regard to the colouring matter from tetramethyldiamidobenzhydrol and (1.2)-α-naphthylamine sulphonic acid. A mixture of 4·5 kilos. of the α-naphthylamine sulphonic acid, 5·4 kilos. of tetramethyldiamidobenzhydrol, 40 litres of water, and 5 kilos. of sulphuric acid of 66° B., is heated for a short time to about 90° C. until the tetramethyldiamidobenzhydrol has disappeared. The melt is then poured into about 20 litres of water and a small excess of sodium carbonate is added. The sodium salt of the resulting leuco compound separates in crystals sparingly soluble in cold, but more readily in hot water. In order to oxidise it, 2·48 kilos. of the dry sodium salt are dissolved in strong acetic acid, together with a little dilute muriatic acid, and 4 kilos. of a 30 per cent. lead oxide paste are added. The precipitated dyestuff is filtered off and redissolved in dilute sulphuric acid. After filtering from the insoluble lead sulphate, the colouring matter is salted out. It has the following constitution:—



$$HO—C\begin{cases} C_6H_4.N(CH_3)_2 \\ C_6H_4.N(CH_3)_2 \\ C_{10}H_5(OH)SO_3Na \end{cases}$$

It dyes wool blue from an acid bath. Instead of directly oxidising the leuco compound as above, it may be first sulphonated and then oxidised, the colouring matter finally being either salted out or its solution dried down.—T. A. L.

Application of Nonsulphonated Azo Colouring Matters Insoluble in Water as Body-colours and in Substitution for Mineral Colours for Printing on Textile Fabrics. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 21,166, November 21, 1892.

This is a modification of the process for printing on cotton fabrics with the red obtained from diazotised *p*-nitraniline and β-naphthol, more especially on indigo-blue grounds. The fabric is printed with a well ground-up mixture containing the following ingredients: 100 lb. of "dry lake from *p*-nitraniline and β-naphthol," 400 lb. of water, 80 lb. of gum water, 140 lb. of albumen water (1·1), and 70 lb. of neutral sodium chromate. After drying, the goods are passed for 20 seconds at 60° C. through a bath containing 7 oz. of sulphuric acid of 66° B., and 7 oz. of oxalic acid, well washed and dried. The employment of other insoluble azo-colouring matters in a similar manner gives brilliant orange-reds, reds, and claret-reds, which are fast to water, washing and light, and possess an advantage over vermilion both as regards purity of shade and price.—T. A. L.

Improvements in the Manufacture of Tetra-nitro-anthrachrysone. O. Imray, London. From the "Farbwerke vormals Meister, Lucius and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 22,443, December 7, 1892.

Anthrachrysone is dissolved in 12 times its weight of concentrated sulphuric acid and the solution is poured into nitro-sulphuric acid containing sufficient nitric acid to convert the anthrachrysone into a tetra-nitro compound. During the nitration the nitro compound separates as a yellow crystalline mass, and towards the end of the operation the whole is heated to about 80° C. After cooling, the mixture is poured on to ice and diluted with sufficient water to precipitate the whole of the nitro compound. The crude product thus obtained is purified by precipitating it from its aqueous solution by adding concentrated hydrochloric acid, and the precipitate is washed with diluted hydrochloric acid. Tetra-nitro-anthrachrysone dissolves easily in the usual solvents, but is insoluble in benzene, petroleum ether, and chloroform. It is precipitated by chloroform from its solution in glacial acetic acid in small crystals, which fuse and detonate when heated to 280°—300° C. The sodium, potassium and ammonium salts are insoluble in alcohol and detonate when heated. The substance can be used as a dyestuff and gives brown shades on chromed wool and claret-brown shades on wool mordanted with alumina. The colours obtained are brilliant and fast to fulling.—T. A. L.

A New Group of Basic Colouring Matters and Means for producing the same. S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 22,572, December 8, 1892.

The dyestuffs described are azo colouring matters containing a basic group, and are thus capable of dyeing cotton mordanted with tannin. The new base for producing these colouring matters is *p*-amido-benzyl-dimethylamine $(CH_3)_2.N.CH_2.C_6H_4.NH_2$, which is obtained by condensing *p*-nitrobenzyl chloride with dimethylamine and reducing the condensation product. The following example illustrates the method employed for producing the dyestuffs:—A solution of 15 kilos. of *p*-amido-benzyl-dimethylamine and 40 kilos. of muriatic acid is diazotised with 7 kilos. of nitrite. The easily soluble diazo compound is run into a diluted solution containing 14·5 kilos. of β-naphthol, 4 kilos. of sodium hydrate, and 40 kilos. of sodium carbonate. The dyestuff separates in orange-coloured flakes, and, after filtering off, is dissolved in 12 kilos. of hydrochloric acid and 200 litres of water and precipitated with salt. The hydrochloride of the dyestuff forms a greenish tarry mass, which dissolves easily in water to an orange solution and dyes tannined cotton the same shade fast to washing and light. By substituting other components for the β-naphthol, other shades can be obtained varying from red, through orange, to yellow and brown.—T. A. L.

The Manufacture or Production of New Colouring Matters. H. E. Newton, London. From the "Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 23,211, December 16, 1892.

This is an extension of the following specifications: Eng. Pat. 8299 of 1889 (this Journal, 1890, 608); Eng. Pat. 18,517 of 1889 (this Journal, 1890, 1032); Eng. Pat. 5984 of 1891 (this Journal, 1892, 345); and Eng. Pat. 14,927 of 1892 (this Journal, 1893, 673). The subject-matter of the last-named specification is the production of colouring matters by combining the diazo compounds of certain amido-carboxylic acids and their derivatives with phenols, naphthols, dihydroxynaphthalenes, and their sulphonic and carboxylic acids, or with amidonaphthol sulphonic acids, or with *m*-phenylene or *m*-tolylene diamine. In the present extension it has been found that the amido-carboxylic acids and amido-hydroxycarboxylic acids of Eng. Pat. 14,927 of 1892 can be replaced by amido-phenol ether carboxylic acids, their homologues, or substitution products. The actual claims only refer to the production of colouring matters from diazotised amido-anisic acid or amido-ethyl-salicylic acid and the 1.3, 1.4, or 1.4^1, α-naphthol sulphonic acids. The colouring matters obtained give brilliant shades on chromed cotton, some of them being equal in brilliancy to alizarin red.—T. A. L.

The Manufacture and Production of New Basic Dyes and of New Materials for use in their Preparation. J. Y. Johnson, London. From the "Badische Anilin und Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 23,397, December 19, 1892.

These colouring matters belong to the rhodamine series, and are derived from mono-alkylated amido-cresols, which are obtained by fusing the mono-alkyl-*o*-toluidine-*p*-sulphonic acids with potash. The compounds thus obtained have the general formula $C_6H_3.CH_3.NHR.OH[1:2:4]$, and can be converted by heating with phthalic anhydride into symmetrical dialkylated rhodamines, according to Eng. Pat. 15,374 of 1887 (this Journal, 1888, 745). By further alkylation, as described in Eng. Pat. 9633 of 1892 (this Journal, 1893, 441), these dialkyl-homo-rhodamines yield new basic dyestuffs. The following details are given:—About 10 kilos. of ethyl-*o*-toluidine are dissolved below 60 C. in 20 kilos. of sulphuric acid containing 23 per cent. of anhydride, and subsequently 30 kilos. of 70 per cent. anhydride are gradually added. The melt is allowed to stand at 40°—70° C. until a test dissolves completely in dilute alkali, when the whole is poured on to ice. The sulphonic acid separates in a crystalline form, and is converted into its sodium salt. This is then fused with two to three times its weight of caustic potash at 260° C. for some hours, until a test shows the absence of sulphonic acid. The melt is then dissolved in water acidulated with hydrochloric acid, and, after filtration and neutralisation with soda, is extracted with ether or benzene. On distilling off the solvent the ethyl-*o*-amido-*p*-cresol remains as an oil, which solidifies on standing and can be recrystallised from a mixture of benzene and petroleum ether. For the production of the so-called homo-dialkylrhodamine, about 10 kilos. of the ethyl-*o*-amido-*p*-cresol, 10 kilos. of phthalic anhydride, and 5 kilos. of zinc chloride, are heated in an enamelled pot to 170°—200° C. for about one hour. When cold, the melt is powdered, well washed, and digested for 24 hours with dilute caustic soda solution. The homo-rhodamine base thus obtained is filtered off, washed, and dried. It is converted into its hydrochloride by dissolving in hydrochloric acid and pouring into a small quantity of water. To further alkylate these compounds the homo-rhodamine base is dissolved in methyl, ethyl, or amyl alcohol, or in glycerol, and hydrochloric acid is passed through the solution, or any of the other methods described in Eng. Pat. 9633 of 1892 may be employed.—T. A. L.

Improvements in the Manufacture of Colouring Matters. H. H. Lake, London. From Kalle and Co., Biebrich-on-the-Rhine, Germany. Eng. Pat. 23,672, December 22, 1892.

When *p*-nitrotoluene sodium sulphonate is heated with one-tenth its weight of soda to 103° C. (Chem. Ind. 1887, 307) it yields a yellowish red dyestuff which dissolves in concentrated sulphuric acid with a violet colour and is said to be identical with the product obtained according to Ger. Pat. 38,735, by mixing 5 kilos. of *p*-nitrotoluene sodium sulphonate, 70 litres of water, and 3 kilos. of soda lye of 30° B. According to the present specification a substance of definite composition is obtained by acting with a considerable excess of soda lye at a low temperature on the *p*-nitrotoluene sodium sulphonate, the product obtained being yellower and having the formula of the sodium salt of a dinitrosostilbene disulphonic acid. It dyes wool or unmordanted cotton a reddish-yellow. On reduction it yields an orange-red dyestuff, whilst oxidising agents produce a greenish-yellow colouring matter. The former dissolves in concentrated sulphuric acid with a blue and the latter with a brown colour. A solution of 10 kilos. of *p*-nitrotoluene sodium sulphonate, 100 litres of water, and 20 kilos. of soda lye of 40° B. is heated for an hour to about 70° C. The colour of the solution which at first is an intense magenta changes to orange-yellow, and the sodium salt of the new acid separates out in orange-yellow crystals. The oxidation product is obtained by mixing the dyestuff paste with 7·5 kilos. of sulphuric acid (2 : 1), and adding 4·2 kilos. of powdered potassium bichromate with constant agitation. After standing 12 hours the reaction is complete. An equal volume of water is then added, the dyestuff is filtered off, washed with dilute brine, dissolved in ammonia, and evaporated to dryness. The reduction product is prepared by dissolving 10 kilos. of the sodium salt of the new acid, and 13·4 kilos. of ferrous sulphate in 100 litres of water. Sufficient ammonia is then added to precipitate the ferrous oxide and the whole is boiled and filtered hot from the ferric oxide. The dyestuff is precipitated from the solution with salt. A product having similar properties can be obtained by heating one part of the sodium salt of the new acid with 5 parts of water for three hours to 180° C.—T. A. L.

Improvements in the Production of Paramagenta and its Homologues from the Corresponding Leuco Bases. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, und Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 23,893, December 27, 1892.

Hitherto no satisfactory method for use on a manufacturing scale has been devised for oxidising triamido-triphenylmethane (paraleucaniline) and its homologues, triamido-diphenyl-tolyl-methane, triamido-ditolyl-phenyl-methane, and triamido-tritolyl-methane, into the corresponding carbinols (rosaniline bases). The oxidation can, however, be performed by dissolving the leucaniline bases in acetone, methyl ethyl ketone or in ethyl or methyl alcohol, and oxidising them in presence of water and salt by means of manganese peroxide and acetic, tartaric or oxalic acid. About 10 kilos. of paraleucaniline are dissolved in 15 kilos. of acetone and mixed with 10—12 kilos. of diluted acetic acid, 10 litres of brine, and 2 kilos. of salt, and oxidised by running in Weldon mud. After agitating about an hour, the acetone is distilled off at 60°—70° C., and the paramagenta remains behind after running off the salt solution. It is extracted by repeated boiling with water and is precipitated from its aqueous solution by adding salt.—T. A. L.

Manufacture of Yellow to Red-brown Colouring Matters, suitable for Dyeing Wool. O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 188, January 4, 1893.

The colouring matter described is the sodium salt of the disulphonic acid of anthrachrysone, having the formula $C_{14}H_6O_6(SO_3Na)_2$. Purified anthrachrysone is mixed with 3—4 times its weight of fuming sulphuric acid containing 10—20 per cent. of SO_3, and the mixture is heated to 100° C. until completely soluble in water. The melt is then poured into a large quantity of water, boiled, filtered from unaltered anthrachrysone, and the sodium salt is precipitated by adding sodium carbonate. On recrystallisation from dilute acetic acid the acid sodium salt forms golden leaflets with a greenish reflex. It dyes unmordanted wool yellow from an acid bath, gives reddish-brown shades on chromed wool and orange shades on wool mordanted with alumina. The shades produced are said to be bright, even, and fast to soap.—T. A. L.

V.—TEXTILES: COTTON, WOOL, SILK, Etc.

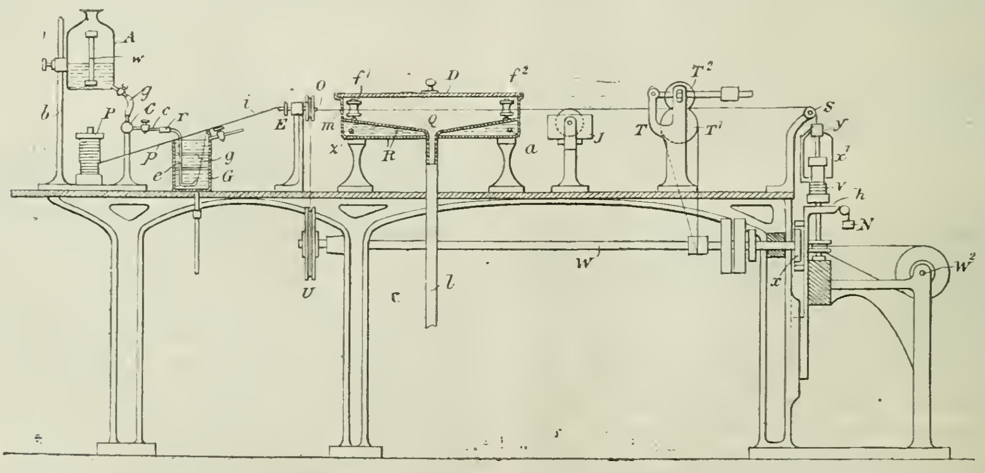
PATENTS.

Improvements in the Method of and Apparatus for Rendering Textile Fabrics Waterproof by one Treatment or Process. J. Miller and J. Miller, jun., Bradford. Eng. Pat. 14,029, August 3, 1892.

These are improvements upon Eng. Pat. 9711, 1890 (this Journal, 1892, 937). For regulating the supply of ingredients insoluble in water the inventors employ adjustable rollers or doctors placed upon and bearing against one side of the cylinder over which the cloth passes. Also for pressing the ingredients into the cloth, they employ a loose roller, which bears upon the cloth as it passes over the cylinder. Also the cloth in passing through the machine may pass over suitable reversible expanders, then through a trough and over reversible expanding suction tubes, suitable for one or two pieces in width, such suction tubes being constructed with internal divisions, dispensing with covers. The fabric then passes under and over two or more heated cylinders, over a compensating roller (for taking up the slack) expanders and guide rods to the cylinder working within the trough containing ingredients insoluble in water; then through a similar series to the one just described, then forwards over guide rod and expander to two or more heated rollers, after passing over and under which it is taken up by a tentering or other drying machine.
—E. G. P. T.

Improvements in the Process and Machinery for Producing a Thread or Filament similar to Silk. F. Lehner, Zürich. Eng. Pat. 22,736, December 10, 1892.

These are improvements on a previous patent, 11,831, 1891, (this Journal, 1892, 680). By the process a solution mainly composed of nitrocellulose is made to flow from small orifices into a liquid, such as water, turpentine, &c., and is drawn out into a fine thread. To produce such a thread from a 5 per cent. solution of nitrocellulose is a comparatively easy matter, but when, in order to obtain stronger threads, the nitrocellulose in solution is raised to 10 per cent., the solution becomes so thick that the production of a thread requires a pressure of several atmospheres to make it flow through fine orifices. The inventor gets over the difficulty by treating a strong nitrocellulose solution with sulphuric or other mineral acid. As an example, to a 20 per cent. solution of nitrocellulose in wood spirit or ether, 1—2 parts of sulphuric acid (66° B.) are added, and heat is applied. A compact precipitate, redissolving on shaking, is produced, and the solution is then much clearer and more mobile than before. The machine for manufacturing the threads is constructed as follows:—The reservoir A, which contains the solution, is provided with a gauge glass *w*, and can be adjusted higher or lower on the support *b*. The reservoir is also connected by a rubber tube *g* to a pipe C. This pipe C has a number of outlets, connected by a number of rubber tubes ***r*** to a corresponding number of S-shaped glass



tubes *e*. The upper bend hooks over one side of a trough G, the lower bend is close to the bottom of this trough, and the bent-up end is made to terminate in a narrow aperture. From this narrow aperture the solution enters the solidifying liquid contained in G, and is then drawn out and extended into threads. Any suitable solidifying liquid may be used, as for example, turpentine, or water, or petroleum. The glass tubes are kept separate in the trough G by loosely inserted glass partitions, which do not impede the circulation of the liquid, but prevent the filaments from becoming entangled, should any filament break. Any number of the filaments *i*, seven is a suitable number, are, as they form, conducted jointly to guides at E. At E, if desired, a thread or filament *p* of any other material, natural or artificial, may be added, for instance, a cotton thread, real silk thread, or others, this additional thread is contained on the spool P, and is guided from the spool below the tube C, over the trough G to the guide E. The united filaments *i* and the natural filaments *p* are now steadily drawn off by the mechanism T, and then guided through a narrow aperture *m* to the drying chamber Q, which is closed as air-tight as possible, and provided with a lid D. On leaving the drying chamber the filaments reach the denitrating appliance T. This consists of a roller partly immersed in a denitrating liquid, by preference ammonium sulphide, which removes a portion of the nitro groups and neutralises any free acid which may adhere to the filaments. By the drawing-forward mechanism T the filaments are then drawn over the guides S to the spinning apparatus x^1, which may be of any known suitable construction.—E. G. P. T.

Improvements in the Manufacture of Linoleum and similar Floor-cloth Preparations. A. Campbell, Fifeshire. Eng. Pat. 23,325, December 19, 1892.

Dried peat, turf, "moss litter," or other similar vegetable matter is thoroughly dried and ground to powder, which is then used instead of ground cork for making linoleum and similar floor-cloth preparations.—C. R. A. W.

Improvements in the Manufacture of Textile Fabrics, also applicable to Cord, Rope, and the like. W. Darlow, Plaistow, London. Eng. Pat. 23,741, December 23, 1892.

The invention consists in weaving or intertwining threads of aluminium, either by itself or along with the material usually employed in the manufacture of cloth of various descriptions, lace, rope, cord, and the like.—E. G. P. T.

Improvements in the Method of and Apparatus for Extracting Suint or Yolk from Wool. R. J. Urquhart, Manchester. From E. Richard-Lagerie, Roubaix, France. Eng. Pat. 12,433, June 24, 1893.

See under XII., *page* 1044.

An Improved Method of Conditioning Textile Fibres and Apparatus therefor. W. Saulmann, Berlin. Eng. Pat. 9,830, May 17, 1893.

A number of drying drums are arranged in a box made of non-conducting material over a source of heat. The drums can be shut off from the outside by means of stop-cocks, and are for the reception of the textile fibres to be dried. They are all, at one end, in connection with a single discharge pipe leading to a fan. At the other end they give admission to a current of air which has first been dried by passing through large upright vessels or towers containing hygroscopic materials, and then heated by passing through a spiral coil contained in a heating tower. The drums, which are weighed at the beginning of the operation, after being charged with the damp fibre, are again weighed at the end of the operation, after the stop-cocks have been closed. —E. G. P. T.

An Improved Impervious Sack or Sacking, and a Method and Means for the Production thereof. E. Pierret, Vilvorde, Belgium. Eng. Pat. 17,003, September 9, 1893.

The sacking consists of a woven fabric or ordinary sacking of either flax, jute, or hemp. It is coated on one side with a compound adapted to render it impervious to damp or atmospheric influence. This compound consists of a mixture of artificial bitumen (refuse from petroleum distillation), 60—80 parts, pitch, such as is obtained as refuse in the saponification of palm-oil, 5—20 parts, and chalk about 20 parts. After application of this mixture, a layer of thin paper is pressed down upon it, so as to act as a protection against adhesion of other matters. This sacking may be prepared in the piece and then cut up to form sacks or bags. A machine for the application of the compound to the sacking forms part of the claim.—E. G. P. T.

VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

Preparation of Chlorate of Soda. G. A. Schoen. Bull. Soc. Ind. Mulhouse, February—March 1893, 93.

See under VII., *page* 1029.

The Metallic Sulpholeates and their Use as Mordants for Steam Colours. A. Scheurer. Bull. Soc. Ind. Mulhouse, February—March, 1893, 95.

Sulpholeate of alumina (prepared by precipitation and well washed), admixed with colouring matters capable of forming alumina lakes, combines with them and is used on the fibre by the process of steaming. Alizarin under these conditions gives a colour which attains its maximum of brilliance on simply washing, if printed on to calico prepared with sulpholeate of soda or ammonia. An addition of stannic sulpholeate adds considerable fire to the red. Alizarin-orange fixed in the same way gives very good results and the colour keeps well. Persian berries, bark, and wild extracts, and all colouring matters fixable by acetate of alumina, also give good results with the sulpholeate. The sulpholeates of chrome and iron also give excellent results, particularly for pale shades, when substituted for the acetates of these metals. Scheurer, Rott, and Co. have used the sulpholeate of alumina since July 1881. (The firm of Zurcher also have been in the habit of using sulpholeate of magnesia as an addition to steam-pinks.)—W. E. K.

The Destructive Action of "Steaming" on Cotton and Wool. A. Scheurer. Bull. Soc. Ind. Mulhouse, February—March 1893, 89.

Two series of experiments were made with calico, in the one case the cloth being well boiled out with water, soured, and well washed (grey), whilst in the other the cloth was subjected to a soda boil and well washed (white). The cloth thus treated was then steamed for from 60 to 540 hours at a constant temperature of 99°—100° C., and the strength tested at intervals of 60 hours. The grey and white cloth show practically the same results. The first 60 hours' steaming has a weakening effect equal to 20 per cent., and up to 360 hours the destruction of the cellulose goes on regularly, the cloth being weakened to the extent of 70 per cent. The destructive action is then slower, and at 540 hours it amounts to about 85 per cent.

The experiments on wool were made with grey cloth, scoured with lukewarm soap and soda-ash, washed, soured with weak oxalic acid, and again thoroughly washed. The cloth was then steamed, but for a shorter time than the cotton, as the destructive action is greater. During the three first hours the wool is weakened 18 per cent., and afterwards the destructive action slackens and equals about 12 per cent. for each successive interval of 12 hours, amounting in 60 hours to 75 per cent., a destructive effect equal to that produced on cotton only after 420 hours' steaming.—W. E. K.

The Dyeing of Woollen Hats. E. Herzinger. Färber-Zeitung, 1893, 281—282 and 300—302.

The artificial organic dyes are at the present time principally employed in this industry (Germany) in place of the dyes of natural origin, on account of their greater colouring power and clearness of tone. Of these, the colouring matters derived from anthracene are employed with especial advantage in the dyeing of hats which have to be subsequently stiffened, and then, in an after process, cleansed on their surface with alkalis, the supreme fastness of the alizarin dyes rendering them particularly suitable for application to such purpose; moreover, the hats so dyed do not acquire a harsh feel thereby, and do not suffer any change of colour in the operations of finishing and stiffening. The dyes derived from benzene and naphthalene are almost restricted in their application in this industry, to the colouring of women's hats, in both pale and dark shades.

Preliminary Operation.—Previous to dyeing, the hat bodies are thoroughly moistened by immersion in boiling water for ½—¾ hour.

Mordanting.—For 18 dozen unstiffened hat bodies (weighing in all about 18 kilos.), or 22 dozen stiffened ones (weighing about 25 kilos.), 800—850 grms. of potassium bichromate and 280 grms. of oxalic acid are taken, in a bath of which the hat bodies are boiled 1½ hours.

Oxalic acid is employed in mordanting in preference to tartaric acid, as the mordant which is produced by its agency, while adapted for the dyeing of dark shades, furnishes paler colours of purer tone than does the mordant formed from potassium bichromate and tartaric acid.

For dyeing pale colours, a boiling with 8—10 per cent. of common salt for half an hour, after treating as described, is further to be recommended.

Dyeing.—The dye-bath having been heated to a temperature of about 30°, the requisite dyes are added, with 800 grms. of ammonia solution and 3 kilos. of sodium sulphate, and then the mordanted hat bodies. These are worked about for 20 minutes before the temperature is further raised, which is so accomplished that the bath arrives at the boil in 1¼ hours, and is maintained boiling, according to the thickness of the felt, for ¾—1½ hours, or until completely penetrated by the dye. The hat bodies are then taken out, placed on a stillage, and straightened. Meanwhile a second bath is prepared, consisting of one-third of the first bath and two-thirds cold water, to which 2½ kilos. of acetic acid and 1 kilo. of sodium bisulphate are added. Into this the hat bodies are now put, and then the temperature of the bath is gradually raised to 100°, and kept thereat for ¾ hour. In this second bath the shades may, if necessary, be conveniently darkened or modified by the addition to it of rapidly dyeing colouring matters, such as a fustic extract, Anthracene yellow C, Oranges II and IV, Azocarmine, Patent blue B, Cyanine B, Cyanol extra, and Anthracite black, the employment of alizarin colouring matters at this stage being less practicable in consequence of the longer time which they require to dye.

The following are examples of appropriate mixtures of dyes for obtaining the shades in vogue.

[The quantities given refer to the weights of goods mentioned above; and the dyes, except when otherwise stated, are employed in the state of powder.]

DRABS.

	Grms.
Anthracene brown	25—65
Alizarin yellow GGW	5—8
Alizarin black	3—25

BROWNS (=" MORLOV," " NUTRIA," AND " TABAK ").

	Grms.
Anthracene brown	75—239
Anthracene yellow C	10—20
Azocarmine, concentrated paste	0—10
Cyanine B	10—0
Anthracite black B	30—55

OLIVE BROWN.

	Grms.
Fustic extract, syrup	2,250
Anthracene brown	250
Alizarin black WR	80

GREYS.

	Grms.
Alizarin black WR	15—30
Galleïn	20—30
Patent blue B	4—60
Azo-orseillin V	2½—0

Greys are also obtainable, without previous mordanting of the wool, with Anthracite black alone, sodium sulphate being employed as assistant to the dyeing.

In the dyeing of darker shades of brown it is advisable to dispense with chrome as mordant, owing to the rims of the hat bodies mordanted with it taking a deeper colour than the rest of the felt. A preferable method of dyeing in this case, when phenolic colouring matters are used, is to apply them before the mordanting salt or salts, as in the following example, in which the quantities mentioned are for 18 dozen unstiffened or 21 dozen stiffened hat bodies.

MEDIUM OLIVE BROWN.

Boil the wool-felt, which has previously been thoroughly moistened, for 1½ hours with—

Sumac extract	1 kilo.
Fustic extract, syrup	3 kilos.
Logwood extract, syrup	150 grms.
Acetic acid	300 „
Cloth red B	70—80 „

then fix with—

	Grms.
Copper sulphate	750
Ferrous sulphate	400

by boiling ½—1 hour.

The fashionable coffee-brown shade is obtained in this manner, employing, however, a larger quantity of cloth red and less fustic than those given. 10—30 grms. of magenta may be added to the bath, after dyeing as above, to redden the shade, if desired, the hat bodies being then immersed in the bath for 20 minutes longer.

Hat bodies which have been felted in the presence of acid do not sadden so well with ferrous sulphate as those felted by the aid of alkalis. This difficulty may be overcome by increasing the quantity of ferrous sulphate which is employed and adding a little soda to the bath, or it may be evaded by dyeing the mordanted hat bodies in an acid bath with appropriate dyes, as Cloth red B, Anthracite black B, and Anthracene yellow C.

For *blacks*, logwood is still employed as chief dyestuff, along with fustic, Azo yellow, Indigo carmine, Acid violet 6 B, and Patent blue, and in conjunction with mixed mordants of chrome and copper and copper and iron. Woollen hats which are to be stiffened are proofed before dyeing, as the logwood colour-lake, which becomes deposited in and about the fibres on dyeing, resists the penetration of the pores of the felt by the shellac solution employed for stiffening, and thus prevents this operation being afterwards performed. The following two recipes illustrate the mode of dyeing, the quantities prescribed being for 50 dozen stiffened hat bodies.

BLACK ON CHROME-COPPER MORDANT.

Mordant by boiling for 1¼ hours with—

	Kilos.
Potassium bichromate	2
Acid potassium tartrate	1·75
Copper sulphate	1
Oxalic acid	0·3

dye for 1 hour with a freshly-prepared decoction of 45 kilos. of logwood and 200 grms. of fustic extract.

Black on Iron Copper Mordant.

Mordant for $1\frac{1}{2}$ hours with—

	Kilos.
Ferrous sulphate	4·5
Acid potassium tartrate	2
Copper sulphate	1

and dye with the extract of 37·5 kilos. of logwood and 0·75 of fustic extract syrup.

Mélanges.—These are obtained by dyeing wool in the loose state in the ordinary way, mixing variously-dyed portions, and forming and felting them together to produce the hat bodies.

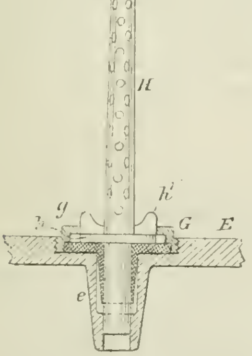
If the felting is effected with the assistance of sulphuric acid, colouring matters dyeing on the chrome mordant, as Alizarin black, Alizarin blue, Alizarin orange, Anthracene brown, Alizarin yellow GGW, Anthracene yellow, and Anthracite black, are employed for colouring the wool, but on no account logwood. For black, Naphthylamine black D (5 per cent.), which is applied without mordant in a bath acidified with sodium acid sulphate ("bisulphate of soda") ($2\frac{1}{2}$ per cent.), and acetic acid ($2\frac{1}{2}$ per cent.), is commendable. For *white*, the yellow tint of the wool which remains after bleaching is neutralised with a minute quantity of formyl violet 4 BS.

When the felting is performed with the aid of a solution of soap, logwood and other natural dyestuffs may be employed for the obtainment of various shades of olive and grey, and, along with alizarin red S and orange, for browns and brown olives, the wool being mordanted with simple or mixed mordants of alumina, chrome, and copper. In chroming, excessive action on the wool is to be avoided, on account of the injury to the felting properties of the fibre which it occasions. For whitening the wool which is to be incorporated in an undyed state with the coloured fibres, a small quantity of methyl violet 6 B may in this case be employed.—E. B.

PATENTS.

Improvements in or connected with the Fastening or Attaching of the Perforated Spindles or Skewers in Cop-Dyeing Machines. R. Shaw, Manchester. Eng. Pat. 17,047, September 24, 1892.

The cop-skewers H (see figure) are fixed in the plates E by means of metallic screw-washers *g*, which fit over projections h^1 on flanges *h*, with which the skewers are provided, and rest on india-rubber seatings G.



Instead of employing a separate washer for each skewer, a plate with a number of projecting sockets constructed so as to fit down into the sockets *e* of the plate E may be used; and instead of a screw-washer a plain metal washer held in position by screws projecting from the plate E may be employed.—E. B.

Improvements in the Production of Fast Colours on Fibres by Means of Dyeing and Printing. P. H. Newton, London. From "The Farbenfabriken vormals Friedrich Bayer and Co.," Elberfeld, Germany. Eng. Pat. 20,444, November 11, 1892.

The diazo-azo compounds obtained by the combination of one molecular proportion of a tetrazo salt (of benzene, diphenyl, phenyltolyl, ditolyl, mono-alkylhydroxydiphenyl, mono-alkylhydroxyditolyl, diphenoldialkyl ether, diphenoxyacetic acid, naphthalene, fluorene, stilbene, carbazol, diphenylene oxide, ditoluylene oxide, &c. (Eng. Pat. 2213 of 1886), with one molecular proportion of an aromatic amido- or hydroxy-compound, possess the property of dyeing vegetable fibres and silk at temperatures below 60° C. without undergoing decomposition. The diazo compounds thus fixed upon the fibre can be converted into valuable dyes by treatment with solutions of amido bases or phenols or their sulphoxy- or carboxy-derivatives. A brown-red colour, for example, is dyed on cotton by immersing the latter first in an acidified solution of naphthalene-azo-diazo-diphenyl chloride at 30°—40° C. for 3—5 hours, and then, after wringing (but without rinsing), passing it into a dilute alkaline solution of β-naphthol. Similarly an intense black is developed on cotton, by treating it successively with naphthalene-azo-diazo-diphenyl chloride, α-naphthylamine, nitrous acid, and 1 : 8-dihydroxynaphthalene-α-monosulphonic acid.

For printing purposes a paste containing 5 to 6 per cent. of any of the above-mentioned diazo-azo compounds is prepared, and for application is incorporated with a suitable thickening paste, acetic acid and sodium acetate, the printed material, without being dried, being passed immediately into the developing bath. A second method of printing consists in preparing the yarn or tissue with a developing agent (that is, a phenol or amido base) before applying the diazo-azo paste. In the case of the amido-diazo-azo compounds, the process may be modified by subjecting the printed materials to a diazotising operation before developing.—E. B.

A Machine for Dyeing Wool, Yarns, and similar Material. R. B. Archibald, Tillicoultry, Scotland. Eng. Pat. 21,189, November 22, 1892.

The purposes of this invention are to avoid oxidation by exposure of the material to air, and to obtain even dyeing without moving the material during the process. In this machine the wool is enclosed between an upper and a lower perforated plate, which together form a tray. A series of such trays is arranged one above another, with a perforated plate between each two, in a cage made of tinned steel. This cage is provided with gearing for raising it out of the liquor when required. The dye solution is caused to circulate in various directions through the various sieves and trays.—R. B. B.

An Improved Process for the Production of Coloured Patterns upon Aniline Black Grounds in Calico Printing. The Thornliebank Company, Limited, and W. E. Kay, Thornliebank, Glasgow. Eng. Pat. 713, January 12, 1893.

The goods are first padded with a solution containing aniline salt and a chlorate and ferrocyanide of an alkali metal, this being a mixture capable of forming aniline black, when subjected to the usual ageing process. After carefully drying, a solution of a basic coal-tar colour is printed on the fabric, together with the resist and thickening. The resist consists of a metallic acetate, usually that of sodium or zinc. On subsequent ageing the coloured pattern appears on a black ground.—R. B. B.

Improved Means for Cleaning, Mordanting, and Dyeing Fabrics and Tissues. H. Gardner, London. From C. P. Andersen, Copenhagen, Denmark. Eng. Pat. 15,085, August 5, 1893.

A preparation is described containing palm oil, brine, onions, bark extract, vinegar, turpentine, potash, and soda lyes. Boracic acid and a colouring matter are added, and the mass, dissolved in or diluted with water, is applied by means of a brush or by friction to the fabric, which assumes thereby a clean, fresh, and new appearance.—R. B. B.

VII.—ACIDS, ALKALIS, AND SALTS.

The Melting Points of Inorganic Salts. V. Meyer and W. Riddle. Ber. 1893, **26**, 2443—2451.

The melting points of various salts have been determined by fusing sufficiently large quantities in a platinum dish holding 200 cc., superheating to some extent, and then allowing to cool, stirring the while with a stout platinum rod. When solidification commences the temperature remains practically stationary for awhile, so that the remaining air (or nitrogen for higher temperatures) can be expelled by means of a current of hydrochloric acid gas whilst the temperature is constant, and measured over water, the temperature being known from a comparison of the volume of air (or nitrogen) thus obtained, and that originally contained in the air thermometer at the starting temperature.

As check experiments, the fusing point of an alloy of lead and tin was determined by means of this arrangement (using an earthenware dish) to be 192°—193°, the same figure being obtained by means of a mercurial thermometer; whilst the average values of several concordant observations gave 80·4°, 275°, and 419° as the melting points of naphthalene, anthraquinone, and zinc respectively.

The following mean values were obtained with the salts, &c. examined, 10 observations being made in each case:—

Substance.	Melting Point.
	° C.
Sodium chloride	851
„ bromide	727
„ iodide	650
Potassium chloride	766
„ bromide	715
„ iodide	623
Potash	1,045
Soda	1,098
Borax	878
Sodium sulphate	843
Potassium sulphate	1,073

—C. R. A. W.

Decomposition of Hydriodic Acid Gas by Heat. M. Bodenstein. Ber. 1893, **26**, 2603—2611.

When hydriodic acid gas is heated to 100° in a sealed tube for three months from 0·0012 to 0·0024 per unit of gas is decomposed; whereas 180° is the lowest temperature of decomposition, as usually stated in the text books. With periods of from 150 to 500 hours at temperatures 290°—340° larger proportions are decomposed, and still greater ones at 350°—518° in shorter times still; thus:—

Temperature.	Time.	Decomposition per Unit of Gas.
290° metal bath	500—700 hours	0·1637
310° diphenylamine vapour	300—400 „	0·1669
320° metal bath	264—336 „	0·1601
340° phenanthrene vapour	150—200 „	0·1706
350° mercury vapour	96—140 „	0·1763
394° retene vapour	24—30 „	0·1957
448° sulphur vapour	3—5½ „	0·2143
578° phosphorus sulphide vapour.	15—20 minutes	0·2363

The amounts of decomposition stated in the last column are the constant values attained when the two reversible actions taking place exactly balance one another; *i.e.*, the tendency of hydriodic acid to break up into iodine and hydrogen, and the opposite tendency of hydrogen and iodine to recombine, forming hydriodic acid. The value is a minimum at 320°, in accordance with the thermo-chemical values involved (discussed in a previous paper, Ber. 1893, **26**, 1146); for the value of the heat of formation of hydriodic acid is negative at 18° (—6,100 calories—J. Thomsen), but must become positive at 350°—448°, in accordance with van 't Hoff's principle, since the amount of decomposition increases with the temperature between these limits.

From these data the value of a constant C, representing the rate of change, is deducible, as shown in the previous paper (*loc. cit.*). This constant is dependent on the pressure, varying directly therewith; thus in a series of observations, where the pressures at the time of filling the tubes employed (at 15°) were made to vary, the following values were obtained as the amounts of decomposition produced, when equilibrium was attained between the decomposing and recomposing tendencies; it is remarkable that the amounts decomposed *increase* with the pressure:—

Temperature.	Pressure in Atmospheres.			
	0·5	1·0	1·5	2·0
Mercury vapour = 350°.	0·1349	0·1763	0·1920	0·1987
Sulphur vapour = 448°.	0·2019	0·2143	0·2225	0·2306
Phosphorus sulphide vapour = 518.	0·2251	0·2363	0·2412	0·2443

From these values, together with those described in the previous paper, the following mean values of C result:—

Temperature.	Pressure in Atmospheres.			
	0·5	1·0	1·5	2·0
350°	0·0000345	0·0000699	0·0001151	0·0001571
448°	0·00266	0·00503	0·00820	0·01143

i.e., for the relative pressures 1, 2, 3, and 4, the respective values of C are:—

At 448° .... 1: 1·889; 3·084; 4·286
At 350° .... 1; 2·025; 3·414; 4·660

Analogous results have also been obtained in various experiments made in similar fashion, but differing in that free iodine and hydrogen were heated together so as to produce hydriodic acid gas; obviously the same limits should be attained by both methods. Thus, in sulphur vapour (448°) the synthetic production of hydriodic acid was found to be 0·7896 per unit of materials; whence 0·2104 represents the amount of uncombined elements; 0·2143 is the mean value found in the above described decomposition experiments (1 atmosphere pressure throughout), 0·2150 being the value previously arrived at in the former paper. From the figures thus obtained the values of a corresponding constant, C^1, are calculable.—C. R. A. W.

Acid Calcium Sulphate. H. Endemann, J. Anal. and Applied Chem. 7, 181—184.

In seeking for some substance which would moderate the action of sulphuric acid for technical purposes, where it was not desirable to moderate the action by still further dilution, the author was led to examine acid calcium sulphate. He finds that this substance exists in a solution of calcium sulphate in its equivalent of sulphuric acid, and that it behaves in a similar way to the bisulphates of the alkali metals. When diluted with water it is partially decomposed into calcium sulphate and free sulphuric acid. The amount of free acid was determined by comparing the quantities of glucose, which were formed from dextrin when this substance was heated with the solution under examination, and with sulphuric acid of known strength. By making the temperature and the time of treatment the same in both cases, then the amount of glucose formed is only dependent on the concentration of the acid.

By comparing a solution containing 20 cc. of normal sulphuric acid, 80 cc. water and 0·56 grm. of crystallised calcium sulphate with one containing only the first two of these constituents, it was found that the former behaved as if it contained 81·8 per cent. of its sulphuric acid in the free state.—J. S.

Preparation of Chlorate of Sodium. G. A. Schoen. Bull. Soc. Ind. Mulhouse, February—March 1893, 93.

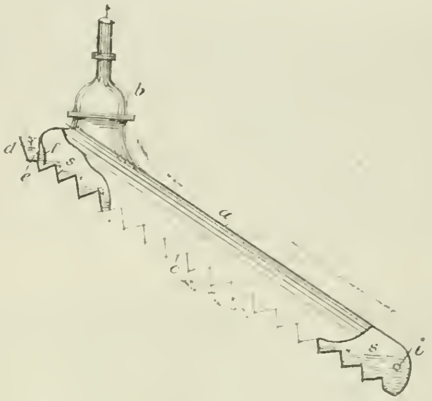
Chlorate of sodium prepared from chlorate of potassium contains a considerable quantity of the latter salt, which renders it unsuitable for certain purposes in calico printing. This inconvenience is remedied by the following process of preparation. Chlorate of calcium is first prepared by the same process as that adopted for the potash salt and then precipitated by carbonate or sulphate of sodium, thus yielding a mixed solution of chlorate and chloride of sodium. Sulphate of sodium is cheaper than carbonate, but does not precipitate the lime so well as the latter. The solution is evaporated until the temperature just approaches to 132° C., which is the boiling point of a saturated solution of chlorate of sodium. During this concentration the chloride of sodium is deposited and is raked out. The solution is then cooled and the chlorate crystallised out. The mother-liquor may then be further evaporated and the salt recrystallised.
—W. E. K.

Preparation and Properties of Potassium Cyanate. H. Erdmann. Ber. 1893, 26, 2438–2443.

A greatly improved yield of potassium cyanate is obtained when C. A. Bell's process is used by attending carefully to the following points. The potassium ferrocyanide must be *absolutely* anhydrous, being dried and powdered and again heated, until a sample gives off no water on ignition in a dry test tube; 200 grms. of the powder are then intimately mixed with 150 of warm recently fused powdered potassium bichromate and heated as usual; little or no ammonia is evolved if the last traces of moisture have been expelled from the ferrocyanide. The product is treated with a mixture of 900 cc. of 80 per cent. alcohol and 100 cc. methylic alcohol, this mixture being preferable to pure alcohol, the whole being boiled 10 minutes on a water-bath with vigorous shaking. The solution is filtered into a beaker standing in ice; the black insoluble residue is also cooled, and finally treated again with the mother-liquors of the potassium cyanate that crystallises out. The crystals are drained on a vacuum filter, washed with ether, and dried over sulphuric acid *in vacuó;* 65 grms. of cyanate nearly free from carbonate may be thus obtained, a result never attainable with pure spirit. The mother-liquors yield a notable amount of urea on treatment with ammonium sulphate.—C. R. A. W.

"Cascade" Platinum Concentrating Still for Sulphuric Acid. Chem. Zeit. 17, 817—818.

In the design of platinum concentrating stills, the chief point to be aimed at is a thin layer of acid distributed over a large heating surface. In the apparatus illustrated, which has been patented by G. Siebert, of Hanau a/M., this is effected by an inclined still, the bottom of which consists of a series of steps. The acid enters at *d*, and flowing down the stepped bottom passes out at *i* into a cooler. The effect of the steps is three fold; first, it spreads the acid evenly over the whole width of the still; second, it gives a largely increased heating surface for the same length of still; and third, it causes the gradual concentration of the acid, each step forming a separate concentrating pan, with the effect that the loss of platinum during working is reduced, as the highly concentrated acid only comes in contact with the lower part of the still.



At the chemical works of H. Blank at Hankelsablage, Königs-Wusterhausen, the following results have been obtained in 24 hours at the normal rate of working.

5,000 kilos.	Acid of 97 per cent. H_2SO_4.	Distillate 40°—45° B.
6,000 kilos.	Acid of 96 per cent. H_2SO_4.	Distillate 35°—40° B.

and with forced working,

8,000 kilos.	Acid of 95 per cent. H_2SO_4.	Distillate 20°—25° B.
9,000 kilos.	Acid of 94 per cent. H_2SO_4.	Distillate 18°—20° B.
11,000 kilos.	Acid of 93 per cent. H_2SO_4.	Distillate 12°—14° B.

all at 15° C.

With a production of from 8,500 to 8,600 kilos. of sulphuric acid containing 93 per cent. to 94 per cent. monohydrate, in 24 hours, the coal consumption was 14 per cent. of the weight of acid produced.

Further figures are given, comparing the Cascade still with those of Delplace and Prentice.

The loss of platinum after concentrating 242,687 kilos. of acid was too small to be determined. The still weighs 23·6 kilos., and is 1·55 m. long, by 50 cm. wide, the fall being 25 cm.—R. B. P.

PATENTS.

Improvements in and relating to the Manufacture or Production of Chlorine and Sodium Amalgam. J. Greenwood, London. Eng. Pat. 5999, April 7, 1891.

See under XI., page 1042.

Improvements in Tanks for containing Hydrochloric Acid. T. D. Owens, New Brighton, Chester. Eng. Pat. 21,294, November 23, 1892.

The tanks are constructed of an outer and inner shell of wood, or of other suitable material, the interspace being filled by running in a molten mixture of about equal parts of sulphur, ground pyrites, and sand. The inner wooden or other shell may be dispensed with, the composition being used as a facing to a backing of timber, slate, vulcanite, or metal. The invention is applicable in the construction of cells for electrolytic processes, as well as for acid-chambers, towers, and the like.—E. S.

Improvements in the Production of Carbonic Acid. S. Walker, Birmingham, and S. S. Walker, Woodside, Warwick. Eng. Pat. 22,238, December 5, 1892.

Alkaline - earth carbonates, but preferably calcium carbonate, as limestone or chalk, are heated in retorts provided with means for causing the materials to travel from end to end, while a current of steam, or of carbonic oxide or other suitable gases, is passed through. The issuing gases are scrubbed in suitable apparatus with water containing such purifying substances as may be needed. The carbonic acid may be stored in a holder, to be pumped and compressed into a liquid, or may be otherwise applied. The alkaline-earth oxide, or quicklime resulting from the process, is hydrated and exposed to the action of gases of combustion, to carbonate it for re-use.

Another process consists in heating calcium carbonate mixed with wood charcoal or coke, to obtain carbonic oxide, which is passed over a suitable heated metallic oxide, such as native or artificial ferric oxide, or copper oxide, to reduce the oxide and obtain carbonic acid. The metals obtained may be re-oxidised and used over again.—E. S.

An Improvement in the Manufacture of Bicarbonate of Soda and Soda-Ash. F. H. Gossage and J. Williamson, Widnes. Eng. Pat. 22,523, December 8, 1892.

The invention has reference to the manufacture of bicarbonate of soda and soda-ash from sulphide of sodium, the sulphide of sodium being produced from its sulphate by heating said sulphate in a furnace in conjunction with alkali waste or sulphide of calcium, and carbonaceous matter. The crude sulphide of sodium produced as specified, or by other methods, is lixiviated, and the solution at a specific gravity of about 1·15 to 1·20—that is, containing about 12 to 13 per cent. of soda, is introduced into a suitable apparatus and then carbonic acid gas is passed through it for some hours. The effect of this at first is to precipitate the silica, alumina, and iron in the solution. If longer continued, bicarbonate of soda begins to separate out, and as soon as signs of this beginning are observed, the introduction of the gas is stopped and the precipitated matters are filtered off. The filtered solution is then returned to the apparatus or taken to another one, and is again treated with carbonic acid gas, whereby bicarbonate of soda of a crystalline structure is precipitated and sulphuretted hydrogen gas evolved. This is carried on until about 3 or 4 per cent. of soda remains in solution, when it is stopped, this being the limit of efficient working. The bicarbonate of soda is then separated from the liquid. The temperature at which the process should be conducted is about 80° to 90° F. It is preferable to use the sodium sulphide solution of the higher specific gravity 1·20, as the bicarbonate of soda formed is then found to be of a denser and more crystalline nature, and when converted into soda-ash, gives an ash of greater density. To render the bicarbonate pure it is washed with water, whereby traces of sulphate or chloride of sodium are removed.

Soda-ash of a high degree of strength and purity is produced by calcining this bicarbonate. The solution separated from the bicarbonate, together with the washings, may be used for lixiviating a further quantity of sulphide of sodium. The sulphuretted hydrogen evolved may be used for the production of sulphur by any known means.
—H. S. P.

Improvements in Apparatus for the Manufacture of Sulphate of Ammonia and Liquid Ammonia. R. Dempster, Manchester. Eng. Pat. 22,602, December 9, 1892.

In the treatment of ammoniacal liquors for the recovery of ammonia, after leaving the "heater," the hot liquors, according to the new invention, are conducted into a casing or vessel divided into two compartments, or two vessels may be used, one placed above the other. Two or more vertical pipes, open or perforated at the bottom and with a perforated bell or spraying plates arranged at the top are fixed in these vessels. The liquid is run into their upper vessel to a certain height, and a jet of steam introduced into the lower end of the vertical tubes. In this way the liquor is carried up the tubes and ejected at their upper ends in a spray, thus allowing the easy disengagement of the ammonia gas, which is taken away by a pipe in the cover of the vessel. When the liquid in this vessel reaches a certain height it flows by an over-flow pipe into the vessel below, where it comes into contact with cream of lime, which liberates from it the "fixed" ammonia, the disengagement of which from the liquid is again facilitated by a similar spraying arrangement to that in the upper vessel. The ammonia escapes from the lower vessel into the upper one by a pipe, and thence is drawn off to the saturator.
—H. S. P.

Improvements in the Manufacture of Boric Acid and Borates. Dr. P. Marquart, Bettenhausen, Prussia. Eng. Pat. 22,714, December 10, 1892.

The inventor has found that in minerals containing boric acid and lime, the acid may be displaced by passing carbon dioxide or sulphur dioxide through a paste made by mixing the finely-ground mineral with water, preferably heated. When minerals containing soda as well as boric acid and lime are treated, carbon dioxide may be used, such as comes from a lime kiln or furnace. After the treatment, the liquid contains acid sodium borate, from which boric acid may be separated by mineral acids; or by neutralising with soda, borax is obtained. If sulphur dioxide is applied instead of carbon dioxide, it may be taken from an ore-roasting furnace. In this case, the hot lye, containing boric acid, is set to crystallise in vats; and the mother-liquor may be treated with a mineral acid to obtain another crop of the boric acid.

In the case of minerals not containing soda, sulphur dioxide is preferably used. The calcium sulphite occurring as a by-product is collected. After crystallising out boric acid from the lye, as described in the former case, the mother-liquor may be used instead of water on the next portion of mineral treated.—E. S.

Improvements in and connected with the Production of Caustic Soda from Sulphide of Sodium or Sulphydrate of Sodium, partly applicable also to the Manufacture of Bicarbonate of Soda and Soda Ash. F. H. Gossage and J. Williamson, Widnes. Eng. Pat. 23,616, December 22, 1892.

The solution of the sulphide or sulphydrate of sodium is first treated in the cold with carbonic acid gas until the silica, iron, and alumina present in the solution are precipitated. These precipitates are filtered off, and the filtered liquid is run into a suitable vessel and there heated to the boiling point, and it is then again treated with carbonic acid gas, the effect of which is the direct conversion of the sodium sulphide or sulphydrate of sodium solution into a solution of the mono-carbonate of soda; which, by causticising in any suitable way, is converted into caustic soda. The gases which are evolved in the decomposition of the sulphide or sulphydrate are relatively very rich in sulphuretted hydrogen, and may be used for the manufacture of sulphur or sulphuric acid by any known method. If it be desired to make bicarbonate of soda and soda-ash from the solution of carbonate of soda obtained as above described, this solution must be subsequently treated, at a low temperature, with carbonic acid gas, and converted into bicarbonate of soda of a crystalline form, which can be readily separated from the liquid; and from this bicarbonate of soda soda-ash may be made in any known way. (See preceding abstract.)—H. S. P.

Improvements in Electrolytic Apparatus for the Manufacture of Chlorine and Alkali by Electrolysis of Compounds thereof, and Anodes to be employed therein. E. T. Parker, Wolverhampton. Eng. Pat. 23,733, December 23, 1892.

See under XI., *page* 1042.

An Improvement in the Manufacture of Sulphate and other Salts of Ammonia. F. M. Spence, D. D. Spence, and G. Sisson, Manchester. Eng. Pat. 92, January 3, 1893.

The improvement consists in slaking the lime to be used for expelling the "fixed" ammonia from ammoniacal liquors, with a portion of the hot waste liquor from the still in which the ammonia liquor is distilled. This is done in a suitable lime-mixer provided with an agitator. The inventors claim that the following advantages are gained over the usual plan of slaking the lime with water: (*a*) The milk of lime is introduced hot into the still, thus saving fuel, as less steam is required than when as hitherto cold or only slightly warm water is used for slaking and mixing the lime; (*b*) less waste liquor is produced, and therefore less ammonia is lost in the waste liquor; (*c*) any excess of lime that may be contained in the waste liquor is utilised and thus less lime is used.—H. S. P.

Improvements in Electrolytic Apparatus for Decomposing Chloride of Sodium or Potassium in Solution, and for leading away the Products of Decomposition. T. J. Holland, Tunbridge Wells. Eng. Pat. 5525, March 14, 1893.

See under XI., *page* 1043.

A New or Improved Process for obtaining Chlorine from the Spent Liquors of Soda Ash, from Brine, and from other similar Substances, and Means and Apparatus for Producing Chloride of Lime therefrom. H. Cosnett, B. C. Bonnison, and S. Hayes, of Macclesfield, and P. Smallwood, Witten, Northwich. Eng. Pat. 5849, March 18, 1893.

The spent liquors produced in "Solvay's ammonia-soda process" are run into a series of three retorts, connected by a horizontal pipe communicating with the bottom of each, the retorts being set as to their lower halves in a chamber heated from a fire-place to about 100° F. The upper part of each retort is provided with two valved funnel-tubes, one for admission of potassium permanganate solution, and the other for sulphuric acid. The chlorine evolved from the liquor by the action of these reagents is conducted to a lead-lined rectangular chamber charged with slaked lime. This chamber is fitted with doors for charging and discharging, windows or peepholes, louvres for admission of air when the process is finished, and a door opening outwards and a drop door arranged inside for opening and closing by a cord, for testing the progress of the operation. Details of the apparatus are shown and described. About twenty parts of spent liquor or brine are used to one part each of potassium permanganate and sulphuric acid. The quantity of lime introduced to the lead chamber for conversion into bleaching powder is proportioned to the charge of brine. —E. S.

Improved Means for Use in the Manufacture or Production of Sulphurous Acid and Sulphites. M. Prentice, Woodfield, Suffolk. Eng. Pat. 9042, May 5, 1893.

Sulphur is burned in a chamber set over a fire-place, a regulated proportion of air or oxygen being admitted by means of a sliding door. The sulphur dioxide passes first through a cooler and purifier, whence it is drawn by a fan, and discharged through a pipe nearly reaching the bottom of a covered vessel containing water, or a solution of the hydroxide or carbonate to be sulphited. A second condensing vessel is shown, similar to the first, which receives the excess gas. Taps are provided for drawing off the sulphurous acid or sulphite solution, as the case may be. Alternatively, the sulphur dioxide may be passed through a chamber in which salts or substances to be acted upon are placed on shelves.—E. S.

Process and Apparatus for obtaining Common Salt by the Refrigeration of Brine. C. D. Abel, London. From C. Hirzel, Winterthur, Switzerland. Eng. Pat. 17,054, September 11, 1893.

Advantage is taken of the formation of a definite hydrate of sodium chloride ($NaCl.2H_2O$) at temperatures between − 15° and − 22° C., to separate salt from brine. As at − 22° C. saturated brine congeals, with formation of the decahydrate, the cooling is carried to about − 20° C., and the mother-liquor left on separation of the crystals, is returned to the bore hole leading to the brine or rock salt beds, being caused on its way to cool fresh entering brine. The hydrated salt crystals are desiccated in a current of hot air or gases.

The apparatus for carrying out the first part of the process, consists of a cylindrical vessel, conical at bottom, in which a refrigerating medium is made to act upon the brine within a vessel open at both ends. The brine on its way to the refrigerator, passes from a reservoir into the top of a tubular casing containing a bundle of pipes, through which latter the exhausted and cold brine flows upwards to be led away. The fresh brine flows from the bottom of the casing, much cooled, up a tube into the cylinder where the separation of crystals is effected by further cooling. A rotary stirrer is set in motion periodically, to detach the crystals as they form on the cooling surfaces. To facilitate such detachment, the vaporising coil is so connected to the compressor and the condenser of the refrigerating machine, that by reversal of a valve, the coil may act momentarily as condenser, whereby the salt crystals are melted off and washed away by the action of the stirrer. The crystals are discharged by a tube leading from the bottom of the conical cooler, and are pumped up on to an inclined board whence the drainings return to the cooler. The board has a tumbling device for discharging the hydrated salt into trucks, to be conveyed for drying to an ordinary hearth; or the salt is discharged into a hopper with feeding rollers into the drying apparatus, in which are arranged superposed endless travelling aprons, on passage over which the salt is exposed to the action of a current of air that has passed through heating apparatus, the heated air being drawn by a fan in a direction contrary to the direction of travel of the salt to be dried. A shoot is provided for the dried salt.—E. S.

Improvements in the Process and Apparatus for the Recovery from Sulphate Lyes or Liquor, of Sulphuric Acid free from Arsenic and Antimony. C. von Grabowski, Eisleben, Germany. Eng. Pat. 15,218, August 9, 1893.

The invention relates to the removal of arsenic and antimony from sulphate lyes containing free sulphuric acid, such, for instance, as the liquor used in the electrolytic recovery of pure copper, which gradually becomes charged with impurities in the course of that process. After concentrating such liquor and crystallising out the sulphate of copper, the mother liquor remaining contains in addition to free sulphuric acid and metallic sulphates, arsenic and antimony in considerable quanities, and is unsuitable for being directly purified by electrolysis. By the process which is the subject of this patent, such mother liquors are first evaporated to a seecific gravity of about 52° B., during which evaporation a deposition of the sulphates occurs, "and are then subjected in cells or vessels of about 1 cubic metre capacity to the action of an electric current of high strength (60—80 ampères per square metre of anode surface) using anodes and cathodes of lead or copper." The arsenic and antimony are thereupon deposited on the cathodes in a reguline form or in the form of a metallic sulphide, so that the lye entirely freed from them, is again available for use.—H. S. P.

Improvements in Apparatus for the Manufacture of Sulphuric Acid. F. B. Hacker and P. S. Gilchrist, Charleston, U.S.A. Eng. Pat. 15,895, August 22, 1893.

The object of the invention is to reduce the chamber space needed in the manufacture of sulphuric acid, to increase the quantity of acid, to provide for carrying off the excessive heat caused by the mixing of the gases, and to effect the quick and thorough mingling of the molecules of the gases as they pass from chamber to chamber. To obtain these results the inventors erect between two chambers (or between the Glover tower and the first chamber or between the last chamber and the Gay-Lussac tower if desired) a pipe or column traversed by a number of horizontal tubes preferably of lead. The gases enter at the bottom of this column, from one chamber, circulate between the tubes, and pass on into the next chamber by an opening near the top. The tubes are enclosed by a casing within the column, and a current of air is drawn by natural draught between this casing and the outer wall of the column, passes through the tubes and escapes by an outlet pipe or stack at the top of the column. In this way the gases are cooled and well mixed as they are circulating between the pipes in passing from one chamber to the next. On the top of the inner casing are a number of lutes or dishes containing weak sulphuric acid or water, which is arranged to drip downwards over the pipes, thus reducing the temperature within the casing, and supplying moisture in the form of vapour which promotes the acid process. By a modified arrangement the chambers are connected by a straight or horizontal casing, which thus forms a straight passage between the chambers, and this passage is interrupted by numerous cross tubes, through which air is drawn by connection with an air-flue and stack.—H. T. P.

Improvements in Processes for the Manufacture of Aluminium Compounds. W. E. Case, Auburn, New York, U.S.A. Eng. Pat. 17,111, September 12, 1893.

The object of the invention is to obtain an aluminium compound free from iron, "capable of many uses in the arts." Starting with aluminium sulphate containing both ferrous and ferric compounds, the aqueous solution is heated, preferably to 180° F., with nitric and sulphuric acids in suitable proportion to oxidise the ferrous salt, and calcium fluoride, as ground fluorspar, is added, the temperature being maintained for several hours. The reaction that takes place is represented by the equation $Al_2(SO_4)_3 + 2\ CaF_2 = Al_2F_4SO_4 + 2\ CaSO_4$. The calcium sulphate and undecomposed calcium fluoride are separated, and the liquor, preferably at a density of 1·04, is treated with a small portion of solution of an alkali carbonate or hydroxide. When, by successive treatments if need be, the iron is completely thrown down, as shown on testing the liquor with potassium ferrocyanide, the separated liquor is completely precipitated by the alkali solution, to obtain the iron-free aluminium compound desired, which is separated by filtration or otherwise.—E. S.

Method of and Apparatus for Manufacturing Sulphuric Acid. F. J. Falding, Cleveland, U.S.A. Eng. Pat. 17,602, September 19, 1893.

The invention consists in surrounding the pyrites burners with an external jacket composed of hollow fire-bricks, or tiles or other suitable material, so built as to form a series of air channels, through which air may be circulated if desired; and in an arrangement for concentrating the sulphuric acid, by heat supplied from the hot burner gases. The hollow brick jacket serves to prevent radiation from the burners, and if desired hot air may be supplied through the air channels to the grates of the burners. The concentrating apparatus consists of what from the descriptions and drawings may be considered to be a small subsidiary Glover's tower, which is introduced between the burners and the Glover tower. The denitrated acid flowing from the Glover tower is raised to a tank above the concentrator, and discharged by a distributing appliance into the apparatus, which is filled with a suitable packing, and there it meets the ascending hot gases from the burners, which after leaving the concentrator then go on to the Glover tower. In other modifications a portion only of the gases from the burners passes through the concentrating apparatus. By this method of denitrating in one tower and concentrating in another, a Glover tower acid of 60° B. can be concentrated up to 66° B.—H. S. P.

Erratum.

This Journal, 1893, 925, first abstract, for "*potassium cyanide*" read in title and lines 15 and 16, "potassium cyanate."

VIII.—GLASS, POTTERY, AND EARTHENWARE.

On the Technology of Glass. R. Zsigmondy. Dingl. Polyt. Journ. **289**, 254—261, 283—288, 296—302, and **290**, 10—15.

A report, with full analytical and tabular data of all the important work done during the years 1891 and 1892, on the technology of glass. It is intended as a continuation of a previous report on the same subject in Vol. 278 of the same journal. Special attention has been devoted in recent years to the study of the physical properties of glass and their relation to chemical composition. The technical glass laboratory at Jena takes a foremost position in this respect, not only on account of researches made by its own staff, but also on account of the ready manner in which it has provided other investigators with glass of excellent quality.

The recently published researches of Winkelmann are of great theoretical interest. His results enable us to calculate the specific heat of a glass from its composition. Of special interest are the two publications by O. Schott on the temperatures at which strains in glass disappear and on the coefficients of expansion of glass. The latter has led to the invention of Schott's compound glass (*Verbundglas*), which has extraordinary powers of mechanical and chemical resistance, and is very little affected by changes of temperature. The action of these and other effects upon the surface of glass has been studied by Kohlrausch, R. Weber, Mylius, Förster, &c.

Physical Properties.—A. Winkelmann has systematically studied the specific heat of glass of various compositions, made in the technical glass laboratory at Jena. The chemical composition of each sample is given in Table I., and the observed and calculated specific heats of the samples in Table II. The specific heats vary from 0·2318 to 0·0817; naturally, those glasses the components of which have the smaller atomic weights are found to have the higher specific heats.

The specific heats in the second column were calculated according to Wöstyn's law—

$$C = \frac{n_1a_1c_1 + n_2a_2c_2 + n_3a_3c_3 + \ldots\ldots}{n_1a_1 + n_2a_2 + n_3a_3 + \ldots\ldots\ldots}$$

when C = required specific heat of compound, $c_1c_2\ldots\ldots$ = specific heat of the elements, $a_1a_2\ldots$ = atomic weight of the elements, $n_1n_2\ldots\ldots$ = number of atoms in the compound. The products obtained by multiplying the specific heat of each specimen into its density are fairly constant, varying, for the above 18 samples, between 0·47 and 0·57. There is no simple relation between specific heat and thermal conductivity.

O. Schott has published interesting researches on the physical properties of glass, and has determined in the following manner the temperatures at which molecular displacement can occur in glass, or at which the first beginning of softening occurs:—Cylinders of glass (cooled in air), 20 to 40 mm. long and 10 to 15 mm. in diameter are cut flat and polished at the ends. Viewed lengthwise in polarised

TABLE I.

Current Number.	Factory Number.	Chemical Composition.												
		SiO_2	B_2O_3	ZnO	PbO	MgO	Al_2O_3	As_2O_5	BaO	Na_2O	K_2O	Li_2O	CaO	P_2O_5
1	S. 185	..	71·8	..	..	..	22·4	..	..	..	..	5·8	..	..
2	S. 205	..	69·1	..	..	..	18·0	0·2	4·7	8·0	..	..	..	..
3	172^{III}	64·4	12·0	..	..	11·0	4·5	..	..	8·0	..	..	..	..
4	164^{III}	55·0	..	..	..	..	17·0	..	..	14·0	14·0	..	..	..
5	802	71·0	14·0	..	..	..	5·0	..	..	10·0	..	..	..	..
6	16^{III}*	67·3	2·0	7·0	..	..	2·5	..	..	14·0	..	..	7·0	..
7	165^{III}	73·8	..	5·0	..	..	3·5	..	..	10·5	..	..	7·0	..
8	1,419	67·9	..	5·8	8·1	..	1·0	0·3	..	16·8	..	..	..	..
9	S. 201	..	3·0	..	..	..	10·0	0·5	..	..	12·0	..	..	70·5
10	290	58·7	..	..	..	..	..	0·3	..	..	33·0	..	8·0	..
11	665	..	41·0	59·0	..	..	..	..	..	..	..	..	..	..
12	121^{III}	51·3	14·0	5·0	..	..	4·5	0·2	25·0	..	..	..	..	..
13	S. 206	..	3·0	..	..	..	8·0	1·5	28·0	..	..	..	..	59·4
14	S. 95	..	3·0	..	..	..	1·5	1·5	3·8	..	..	..	..	56·0
15	1,492	34·2	10·2	7·8	..	..	5·0	0·7	42·1	..	..	..	..	..
16	S. 120	..	42·8	..	52·0	..	5·0	0·2	..	..	..	..	..	..
17	O. 331	45·22	..	..	46·0	..	..	0·2	..	1·0	7·5	..	..	..
18	S. 163	22·0	..	..	78·0	..	..	..	..	..	..	..	..	..

* Ordinary thermometer-glass.

TABLE II.

No.	Specific Heat.		
	Observed.	Calculated. (*Kopp.*)	Percentage Difference. Obs.—Calc.
1	0·2318	0·2652	− 14·4
2	0·2182	0·2406	− 10·3
3	0·2086	0·2180	− 4·5
4	0·2044	0·2122	− 3·8
5	0·2038	0·2139	− 5·0
6	0·1988	0·2038	− 2·5
7	0·1958	0·2020	− 3·2
8	0·1907	0·1935	− 1·5
9	0·1901	0·2169	− 14·1
10	0·1887	0·1898	− 0·6
11	0·1664	0·1776	− 8·1
12	0·1617	0·1704	− 5·1
13	0·1589	0·1766	− 11·0
14	0·1464	0·1603	− 9·5
15	0·1398	0·1442	− 3·2
16	0·1359	0·1431	− 5·3
17	0·1257	0·1272	− 1·2
18	0·08174	0·07969	+ 2·5

light they exhibit the appearances characteristic of uniaxial crystals, a black cross with coloured rings, the number of the latter depending upon the strain in the glass. If the rods be gradually heated, the strain begins to disappear and the number of rings begins to diminish at a certain temperature. This temperature was observed in the case of five specimens of glass, with the following results:—

	° C.
1. Crown 682	400—410
2. Flint 672	350—360
3. Borosilicate crown 792	400—410
4. Jena normal thermometer glass	400—410
5. Borosilicate thermometer glass 59^{III}	430—440

This *first indication* of softening must not be confused with the temperature at which glass actually softens, becomes plastic, and bends. This latter temperature is much higher. Experiments made with thermometers for measuring high temperatures show that they can be used without serious error considerably above the temperatures given—probably, indeed, up to 550° C.

The French thermometer-maker Baudin recommends heating thermometers for eight days in boiling sulphur as a means of obviating changes in the zero-point. Schott examined in polarised light a short tube of 59^{III} glass which was heated for four days in boiling sulphur. At the beginning the rings were innumerable; at the end they were reduced to three.

Co-efficients of Expansion of Glass.—Most of the published data relate to glass of unknown composition, and are therefore of comparatively little use. Regnault is the only investigator who appears to have supplied information respecting chemical composition with the physical data; and even his researches do not enable us to draw any conclusion as to the influence of different oxides upon the expansion of glass. A careful and extensive investigation of the coefficients of expansion of a large number of glasses of various compositions (made by the Jena firm) have been carried out by Professor Winkelmann, Dr. Straubel, and Dr. Pulfrich, using a dilatometer according to Fizeau's method as modified by Abbe (Wied. Ann. **38**, 453). The tabulated data occupy the best part of three large pages, and the principal results can only be given here. Of these, the most striking is the predominating influence of alkalis upon the value of the coefficient of expansion. By increasing the amount of alkali in a glass, its coefficient of expansion could be increased until it approximated nearly to that of nickel or iron. The tables further show that the expansion of different glasses for equal intervals of temperature varies within much wider limits than has hitherto been believed; for example, a specimen of glass containing 12 per cent. of alumina was found to have a coefficient of expansion of 0·00003369; whereas a specimen of zinc borate glass free from alkali has a coefficient of expansion of only 0·00001097. In the case of the usual silicate glass it is found that metallic oxides, such as zinc oxide, alumina, lead oxide, and baryta, do not produce any considerable increase in the expansion. Phosphate glass behaves much like the ordinary silicate glass with respect to expansion, whereas borate glass is distinguished by a low coefficient of expansion. Schott has introduced a glass which is of great technical interest and value. It is free from alkali, but can be worked before the blow-pipe, has a small coefficient of expansion, and is distinguished by many excellent qualities. Hitherto the view has been generally held that good glass must contain, together with silica and a divalent or trivalent metallic oxide, the oxide of a monovalent metal (an alkali-metal or thallium). But the glass referred to (121^{III}) is free from alkalis and has the following composition:—

$BaO = 25$ per cent., $ZnO = 5$ per cent., $Al_2O_3 = 4·5$ per cent., $B_2O_3 = 14$ per cent., $Mn_2O_3 = 0·08$ per cent., $SiO_2 = 51·22$, $As_2O_5 = 0·2$ per cent.

Schott was led to the production of his compound glass (*Verbundglas*) by studying the state of strain in ordinary glass vessels and tubes cooled in contact with the air. A hollow glass vessel cooled in contact with the air has its outer skin in a state of compression, whereas the inside is in a state of tension; hence it is easily damaged on the inside, but is resistent on the outside. A hollow glass vessel, if introduced when cold into warm air, has its outer skin thrown into a state of compression; if, when it is hot, it is exposed to cold air its outer skin is thrown into a state of tension. This is the reason why cold air causes glass to crack more readily than hot air does. Schott succeeded in throwing the outer layer into a permanent state of compression by covering the glass vessel with a thin outer layer of glass which has a small coefficient of expansion. The flasks made of this compound glass can be filled with boiling aniline and immediately sprinkled on the outside with cold water; and glass dishes can be heated over the naked Bunsen flame without cracking. Pressure tubes of this compound glass can be made to meet all the requirements of practice. They have been kept in continuous use on locomotives for five months, and when heated to 200° C. they can be sprinkled with cold water without any fear of cracking.

Action of Liquids upon the Surface of Glass.—For some purposes glass is required which is only very slightly attacked by liquids. R. Weber recommends the following three kinds of glass for such purposes—a green glass containing aluminium, a window glass, and Bohemian glass tubing. The following table gives the amounts, in milligrammes, extracted within the time stated from a 100 cc. flask:—

Table III.

Acted on by	Kinds of Glass.		
	11.	12.	13.
Water, 5 hours	$3\frac{1}{2}$	1	$\frac{1}{2}$
25 per cent. sulphuric acid, 3 hours	2	$\frac{1}{2}$	$\frac{1}{4}$
12 per cent. hydrochloric acid, 3 hours	$3\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
10 per cent. ammonia, 3 hours	6	$3\frac{1}{2}$	4
2 per cent. sodium phosphate, 3 hours	10	15	5
2 per cent. sodium carbonate, 3 hours	10	$30\frac{1}{2}$	22

Composition.	Kinds of Glass.		
	11.	12.	13.
SiO_2	61·8	71·22	79·8
Al_2O_3	6·0	1·5	0·9
CaO	16·0	15·0	6·5
MgO	4·0	..	..
K_2O	..	..	13·3
Na_2O	12·1	12·3	..

The general result of researches on the solvent action of liquids on glass is to indicate that this action is least when the silica, lime, and alkali are present in the following proportion:—$6 SiO_2 : 1 CaO : 1·3$ to $1·5$ of alkali. The glass mentioned as number 13 in Table III., is strongly recommended for special purposes such as conducting hot vapours which rapidly attack ordinary glass; but its common use is restricted on account of its difficult fusibility.

F. Förster has carefully investigated the chemical action of water and aqueous solutions on glass and arrives at the following conclusions. 1. Solutions of caustic alkalis act more strongly than water upon glass; for excepting when the solutions are excessively diluted they attack all the constituents of the glass, and in fact dissolve the glass as such. 2. Of the caustic alkalis soda acts most strongly, then potash, and lastly, ammonia and baryta. 3. Rise of temperature considerably increases the action; so also does an increase in the concentration. 4. Pure solutions of alkali do not act so strongly upon glass as solutions which contain silica as an impurity. 5. Alkaline carbonates, even in very dilute solutions, attack glass much more strongly than water does. Their mode of action bears a stronger resemblance to that of other salts than to that of the alkalis. 6. Sodium carbonate acts more strongly than potassium carbonate of equivalent concentration. 7. Of salts, those whose acids form insoluble calcium salts attack glass more strongly than water. Those whose acids form soluble calcium salts attack glass less strongly than water.

The report further contains accounts of publications on the following matters:—*Glass manufacture.* (On the cost of production of glass, on glass furnaces, on table glass, and the apparatus and the machines used in its manufacture). *On the manufacture of glass articles.* (Apparatus and mechanical arrangements used in blowing, moulding, &c.). *Sand blast apparatus. On glass-cutting. On the colouring of glass and on milk-glass and enamel.*

Bibliography.—"Sandstrahlgebläse im Dienste des Glasfabrikation," by Wilhelm Mertens (F. Fischer). 8vo. 2 Mk. 20. Hartleben, Vienna, 1891. The author (who is practically engaged in the work) gives a complete account of the sandblast as at present used. He is also the author of the more recent book, "Die Fabrikation und Raffinirung des Glases."

"Etude sur Saint Gobain," by J. Henrideaux. The author describes the country surrounding Saint Gobain and gives an account of the historical development of the manufacture of mirror-glass at Saint Gobain.

"Handbuch der Mosaik- und Glasmalerei," by Carl Elis (revised after the author's death by J. Andrée). 82 illustrations. E. A. Seeman, Leipzig, 1891. The book is intended for the use of mosaic-workers, glass-painters, architects, artists, &c.—D. E. J.

PATENT.

Improvements in the Manufacture of Rose-Red Glass. H. R. v. Kralik and W. R. v. Kralik, Eleonorenhain, Austria. Eng. Pat. 16,018, August 24, 1893.

Pelouze discovered in 1885 that a rose-red colour could be communicated to glass by the use of selenium. Selenium itself was added to the glass before or after fusion, with the result that a good deal of loss by vapourisation and oxidation took place, and the colour was impaired by the impurities present in the selenium used. The patentees claim to have overcome these objections by employing a selenite or selenate and a reducing agent, instead of selenium itself. A selenite or selenate, such as those of sodium potassium or calcium, is added to the glass before or after fusion, and, when thoroughly incorporated, reduced by the addition of arsenious acid or an arsenite or sulphite, or preferably zinc dust. The quantity of selenium usually sufficient is 2—3 per cent.—B. B.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Progress of the Cement Industry. L. Erdmenger. Chem. Zeit. 1893, **17**, 982—986.

(*a.*) *Constitution of Hydraulic Cement.*—The author considers that Le Chatelier's views on the constitution of cement (this Journal, 1888, 847) are not wholly consonant with the results of manufacturing experience. The formula—

$$\frac{CaO + MgO}{SiO_2 + Al_2O_3} = 3$$

(in which the values for the acid and basic oxides are stated in equivalents, not in percentages), involves the assumption that MgO can be reckoned as CaO, an assumption from which the author dissents. Adopting this amendment and taking the equation as—

$$\frac{CaO}{SiO_2 + Al_2O_3} \leq 3$$

it follows that a sound cement might contain as much as 67 per cent. of CaO. This may be true for cement produced at very high temperatures, *e.g.* that prepared by Michaelis by actual fusion of cement in the oxy-hydrogen flame, but on a manufacturing scale even cements of good quality approximate to the composition, $\frac{CaO}{SiO_2 + Al_2O_3} = 2 \cdot 5$ in place of complying with the equation given above. The author admits however that the clinkered by-product obtained in the manufacture of Teil hydraulic lime, which is particularly well-burnt, has a composition corresponding with Le Chatelier's equation. This cement is quite sound and free from tendency to blow, but has a lower tensile strength than high class Portland cement. If it be postulated that cement with the equational value 2·5 instead of 3 consist partly of tricalcium silicate and partly of dicalcium silicate it is not clear why the clinker from which it is made should not "fall," as $2CaOSiO_2$ has according to Le Chatelier the property of spontaneous disintegration on cooling. Another argument against the formation of $2CaOSiO_2$, and the consequent disintegration of the cement is that cement from the same raw materials may either "fall" or not, according to the manner in which it has been burnt, and that clinker with a tendency to "fall" may be kept sound by spraying it with cold water when drawn from the kiln. The author also traverses Le Chatelier's statement that the setting of Portland cement involves the occurrence of the following reactions :—

$$3CaOSiO_2 + Aq = 2CaOSiO_2 2 \cdot 5H_2O + CaOH_2O$$

and—

$$3CaOAl_2O_3 + CaOH_2O + Aq = 4CaOAl_2O_3 12H_2O$$

on the ground that test pieces of considerable strength may be prepared containing much less water than is thus indicated. He also draws attention to the curious phenomenon known as "Nachhärtung" (after-hardening). This is observed in certain cements which after removal from water attain an abnormal tensile strength (*e.g.* double the original value) on exposure to the air for 1—2 weeks, returning however to their previous value when replaced in water.

(*b.*) *Hardening in Sea Water.*—Candlot's researches (this Journal, 1891, 140) are referred to and commented on. Candlot has shown that by the reaction of the magnesium sulphate and chloride of sea water upon the lime compounds constituting Portland cement, calcium sulphate and chloride are formed, and that the former is the more destructive agent. It reacts with the tri-calcium aluminate of the cement, forming the double salt—

$$3CaOAl_2O_3 + 2 \cdot 5CaSO_4 + 60H_2O$$

which crystallises with great expansive force, and disintegrates the cement. Candlot has prepared this substance artificially. Its composition is similar to that of the body obtained by Michaelis and called by him the "cement bacillus," which corresponds in composition with the formula $3CaOAl_2O_3 + 3CaSO_4 + 30H_2O$, or when less water of crystallisation is present, $3\,CaOAl_2O_3 + 3\,CaSO_4 + 12\,H_2O$. The practical deduction from these investigations is that cements poor in alumina should be used for marine work, a conclusion borne out by the excellence of Teil hydraulic lime for this purpose. Nevertheless, the best means of avoiding failures with Portland cement in harbour work is probably the use of dense concrete and mortar non-porous to sea-water.

(*c.*) *Influence of Magnesia.*—The author, as stated above, considers that magnesia cannot be regarded as replacing lime, but as existing in cement in the free state. The admitted limit in Germany has been raised from 3·5 to 5·0 per cent. The author's high pressure test (this Journal, 1891, 931) which consists in exposing test pieces to high pressure steam at 10—20 atmospheres is stated to detect the existence of a dangerous proportion of magnesia by causing its hydration and consequent expansion to take place in hours or days instead of months or years, which periods are necessary at the ordinary temperature. He considers it preferable to the plan of boiling in water recommended by Maclay, as with the latter the test pieces are subjected to a certain amount of mechanical violence, due to ebullition.

(*d.*) *Cement Testing by the Standard Methods.*—The only points requiring comment are the growing use of the Böhme hammer apparatus instead of the older practice of filling the moulds by hand, tending to uniformity of results, and the necessity of allowing a range of from 8—12 per cent. of water in gauging mixtures of 1 part of cement and 3 of normal sand as being preferable to the rule which prescribes the use of 10 per cent. in all cases.

(*e.*) *Special Tests.*—There is a growing tendency to use various forms of hot test in order to be able to pronounce on the character of a cement without waiting for the lapse of 28 days as in the standard German tests. Cement for pavements and like uses is tested by attrition methods (this Journal, 1893, 519). Bauschinger's apparatus for measuring the expansion of cement test pieces is coming more into use.

(*f.*) *Preparation of Mortar and Concrete.*—The addition of "fat" lime to cement mortar is now commonly adopted, as the product is cheap and strong. Another plan to economise cement is that patented by F. L. Smidth & Co., according to which cement and sand are ground together in a fine state of division. The use of concrete and the Monier system of construction is increasing.

(*g.*) *The Manufacture of Cement.*—Systematic methods of drying raw materials are coming into use with a consequent saving of fuel. Millstones are being, in some cases, replaced by edge-runners and ball-mills, which are cheaper to drive and keep in repair. The question of the best method of sifting the cement is of growing importance, in view of the modern demand for fine grinding. Old-fashioned intermittent kilns are being steadily displaced by continuous kilns ensuring greater economy of fuel, although it must be said that the former still yield the best clinker. The Schöfer kiln, which is a modification of the well-known Dietsch kiln, has recently proved a serious competitor to the latter. The Hauenschild kiln is designed to burn cement of which the raw material has been moulded into spheres, which present the minimum surface of contact with each other, and thus the danger of adherence is diminished, a contingency further guarded against by sprinkling the spheres with lime. The kiln has comparatively thin walls and is jacketed, the space within the jacket being utilised for drying the raw material after it has been moulded to shape. The estimated output for a single kiln is 150 casks per 24 hours.

The use of slag cement has not increased sufficiently to make it a serious rival to Portland cement. One of the disadvantages of slag cement is that the slaked lime which it contains being much lighter than the slag, easily separates from the mixture. The substitution of hydraulic lime for "fat" lime (this Journal, 1890, 863), which has been adopted by Forel, is a distinct improvement, as segregation is thus checked. Moreover, slag cement made in this manner stands better in air and has less tendency to form shrinkage cracks.—B. B.

The Preparation of Cement Mortar. O. Böklen. Thonind. Zeit. 1893, 17, 93, through Chem. Rep. 1893, 17, 45.

The author's patented process (German Patent 66,415) which consists essentially in subjecting a moist mixture of cement with sand or similar material to a considerable pressure with a simultaneous transverse pressure of the individual particles composing the mixture, is said to yield a mortar having greater strength than that prepared in an edge runner or by ordinary admixture. The following table shows the results of some comparative tests.

Test pieces of 1 part of cement and 3 of normal sand, 1 month old, during 14 days of which time they had been kept under water, gave the following figures:—

—	Tensile Strength. Kilos. per sq. cm.				Specific Gravity.	Per Cent. of Water absorbed after 125 Hours.	Loss by Attrition Test.*
	Air-dry.	Water saturated.	Frozen in Air.	Frozen under Water.			
Mixed with a trowel and forced into the moulds with 10 blows.	27·15	17·35	19·55	18·0	1·937	10·2	25·8
Prepared by Böklen's process.	47·20	44·13	39·85	31·25	1·966	6·2	18·2

Concrete was also prepared according to the author's process by first mixing cement and sand in a mortar for half an hour, adding gravel and continuing the mixing for 5 minutes.

The following results were obtained:—

	Tensile Strength. Kilos per Sq. Cm.
Portland cement, 1 part by vol. Normal sand, 10 parts by vol. Gravel, 10 parts by vol.	41
Portland cement, 1 part by vol. Normal sand, 10 parts by vol. Gravel, 20 parts by vol.	22

In this case the moulds were filled by 10 blows of the hammer apparatus instead of the usual number (150). The age of the test pieces was 1 month, of which 18 days were spent under water.—B. B.

The Influence of Temperature on the Time of Setting of Portland Cement. Golinelli. Thonind. Zeit. 1893, 17, 115; through Chem. Rep. 1893, 17, 71.

The author has determined the time of setting of seven samples of Portland cement at various temperatures:—

Sample.	Temperature of Air and Water 16° C.	Temperature of Water 21° C.	Temperature of Water and Air 16° C. Percentage of Water used, various.	
	Percentage of Water 30 per Cent.	Water used 32 per Cent.	——	Water used.
	Hrs. Min.	Hrs. Min.	Hrs. Min.	Per Cent.
1	4 0	0 10	3 45	29
2	10 0	5 0	9 30	28
3	2 10	0 16	0 38	29
4	8 24	0 33	8 5	29·5
5	2 10	0 20	4 5	31·5
6	2 0	0 15	2 0	30
7	2 30	0 10	..	..

—B. B.

Lime and Mortar. Letac and Vivien. Monit. Scient. 1893, 777—788.

The paper discusses the circumstances by which the setting of ordinary mortar is conditioned, and gives the results of numerous experiments in voluminous tables. It is pointed out that the analysis alone of a mortar will not suffice to ascertain its quality, unless that of the lime and the sand used in its preparation be also known. These factors cannot be deduced from the analytical figures of a mortar of unknown origin and history.—B. B.

Influence of Temperature on the Time of Setting of Hydraulic Cements. L. Tetmaier. Thonind. Zeit. 1893, 17, 187.

Examinations of several samples of Portland cement, slag cement, Roman cement, and hydraulic lime at temperatures from 0° to 50° C., lead the author to the conclusion that different cements are differently influenced by alteration of temperature, and that it is scarcely possible to deduce a general law even for one class of cements—*e.g.*, Portland cement, whereby the alteration in setting time can be connected with variation of temperature. Some such relationship can be arrived at for Portland cement of like origin and similar chemical and physical properties, so that the setting time if determined at one temperature can be predicted for another.—B. B.

Overburnt Cement. Thonind. Zeit. 1893, 17, 211; Chem. Rep. 1893, 17, 95.

The conclusions arrived at are (1.) So-called "overburnt" cement may be produced by the action of the mineral constituents of the fuel on the clinker, resulting in the formation of dicalcium silicate in the place of tri-calcium silicate. (2.) Cement of ideal composition cannot be overburnt. (3.) Cement as usually made can be overburnt (*a.*) as a result of the introduction of extraneous acid oxides or (*b.*) by the displacement of the alumina from its lime compounds by silica, or on the other hand by the displacement of a part of the silica by alumina and ferric oxide, the acid properties of which increase with rise of temperature resulting in the formation of $2CaOSiO_2$, which causes cement to "fall." These disadvantages can be avoided by gas-firing.—B. B.

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* See this Journal 1893, 519.

PATENTS.

Improvements in the Manufacture and Treatment of Fire-proof Plastic Material for Cement. R. Stone, London. Eng. Pat. 8518, April 27, 1893.

THE patent relates to improvements in the material described in Eng. Pat. 16,789 of 1890 (this Journal, 1891, 932).

The chief alteration consists in the addition of about 140 lb. of pearl ash or potash to each hundredweight of the "flux," formerly protected, while in a fused condition, the product being added to a ton of the material under treatment. Colouration may be effected by the addition of manganese, sulphate of iron or oxide of iron.—B. B.

A Composition for the Production of Marble-like Plaster. E. Bammann, Berlin, Germany, Eng. Pat. 12,880, July 1, 1893.

ZINC in the form of cuttings or dust is placed in water, and after having been allowed to stand for some time boiled therewith, whereby it dissolves to the extent of about 32 milligrams per litre. The solution is mixed with an equal quantity of a solution of an alkaline silicate, preferably silicate of potash at 3° B. and the mixture diluted with four times its weight of water. One part of gypsum is mixed with two parts of lime and made into a paste with the liquid already described, the product having, it is stated, a marble-like lustre due to the employment of the mixture of silicates used.—B. B.

A Preservative Composition Applicable also for the Manufacture of Artificial Stone Statuary and the like. A. Cléry, London. Eng. Pat. 16,840, September 7, 1893.

THIRTY parts of tin are dissolved in 40 parts of muriatic acid and 30 parts of salammoniac are added. A powder composed of freestone 50 parts, zinc oxide 20 parts, pounded glass 15 parts, powdered marble 10 parts and calcined magnesia 5 parts, is prepared and made into a paste with the liquid above mentioned. Colouring matter may be added. The composition may be used as a damp-proof coating for walls or for repairing stone work or for moulding statues or ornaments.—B. B.

X.—METALLURGY.

A New Process for the Manufacture of Manganese on the Commercial scale. W. H. Greene and W. H. Wahl. Journal of the Franklin Institute, 1893, **135**, 218—223.

THE authors believe it is impossible to obtain by reduction with carbon, manganese containing less than 6 per cent. of carbon as the metal rapidly decomposes carbon monoxide at a red heat. A reduction, in the entire absence of carbon, is therefore necessary if anything like pure metal be required. The pulverised manganese ore is purified to contain less than 1 per cent. of iron and is heated to redness in reducing gases to produce greenish grey manganese monoxide. This is mixed and heated with 18 per cent. of its weight of granulated aluminium and a flux, preferably consisting of lime and fluor spar, in a magnesite crucible or in a plumbago crucible lined with a stiff paste of calcined magnesite. One part of aluminium should yield three parts of manganese; actually the average yield obtained was about 87 per cent. of the theoretical, whilst in one case 93 per cent. was the result. The composition of the metal is manganese 96 to 97 per cent., iron and silicon each from 1 to 2 per cent. On a large scale it is proposed to conduct the operation on a magnesite-lined hearth, reducing gases being in slight excess. By this means the ore will be maintained in the state of lowest oxide until the temperature of reaction is reached, and the fusion of the flux at this stage will protect the manganese formed from contamination by carbon from the flame.—A. W.

A New Method of reducing Metallic Oxides. W. H. Greene and W. H. Wahl. Journal of the Franklin Institute, 1893, **135**, 453—459.

IN the search for commercially available reducing agents for producing metallic manganese (see preceding abstract) the claims of silicon were not overlooked. The cost of the element renders its use in the free state out of the question, but in combination with a metal, as a silicide, it occurred to the authors that it might be made to react on manganese oxide, producing the free metal and silica. In the production of ferro-manganese, a mixture of ferro-silicon, containing 16 to 20 per cent. of Si and about 1 per cent. of C, and any oxide of manganese, is heated on a basic-lined hearth or in a crucible, together with a basic flux, such as lime, magnesia, &c. The silica produced combines with the latter and forms a slag, and the oxide and the silicide are both reduced, forming a ferro-manganese very low in carbon. About 128 lb. of an alloy containing Fe 70, Mn 29, and C 0·7 per cent. were produced from a mixture of 100 lb. of ferro-silicon (containing 10 per cent. of Si and 1 per cent. of C), 70 lb. of manganese monoxide, and 50 lb. of lime. The advantage of such an alloy for the manufacture of rich manganese steel without the introduction of too much carbon is pointed out. 100 lb. of the above alloy, mixed with 40 lb. of decarburised iron, would produce manganese steel of the following composition :—

	Per Cent.
Iron	78·8
Manganese	20·9
Carbon	0·5
Silicon	Trace.

In like manner ferro alloys of nickel (50 per cent.), chromium (20 per cent.), and tungsten (50 per cent.) have been obtained. Only doubtful results were obtained with titanium.—A. W.

Manganese Steel. H. M. Howe. Journal of the Franklin Institute, 1893, **135**, 114—128, 191—200.

THIS paper describes a general lecture on manganese steel, dealing chiefly with that containing about 43 per cent. of manganese and 1 per cent. of carbon. Its peculiar combination of ductility and tensile strength is discussed, and is compared by tables of curves with ordinary and nickel steels. Its preparation, forging, machining, and uses are slightly dealt with. In the last mentioned, the author states that the most important single use for manganese steel is for the pins which hold the links of dredgers of the elevator or bucket type. As they resist the abrasion caused by the sand and grit between them and the links in which they turn, they last from six to eight times as long as ordinary carbon steel pins. Manganese steel ploughshares wear six or seven times longer than chilled cast-iron shares. The side plates of the Blake ore crusher made of hard carbon steel are worn out in two months, whereas, when made of manganese steel only one-fourth of an inch was worn away in ten and a half months. In respect to railway wheels it is believed that chilled cast-iron wheels run about one-third the mileage of manganese steel wheels before the first turning; and, again, the average mileage of the latter is 51 per cent. greater than that of the composite or steel-tyred wheel.—A. W.

Contributions to a Knowledge of Tin and Stannic Oxide. F. Emich. Monats. f. Chem. 1893, **14**, 345—352.

CRYSTALLINE stannic oxide has been prepared by various methods, but it has not been hitherto observed that its formation takes place on merely heating metallic tin in air. The tin used by the author was a pure Banca specimen, in which no foreign metals but copper and iron could be detected. The former was recognised by volatilising 30 grms. of the tin in a stream of chlorine, and the latter by the

Prussian blue reaction in the filtrate from the sulphide of tin (from 2 grms. of metal) thrown down in acid solution. It amounted to 0·001 per cent.

When tin is heated in an inclined, uncovered, porcelain crucible, the film of oxide that forms takes definite shapes, growing in vermiform prolongations similar to those assumed by the so-called Pharaoh's serpents. The reason of this method of aggregation is that the molten metal finds its way through the thinnest parts of the first skin of oxide, and the resulting core is in its turn oxidised, the increase of the original excresence being thus effected. The stannic oxide formed occurs in oblong and rhombic plates, having angles corresponding to the anatase form of the oxide rather than those proper for cassiterite. The author has found that commercial tin oxide contains similar crystals, but that they are much smaller than those prepared in the manner described. The mean specific gravity of the specimens obtained was 7·0096, referred to water at 4° C.; the hardness was between 6 and 7. No formation of crystalline stannic oxide occurred on heating tin or tin oxide in the presence of an indifferent gas, and it was also proved that at the temperature of the experiments no volatilisation of the tin took place, so that crystallisation could not be ascribed to this cause. When impure tin containing iron was used, the oxide first formed was brownish, and that obtained in later stages colourless, the oxidation being selective. As little as 0·001 per cent. of iron could be thus detected, while 0·003 per cent. gave a very distinct coloration to the oxide.—B. B.

The Extraction of Poor Cobalt Ores. W. Stahl. Berg- und Hüttenmänn. Zeit. 1893, **42**, 1; Chem. Rep. 1893, **17**, 48.

Ordinary dry metallurgical processes are useless for poor cobalt ores. Schöneis's patented method of chlorinating roasted ores poor in cobalt, and also Herrenschmidt's process, appear not to be so cheap and simple as that devised by the author. His method consists in removing arsenic from the ore, in pieces reduced to an average diameter of $1\frac{1}{2}$ mm., by heating alternately in a reducing and oxidising flame, adding 10 per cent. of iron pyrites, 15 per cent. of magnesium chloride, and 93 per cent. of an alkaline chloride, and heating to incipient redness for three hours, when a test sample should show that the cobalt is completely chlorinated. The mass is extracted with weak acid, the copper precipitated by sulphuretted hydrogen, the filtrate neutralised with soda, and the manganese, cobalt and nickel thrown down by sodium sulphide. The precipitate is treated with acetic acid and sulphurous acid, and the residue filtered and roasted in a muffle, when it yields, after extraction with soda, a product containing 92 per cent. of Co_3O_4. Ores containing only 0·8—1·0 per cent. of cobalt can be economically treated by the process. Trials on a manufacturing scale on ores containing 1·02, 1·08, 1·49, and 2·81 per cent. of cobalt (and nickel) gave liquors with 4·12, 4·29, and 6·43 grms. of these metals per litre, while the residues contained only 0·04, 0·07, 0·09, and 0·11 per cent.—B. B.

Iron and Steel Wire and the Development of its Manufacture. J. P. Bedson. Iron and Steel Institute, Autumn Meeting, 1893.

This paper deals with the varions developments of the manufacture of iron and steel wire from the earliest periods to the present day. The present method of drawing is as follows:—A wire rod, about 0·2 inch is taken from the rolling mill and placed in a cistern of hydrochloric acid or dilute sulphuric acid to remove the oxide formed in hot rolling. It is then washed in clean water and coated with a mixture of lime and water, which is allowed to dry on. After this the end of the rod is pointed, previously by hand but now by a machine consisting of a pair of rotating hammers running at 120 revolutions per minute, and capable of giving three times the number of blows in the same time, a modification of an American needle pointing machine. The wire rod is then drawn through the draw-plate. The drawer is provided with a block, which revolves at will on a vertical spindle, driven by a horizontal shaft through a pair of bevel wheels under the bench, upon which the drawer works. On this bench top is a tool holder which holds the draw-plate, which plate contains many conically shaped holes of suitable sizes, and at their small end smaller than the rod which has to be drawn. These holes are roughly "pricked" in the plate by an experienced smith, and then the wire drawer finally prepares and shapes the holes to their exact size, when cold, by taper-punches. In this is the art of the wire drawer, coupled with the grinding of his punches suitably and always round and cylindrical. The size desired being decided upon, the drawer passes the point of the rod through the plate, seizes the same with a pair of stout tongs, which are operated as required by power, and pulls a sufficient length through the draw-plate to enable him to secure this end to the vice which is mounted at the top of the block. This accomplished, the block is set in motion, and the whole of the piece is eventually wound on to the block, care being taken to have plenty of tallow or other lubricant on the rod at the point of admission to the conical hole; otherwise the piece would "scrap" and eventually "pull the hole out," and thus deform it from its original size.

Annealing is necessary from time to time and is effected by placing the coils of wire in vertical cylinders, which, when filled with such coils, is hermetically sealed and heated to redness and cooled slowly, the wires being cleaned for drawing as before. In the case of very fine wires, jewelled dies such as diamonds, rubies, &c., are substituted for the metal plates.

The author describes many improvements made by George Bedson, amongst which is the continuous rod-rolling mill by which the billet, about $1\frac{1}{16}$ inch square, and of about 100 lb. weight, was drawn from a Siemens gas furnace, placed immediately in front of the first roll of the mill, and from this passed on through each successive pair of rolls, 16 in number, placed in line and each running at an accelerated speed, according to the draught of each roll. This mill grew in its capacity to 20 tons of wire rod in a turn of 10 hours. Mention is then made of the hard-steel wire trade, where steel containing ·7 and upwards of carbon is so manipulated that it will stand strains up to 120 tons per square inch, with torsional results equally surprising. Such wire of 0·08 inch diameter will stand 40 twists in eight inches, and will allow of winding and unwinding on its own diameter three or four times over. Nearly one-half of the steel wire manufactured in the United States is absorbed in two articles. The first is barbed wire, with an annual production of 200,000 tons, and the second is wire nails, with an equal production. The output of the former in 1874 was five tons, whilst the use of wire nails was scarcely known in the United States 10 years ago.

In the discussion it was pointed out how the absorption of hydrogen from the acid by the iron sometimes was sufficient to render the metal quite brittle, which brittleness, however, was lost on gently warming. Cleaning the wire for the drawer was therefore a great difficulty and half the battle. Basic metal, whether open-hearth or Bessemer, gives better results and is less easily spoilt than any other. Hard carbon wire has to be treated very carefully, the acid used to clean it being so dilute that one could drink it.
—A. W.

The Waste of Heat (Past, Present, and Future) in Smelting Ores of Iron. Sir L. Bell. Iron and Steel Institute, Autumn Meeting, 1893.

The author reviews our knowledge of the economic utilisation of the heat produced in the blast furnace, and the means which have from time to time been adopted to reduce the waste of heat to a minimum. Sixty years ago the coal necessary to produce a ton of pig-iron was reduced from $11\frac{1}{4}$ to 8 tons, and thence to 5, made up of 3 tons of coke and the remainder for blowing engines and for calcining the ore. In the latter case probably about 33 cwt. of the 3 tons of coke were used for actual work and 27 cwt. expended without any useful result. The great saving in fuel by increasing the height of the blast furnace from 40 to 70 ft. or 80 ft. is next shown by various examples of results; and also the doubtful possibility of a further saving by a still more increased capacity of furnace and a higher temperature of blast. The author considers that the minimum possible weight of coke to produce a ton of iron from Cleveland ironstone would average between 19½ and 20½ cwt. Occasionally, perhaps, 19 cwt. might be sufficient for a little while, but taken over longer periods of time the above estimate will probably be found correct. If the expectation to make a ton of Cleveland pig with 16 cwt. of coke were realised the blast would have to be heated to about 1150° C., a temperature not likely to be reached.

The origin of the heat is due mainly to the conversion of coke into CO; next, to some of this CO being raised to CO_2, and lastly to the heat in the blast. If the furnace were filled with coke alone all the escaping gas would be CO. The formation of CO_2 is exclusively due to the action of CO on the iron ore. If then the carbon has to be reduced in quantity it must be by lessening the amount escaping as CO. This, however, is met by an insurmountable barrier, viz., the fact that although CO will reduce iron oxide, CO_2 will oxidise metallic iron. These two antagonistic forces counterbalance one another when about one-third of the carbon in the gases exists as CO_2, at which stage further complete reduction is suspended. In practice, however, this point is rarely or never reached. The more intense the temperature the greater is the oxidising power of CO_2, and in certain cases CO_2 produced by the reduction of the ore passes back again to CO by acting on the carbon of the fuel, thus robbing the furnace of its power of keeping up the requisite supply of heat by carbon, which ought to be burnt at the tuyeres, disappearing in the upper regions of the furnace. If, then, a furnace from any cause has the temperature of its reducing zone unduly raised, CO_2 disappears and CO takes its place. As a practical fact, the oxidising tendency of CO_2, under ordinary conditions, is rendered inoperative by about 240 vols. of CO to 100 vols. of CO_2.

In the brief space occupied by 8 ft. of the charge from the upper end of the furnace, or to a depth, that is, of 16½ ft. from the charging plates, all the chemical action, save such as may be reserved for the zone of fusion, is effected. This is inferred from the close approach to uniformity of composition until the lowest region of the furnace is reached. This space, not less than 54 ft. in depth, acts in reality simply as a zone of heat interception, preventing the enormous waste of heat associated with the short furnaces. The following figures illustrate this:—

Composition of Gases produced per 20 Units of Pig-iron to show Chemical Changes at Various Depths of a Furnace of 80 feet.

—	Depth from charging Plates. Feet.	Oxygen per 20 weight units of Pig-iron.	Carbon per 20 units of Pig-iron.	Oxygen required for conversion of carbon to CO.
A. escaping gases	—	36·87	22·08	—
B. depth below.	16½	25·00	17·29	23·05
C. do.	26	24·71	17·33	23·11
D. do.	39	24·69	17·42	23·23
E. do.	52¼	24·72	18·09	24·12
F. do.	65	24·14	17·98	23·97
G. do.	70½	23·74	17·80	23·73
H. do.	76½	26·97	19·35	25·80
Mean of B. to G. both inclusive	—	24·50	17·48	23·31

In the small area between the surface of the slag and a depth of 70½ feet from the charging plates there is a remarkable increase in oxygen. A portion of this is unquestionably due to the decomposition of the hygrometric moisture of the blast and probably some to the reduction of silicon and phosphorus which are found in the metal. There is also an increase in the carbon which must have been withdrawn from the gaseous contents of the furnace. It seems then that some of the oxygen and this increase in carbon must owe their presence to the dissociation of CO. The difference between the quantities of oxygen in the last column theoretically necessary to convert the carbon into CO and the amounts actually present, shows the amount of oxygen obtained from other sources, chiefly probably from water.

The author then deals with the manner in which the hot blast effects the great saving in fuel and with the attempts to explain it. Probably it is not far wrong to assume that 12½ units of carbon per 20 units of Cleveland iron escape as CO gas. The heat produced by burning this, added to that derived from the combustion of the hydrogen and the sensible heat of the gases, give 80,247 calories to account for. The heat actually engaged in the furnace work, including unavoidable losses from transmission through the walls, &c. would be 84,841 calories. Thus a power amounting to 94 per cent. of that engaged in actual furnace work remains to be applied to other useful purposes. Two-thirds of this, or 53,498 calories, go to the boilers. The estimated heat in the gases of combustion amounts to 25,527 calories on leaving the boilers, thus leaving 27,971 calories as having been used for raising steam and supplying waste. The total waste is 22,034 calories, which means a deficiency at the boilers of 41 per cent. The remaining third of the escaping gases, or 26,749 calories, is utilised in the stoves for heating the air. For 20 units of iron 14,500 calories are required for the blast, and as 5,335 are calculated to be required in the production of chimney draught, there is a loss of 25·8 per cent. of heat in the stoves. The average loss at the boilers and stoves therefore works out to 36 per cent.

Of the 84,841 calories expended on the actual furnace-work all, save 23,000, may be regarded as irrecoverable. The exceptions are those which appear in the solid products, viz., the pig-iron and the slag. The 6,600 contained in the iron at the moment of running from the furnace are speedily dissipated, and, as it must be allowed to set and cool before it can be removed, the heat of fusion can hardly be made use of. The 15,500 calories conveyed from the furnace in the slag are differently circumstanced, inasmuch as the slag can be run into compact masses which cool slowly. The experiments at the Clarence works to utilise this heat in conjunction with the exhaust steam in the evaporation of brine are then briefly described. So far as present figures show, a furnace producing 500 tons per week may be regarded as capable of evaporating brine equal to about 75 tons of salt. About 300 or 400 tons of salt have been practically produced up till now as a result of these experiments.—A. W.

On the Economic Treatment of Low-Grade Copper Ores.

Read November 22, before the Institute of Mining and Metallurgy, by J. H. Collins.

Low-grade copper ores are defined as those ores which contain from less than 1 up to 3 per cent. of copper, as raised from the mine, the author pointing out that while the copper supply of the world was formerly derived almost exclusively from the richer ores, such low-grade ores are now the most important sources of the metal. They may be divided into three great classes: the *sulphide class,* of which the pyrites deposits of Southern Spain and the copper schists of Mansfeld in Germany are good examples; the *oxidised class,* including the copper sandstone of Alderley Edge in Cheshire, and *ores carrying native copper,* such as the amygdaloid and conglomerate beds of the famous Lake Superior district.

The simple and effectual method of hand selection is only applicable to low-grade ores in very exceptional cases; and none of the dry concentration processes so often proposed have as yet proved commercially successful. Ores of the third class and certain sulphide ores are concentrated mechanically with the aid of water, but oxidised ores are generally found to suffer such heavy losses when finely crushed for wet concentration that the method is only employed as a makeshift. A description is given of the process used at Vigsnaes in Norway, where a pyritous ore somewhat resembling the Spanish pyrites is concentrated by the ordinary method of rolls, jiggers, and revolving tables; the special points of interest being the use of sea water for concentration, and the extreme care taken to save even the very finest slimes from so poor an ore, the finished dressed product containing under 3 per cent. of copper. Detailed description is also given of the water concentration of the very poor native copper ores of Lake Superior, where stuff yielding only 0·65 per cent. of copper is crushed under a modified steam hammer and dressed up to a very high percentage at one operation. Though this ore is so poor, it can be treated at a profit; the local conditions, size and softness of ore-body, nature and purity of the ore, and abundant water supply being very favourable.

The so-called chemical methods of treatment are very numerous, but they all involve the two processes of solution and precipitation. The oldest and simplest of all is the *air oxidation process*, which is, however, only applicable to certain ores of the sulphide class. Examples are given of copper mines where the water issuing from the mine contains sufficient copper to pay for precipitation, the copper being brought into solution by natural air oxidation. About 1 per cent. of common salt is sometimes added to the heaps of crushed ore, with the objects of hastening the oxidation and of bringing small amounts of silver into solution, but the advantage is doubtful.

Direct acid-solution methods are only applicable to certain oxidised ores, carrying carbonates, oxides, &c. of copper, and only then when the necessary acid can be cheaply obtained, and where the veinstone is not acted on by the solvent. Hydrochloric acid has been thus used for treating the cupriferous sandstone of Alderley Edge, in Cheshire, and a similar ore at Waldeck, in Germany; but with the present low price of copper it is hardly likely that such a process can be made to pay.

The various open-air methods involving calcination, which are specially applicable to pyrites ores, rich in sulphur and poor in copper, are described in great detail. At Rio Tinto such ores are calcined in open heaps containing 800 to 1,000 tons, which take from six months to a year in burning, the whole cost of the calcination being about 1*s.* 6*d.* per ton; the burnt ores being afterwards washed with water, and the resulting "brown liquors" either precipitated direct with iron, or first used for the washing of raw small ore.

At Maidenpec, in Servia, the Rio Tinto process has been modified to suit a more siliceous ore, mostly in the condition of smalls. Such ore is pressed into briquettes and left to dry, after which it can be roasted in heaps, with a considerable consumption of fuel.

The smoke caused by the open-air calcination of pyrites in Southern Spain proved such a nuisance as to prevent any further extension of the process. This led to many attempts to effect the oxidation and solution of the copper more rapidly than could be done by air-oxidation, and without dissipating the sulphur into the air as sulphurous acid. The ferric liquors obtained by washing the burnt mineral were found to extract part of the copper from crushed small ore, and a still better result is obtained when the burnt ore and raw ore are mixed and washed together. This method, known as the *Ferric Sulphate* process, is now very largely in use at Rio Tinto.

The Joly or Doetsch process had for its object the production, by various methods, of liquors containing ferric chloride and free chlorine, both of which have a very energetic action on cupreous pyrites; but none of its modifications have proved effective on the large scale.

The various processes which start with a roasting of the ore in kilns or furnaces are also noticed, the author pointing out the very limited applicability of the open-air calcination method. Of these the most important is the Longmaid or Henderson process, by which ores already containing very little sulphur are roasted with salt and lixiviated. It has the great advantage of utilising small amounts of gold and silver, and even of arsenic and tin, in ores of copper. The Hunt and Douglas process, which treats roasted ore with a hot solution of ferrous chloride, and precipitates the copper from the liquor so obtained by sulphurous acid, as cuprous chloride, has also been used at various places in the United States. With this one exception the copper solutions obtained by all of these processes are precipitated either as metal by iron, as carbonate with lime, or with sulphuretted hydrogen as sulphide. Of these methods the first is by far the most largely used, although both of the others have been tried on the large scale. Details are given of the mode of procedure, and nature of the resulting precipitate in each case.

Electro-deposition, though largely used for the refining of black copper, has not yet been applied on the large scale to copper precipitation from the dilute and impure solutions formed by lixiviation of low-grade ores.

Even under the best circumstances of fusible ore and cheap fuel, the raw smelting methods can hardly be so cheap as the "wet" methods described. But they have the advantages of a quick and complete extraction of the copper contents of an ore, and the easy utilisation of precious metals which may also be present. Oxidised ores may sometimes be smelted direct to black copper of 94—96 per cent. at one operation, but sulphide ores almost always require preliminary calcination, and are then only converted into a moderately rich matte. Examples are given of open-air and reverberatory roasting—including the roasting of pyritous smalls with the new annular automatic calciner of R. Pearce, of Denver, where the total cost of such roasting is only 2*s.* per ton. Details are also given of the subsequent smelting, in furnaces of various types, to copper matte or to black copper direct.

The kernel-roasting process consists of slowly roasting cupriferous pyrites in heaps, so that a certain part of the copper is concentrated into the middle of each piece of ore as a kernel of rich sulphide, which can be separated by hand and smelted. The process was used for many years on the large scale at Foldal, in Norway, and Agordo, in Italy, and is still of some little importance wherever pyritous ores of copper are slowly calcined in the open air.

The Hollway process is an application of the Bessemer process to sulphide ores, whereby they are smelted by the heat produced by the combustion of the sulphur and metals they contain. In this process pyrites is first melted with coke and then enriched by having a current of air forced through the molten mass, a rich matte and a basic slag being produced and much free sulphur given off. Some interesting experiments with this process are described, the author considering that the process might with advantage have been adopted on the large scale at Rio Tinto. In a modified form, known as the Manhès process, it has since been very successfully applied to the enrichment of poor copper mattes.

In conclusion, the author points out the essential conditions for the treatment of low-grade ores, and discusses the circumstances under which the various processes might prove advantageous.—J. H. C.

Analysis of Low-grade Impure Tin Ores. R. Peele, jun. School of Mines Quarterly, **14**, 1893, 216.

See under XXIII., *page* 1060.

Determination of Carbon in Steel. F. Julian. J. Amer. Chem. Soc. **15**, 113.

See under XXIII., *page* 1061.

Rapid Method for the Technical Analyses of Blast-furnace Slag. O. Textor. J. Anal. and Applied Chem. **7**, 257.

See under XXIII., *page* 1062.

Rapid Method for the Estimation of Phosphorus in Titaniferous Iron Ores. C. Baskerville. J. Anal. and Applied Chem. **7**, 194.

See under XXIII., *page* 1062.

New Method for the Quantitative Determination of Carbon in Malleable Iron and Steel. O. Pettersson and A. Smith. Dingl. Polyt. J. **289** (1), 17—22.

See under XXIII., *page* 1061.

PATENTS.

Improvements in and relating to the Manufacture of Lead and Tin Foil, applicable for Wrappers for Tobacco and all other suitable Purposes. E. Gern and F. W. Taylor, Birmingham. Eng. Pat. 18,713, October 19, 1892.

The rolls used, as well as the foil produced, are continuously cleansed while at work with soap and hot water or steam, the rolls being cleansed from time to time with eucalyptus oil.—J. H. C.

Improvements in and connected with the Smelting of the Sulphurets or Sulphides of certain Metals, and in Apparatus to be used therewith. F. O'Connor Prince, London. From J. Dixon, F. J. Blades, W. S. Douglas, and D. Garlick, Adelaide, S. Australia. Eng. Pat. 18,892, October 21, 1892.

The ores to be dealt with are supplied continuously to the furnace by means of a specially arranged train of regulating wheels. The furnace used is a peculiarly constructed and partially water-cooled cupola built of fire-brick within a containing vessel. The blast is supplied through slits in tuyère bricks of special form. Elaborate tables of "working numbers" are given for the guidance of the furnace-master in regulating the supplies of ore and blast. The apparatus employed cannot be described without reference to drawings.—J. H. C.

Improvements in the Hardening and Tempering of Wire and Tapes, and in Apparatus therefor. E. Ashworth, Manchester. Eng. Pat. 22,617, December 9, 1892.

The wires or tapes are made to pass through heating and tempering tubes or chambers, which are charged with non-oxidising gases, and thence into the quenching and hardening liquid. The tubes may be heated by means of melted lead, electricity, a direct flame, or other suitable means.
—J. H. C.

Improvements in and connected with the Processes of Hardening and Tempering Steel Wire. J. Moseley, Manchester. Eng. Pat. 23,062, December 15, 1892.

The wire is conveyed continuously through an enclosed space or chamber of glass or other suitable material from which oxygen is practically excluded, and thence to a suitable tempering bath. During its passage through this chamber the wire is heated to the required degree by means of an electric current passing through it. The temperature may be controlled by increasing the speed or by modifying the density of the electric current.—J. H. C.

Improvements connected with the Utilisation of Ore-smelting Furnace By-Products. E. Nelson, London. Eng. Pat. 23,332, December 19, 1892.

Twenty parts of already solidified slag from an iron furnace is mixed with from 3 to 5 parts of silicate of aluminium and from 3 to 6 parts of a mixture of 80 per cent. of carbonate of lime and 20 per cent. of alumina. The mixed charge is fused in a suitable furnace and the fused mass is blown into silicate cotton or slag wool by means of a steam or air jet.—J. H. C.

Improvements in the Production and Separation of Sulphide of Nickel from Ores of Nickel and Copper. W. P. Thompson, Liverpool. From C. C. Bartlett, New Brighton, N.J. Eng. Pat. 11,581, June 13, 1893.

The ores, mattes, or other nickeliferous bodies are smelted with a flux composed of nitre-cake, salt-cake, nitrates, or carbonates of alkaline bases, or a mixture of two or more of the same, whereby sulphide of nickel is formed, which, owing to its greater specific gravity, settles to the bottom of the mass, while the compounds of copper, iron, or other metals rise to the top and may be separated in any convenient manner. The nickeliferous "bottoms" are re-smelted with the same flux until a commercially pure sulphide results.—J. H. C.

XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

A New Dynamo for Metallurgical Laboratories and Lecture Rooms, &c. W. Borchers. Zeits. ang. Chem. 1893, 434—435.

A handy form of machine has been constructed to the author's designs by Max Scorch and Co., of Rheydt, capable of maintaining 20 16-candle lamps; or with the aid of accumulators previously charged by the machine, 15 additional ones. The coils round the armatures and magnets are wound in sections, which can be coupled up or otherwise used in various ways, so as to produce currents varying considerably in character, *e.g.*:—

Volts.	Ampères.
4 to 6	120
10 to 15	60
25 to 30	30
50 to 60	15

Accordingly, the machine can either be employed to light the reading room or lecture room of a technical institution, or can be used for a large variety of laboratory experimental purposes.—C. R. A. W.

Electrolytic Reduction of Nitrobenzene in Sulphuric Acid Solution. A. A. Noyes and A. A. Clement. Technology Quarterly, April 1893, **6**, 62—64.

When nitrobenzene is dissolved in four times its weight of sulphuric acid (sp. gr. 1·84) and electrolysed, about 40 per cent. of the theoretical yield of para-amidophenol sulphonic acid was obtained when the current was such as to maintain a temperature of 80° to 90° C. for 15 hours without external heat. A smaller yield was obtained at 50°—60°, whilst above 100° charring occurred. With weaker acid (4 grms. water added to 150 of sulphuric acid) only para-amidophenol sulphate was formed, and not its sulphonic acid.
—C. R. A. W.

Quantitative Analysis by Electrolysis. F. Rüdorff. Zeits. ang. Chem. 1893, 450—453.

The author published in 1892 (Zeits. ang. Chem. **3**, 197 and 695) the results of various experiments on the quantitative separation of metals by electrolysis. Classen has recently (Zeits. anorgan. Chem. 1893, 211 and 401; and in his text-book) traversed various of the statements there made; the author in turn criticises Classen. He also gives improved details concerning the manipulation, &c. requisite to separate copper from cobalt, zinc, iron, manganese, or lead.—C. R. A. W.

Electrolytic Separation of Mercury from Bismuth. E. F. Smith and J. B. Moyer. J. Amer. Chem. Soc. **15**, 28.

See under XXIII., *page* 1063.

Electroltyic Separation of Copper and Antimony. E. F. Smith and D. L. Wallace. J. Amer. Chem. Soc. **15**, 32.

See under XXIII., *page* 1063.

Electrolytic Separations. E. F. Smith and J. B. Moyer. J. Anal. and Appl. Chem. **7**, 252.

See under XXIII., *page* 1063.

PATENTS.

Improvements in and relating to the Manufacture or Production of Chlorine and Sodium Amalgam. J. Greenwood, London. Eng. Pat. 5999, April 7, 1891.

In an iron containing vessel are arranged porous diaphragms separating an anode of carbon, with a metallic core, as described in a former Eng. Pat. 18,990, November 22, 1890 (this Journal, 1891, 642), and between the iron vessel and the porous divisions a space is left which is filled with mercury, and constitutes the cathode in a concentrated solution of sodium chloride fed into the anode compartment; the chlorine is led away, and the sodium combines with the mercury, forming an amalgam, the mercury being caused to circulate from the bottom upwards until sufficiently amalgamated, when it escapes to a receiver.—J. C. R.

Improvements in and relating to the Manufacture of Electric Accumulators. C. Thérye and A. Oblasser, Paris, France. Eng. Pat. 20,598, November 14, 1892.

The accumulator is formed of an open-work or solid metallic plate, surrounded by active material contained in a celluloid envelope, and is subjected to hydraulic pressure to consolidate the whole. The electrodes are enclosed in an envelope or sheath of celluloid prepared from pure cellulose agglomerated with a fatty substance, such as camphor, and free from any admixture of white lead, metallic salts, or similar substances. The envelopes can also be formed of gutta-percha, india-rubber, ebonite, fibrolithoid, vulcanised fibre, or any other materials which are sufficiently good insulators. The joining of the sheets forming the sides and bottom of the cell may be effected by stitching with threads of asbestos or celluloid, or preferably by a paste or cement, which has a base of celluloid.- G. H. R.

Improvements in Galvanic Batteries. W. Walker, Birmingham, and F. B. Wilkins, Handsworth. Eng. Pat. 23,007, December 14, 1892.

According to this invention the carbon element forms the vessel containing the electrodes or the exciting liquid of the battery, and its exterior is left unvarnished or uncoated with any material which will destroy its porosity; so that the hydrogen liberated at the inner surface of the vessel may combine with the oxygen of the air in the pores of the carbon with the object of preventing or largely diminishing polarisation.

In the case of galvanic batteries in which the carbon element is wholly or mainly immersed in the electrolyte, the element is made tubular or hollow, so that atmospheric air may have free access to its interior, and by its oxygen prevent or reduce the polarisation of the battery.—G. H. R.

Improved Methods of Recovering Zinc from the Waste Products of Galvanic Batteries. C. A. J. H. and H. E. R. Schroeder, Balham, Surrey. Eng. Pat. 23,101A, December 15, 1892.

These methods are concerned in the recovery of battery products, mainly the zinc salt produced, by precipitating it with carbonate of soda or other alkaline base, first neutralising free acid by means of lime. The zinc is recovered as metal in the usual manner. To produce the carbonate of soda, sodium sulphate is heated with peroxide of iron, or finely-divided iron and coal, put into a reverberatory furnace, sulphide of iron being produced, from which sulphuric acid may be recovered in the usual manner, and may be employed for the production of nitric acid and the reproduction of the sulphate salt, the peroxide of iron being used over again.

To recover used-up bichromate of potash solutions from batteries which consist of chromic alum, zinc sulphate, and some undecomposed bichromate of potash and a little free sulphuric acid, it is proposed to use lime as the precipitating agent, but sodium carbonate is by far the best. From the exhausted battery solution the excess of acid is first removed by chalk, then a concentrated solution of sodium carbonate is added, which it is best to apply hot or at a boiling temperature as long as a precipitate is produced, the solution being stirred. The precipitate is collected on a strainer, and then heated to a bright red heat. The solution therefore contains the bichromate that had not been decomposed in the battery as potassium chromate, and may be concentrated and converted into bichromate, and the sodium sulphate separated.—J. C. R.

Improvements in and Apparatus for the Manufacture of Chlorine and Alkali by Electrolysis, of Compounds thereof, and Anodes to be employed therein. E. T. Parker, Wolverhampton. Eng. Pat. 23,733, December 23, 1892.

In a series of electrolytic cells with electrodes separated by porous divisions, common salt or chloride of potassium is electrolysed, and the electrolyte is heated to prevent the absorption of chlorine, some hydrochloric acid being formed, which may be affected by steam. The alkali is fixed as carbonate by passing carbonic acid gas (carried in the form of bicarbonate) through the cathode compartment, which may be of iron, the anode being formed by mixing anthracite coal (or coke from anthracite coal) with plumbago and pitch, and compressing the mixture with or without the application of heat, in the former case the anodes being imbedded in plumbago, by which a skin or coating of plumbago is obtained.—J. C. R.

Improvements in the Application of an Electric Current in the Boiling or Evaporating of Solutions or Liquids. E. L. C. Schiff, Delft, Holland. Eng. Pat. 24,071, December 30, 1892.

This invention relates to improvements in the boiling or evaporating of solutions or liquids by the application of an electric current, and more especially to the manufacture of carbonic acid gas, as in the patents granted to E. Luhmann, where potash ley is used with the object of accelerating and furthering its boiling (Eng. Pat. 9171, June 1, 1891; 9646, June 6, 1891; 10,158, June 15, 1891).

The inventor uses a comparatively low current to obviate the decomposition of the water of the solution, and the accumulation of hydrogen and oxygen on the anode and cathode. This current is to be applied as in the electrodeposition of metals, and in the same copper in which the potash ley is to be boiled, or any similar brine or solution requiring evaporation and concentration.—G. H. R.

Electro-chemical Cementation for Separating Copper from Solutions by means of Iron. R. Conedera, Grosseto, Italy. Eng. Pat. 2320, February 2, 1893.

In ordinary cementation the useful reaction almost entirely stops as soon as the iron is covered with a very thin layer of copper, when several reactions then commence which cause a large consumption of iron, the oxidation of the precipitated copper, and in most cases the formation of basic salts of iron which render the operation very slow. On the surface of the liquids under cementation a layer of bars of wrought or cast iron serves to produce an exciting electric current, battery fashion, and graphite, which is obtained from the copper by previous washings, is kept in circulation, and serves to transmit the current from the bars of iron near the surface to those which are arranged within the bath. In this manner the pieces of iron which are plunged into the bath, although they may be covered with copper, and are consequently inert, become so many battery elements.

The ferric salts are reduced to ferrous salts before the cementation, by means of the metallic copper in a very fine powder, mixed with the graphite, which is stirred into the solution.—J. C. R.

Improvements in Electrolytic Apparatus for Decomposing Chloride of Sodium or Potassium in Solution, and for Leading Away the Products of Decomposition. T. J. Holland, Tunbridge Wells. Eng. Pat. 5525, March 14, 1893.

To render the electrolysis of common salt solution more continuous, and to feed the anode chamber with salt, an electrolytic tank of slate or other material is divided transversely or longitudinally in any convenient number of compartments by non-porous partitions, arranged after the manner explained in the specification of the patent granted to J. C. Richardson and T. J. Holland, 2297, February 12, 1890 (this Journal, 1891, 553), and provided with double sides, between which are channels or chambers extending along on either side of the tank.

A supply of solution to be electrolysed is admitted through the chamber communicating with the anode compartments, while the caustic liquor is drawn off by a chamber or channel in communication with the cathode compartments. These channels or chambers within the tank are easily and inexpensively contrived at the time the tank is being made, and by their means the products of decomposition can be constantly drawn off as the electrolysis proceeds, while fresh solution is introduced to maintain the proper level and degree of concentration next the anode.
—J. C. R.

Improvements in Electrolysis. Emile Andreoli, London. Eng. Pat. 12,662, June 28, 1893.

The object of this invention is an improved electrolytic apparatus, in which a chloride of sodium or other solution is decomposed into its constituent parts, while circulating through positive and negative compartments formed by partitions made of asbestos, kieselguhr, or a similar porous porcelain, closely situated between metallic or carbon cathodes, and retort carbon anodes constructed of slabs of retort carbon for the electrolysis of chlorides, to which metallic connection is made without exposing the metal to corrosion by chlorine or oxygen. The mode of construction is as follows:—Out of raw pieces of scurf, slabs are cut of a convenient size, which at the top corners show two shoulders, leaving a protruding piece, which, after being rounded off or not, is fitted into a hole cut in the slate lid Such hole is first internally coated with a cement of litharge, or with any other cement, to keep the anodes firmly in position; the metallic connection being made, it is wrapped with string and coated with a layer of paraffin or other insulating material. The chlorinated and the alkaline solutions circulate through their corresponding compartments, the gases being led away by pipes.—J. C. R.

Apparatus for the Electrolytic Treatment of Liquids. N. Browne, London. Eng. Pat. 15,669, August 18, 1893.

This apparatus is designed with a view of exposing the liquid to be treated to as large a number of electrodes as possible in a small space, and of permitting the apparatus to be readily cleaned.

The liquid to be electrolytically treated is admitted to the highest compartment, and flows either over or under the several electrodes and between them, arranged horizontally or vertically and equidistant, the electrodes forming the compartments by being set in a casing of non-conducting material.—J. C. R.

Improvements in Electric Accumulators or Storage Batteries. G. H. Roe and G. Sutro, California, U.S.A. Eng. Pat. 15,681, August, 18, 1893.

These improvements consist in a series of corrugated and perforated grid plates made of wood, preferably sequoia, or other porous and flexible varieties, permeable by the liquid solution in which the battery is immersed, such plates being alternated with and confined by lead plates or electrodes. The whole is compressed by elastic bands or other suitable means to form a structure self-contained and capable of being placed in or removed from a receiver without disturbance of the active materials sustained by the separating containing plates.—G. H. R.

Improvements in and relating to Electrolytic Apparatus. David Young, London. From La Société Outhenin Chalandre, Fils et Cie, Paris, France. Eng. Pat. 15,906, August 22, 1893.

In this invention the economic production of bleaching products and alkaline solutions, is chiefly aimed at, the apparatus employed being suitable for electrolysing other solutions besides sea-salt or chloride of sodium. The cathodes are of metal, such as wrought or cast iron; and hydrogen is set free and separated, the soda solution being kept apart from the products set free around the anode by cylinders of porous materials, into which the cathodes project horizontally, through orifices in a wall or division formed in the tank separating the soda solution from the anode chamber, which is fed with brine from an outside tank; the cathode chamber is fed with water, by which it is claimed that an excess of salt mixed with the soda solution will be avoided; and the products of the anode chamber may be utilised for the production of chloride of lime or bleaching liquor.—J. C. R.

Improvements in or relating to Electrodes for Primary and Secondary Batteries. A. J. Boult, London. From R. J. G. Hensel, Dresden, Germany. Eng. Pat. 16,136, August 26, 1893.

This invention has for its object the production of electrodes for primary or secondary batteries entirely from a plastic mass of metallic salts, or oxides acting as an electrolyte, without a separate core, with the addition (if necessary) of cementing agents, such mass being compressed in suitable moulds under a high pressure. The electrodes are protected from falling to pieces or from mechanical injuries during their manufacture and handling by dipping the freshly formed and dried electrodes into a solution of soluble silicates, gelatin, melted metals, and such like substances, or by rubbing the electrode over with such coating, or applying it in any other suitable manner, such coating substance being dissolved or otherwise destroyed by the passage of the electric current during formation.
—G. H. R.

Improvements in Electrolytic Cells. Thomas Craney, City of Bay City, Michigan, U.S.A. Eng. Pat. 17,127, September 12, 1893.

In this invention improvements are claimed in the construction of electrolytic cells for the commercial electrolysis of chlorides, such as chloride of sodium, for obtaining the products chlorine and caustic soda, diaphragms being employed composed of carbon compacted into a protective tube or casing extending through the liquid of the compartment, and carbon compacted into the bottom portion of the anode compartment. The anode is formed of powdered gas

carbon, or other dense form of pure carbon pressed into an indestructible tube, which may be baked in the tube and connected with a bottom layer of carbon. A diaphragm tube is shown in the form of a siphon or inverted U tube, with an opening at the bend standing out of the liquid, the legs dipping into separate vessels containing the electrolyte, the electrodes depending from the lids of those vessels.
—J. C. R.

Improvements in Electric Accumulators. A. Koch, Dresden Neustadt, Germany. Eng. Pat. 17,564. September 18, 1893.

The improvement consists in producing an accumulator having a substantial and indestructible combination of the constituent particles of the active material with the electrodes, as well as among themselves, by the addition of plaster of Paris, which, it is claimed, does not increase the weight of the mass, or interfere with its porosity. The plates used for electrodes are preferably carbon instead of lead as combining great solidity with lightness, and being therefore better suited for transport, and also for retaining the plaster and the active material itself within its pores more efficiently.

In forming the paste with which the carbon plates are coated, the inventor prefers the following proportions:—

100 grms. red lead.
40 „ plaster of Paris (gypsum).
30 cub. cm. water.

—G. H. R.

Improvements in Electric Batteries. H. H. Leigh, London. From A. Chevallier, Colombes, France. Eng. Pat. 18,323, September 29, 1893.

This invention relates to the class of batteries known as oxide batteries, and claims to give a constant current by having at its positive pole a head which prevents all polarisation, these results being obtained by means of the combination of the following parts, which characterise the battery, viz., an outside wooden jar, a glass tube (having a series of holes) adapted to receive the zinc rod; within is a porous wood cell having saw cuts, and glass webs fixed about the carbon on the inside of the cell. There is a hole in the top of the carbon having contacts, which carry between them a glass tube filled with mercury, provided with packings, which prevent the mercury from escaping.
—G. H. R.

XII.—FATS, OILS, AND SOAP MANUFACTURE.

Contributions to the Analysis of Liquid Fats. W. Fahrion. Chem. Zeit. 1893, **17**, 434.

See under XXIII., *page* 1064.

PATENTS.

Improvements in the Method of and Apparatus for Extraction Suint or Yolk from Wool. R. J. Urquhart, Manchester. From E. Richard-Lagerie, Roubaix, France. Eng. Pat. 12,433, June 24, 1893.

The improved method consists in treating the wool, without previously steeping it, in small quantities in movable receptacles mounted on carriages, by pouring from different compartments of a tank, or different tanks, liquors of gradually decreasing strength, in more or less divided spray, upon the top of the wool, and exhausting it from below by a pump, the vacuum produced by the pump being made variable by an adjustable shifting valve, and the pressure on the wool and liquors, the velocity of percolation, and the extraction of suint regulated thereby, after which the liquor is raised again and redistributed to the different compartments or tanks according to the strength of concentration indicated by a hydrometer.—E. G. P. T.

An Improved Cleansing Agent. J. Schicht, Aussig, Bohemia. Eng. Pat. 16,689, September 5, 1893.

Concentrated soap solution may be mixed with "benzine" so as to form a permanently liquid mixture, if about 5 per cent. of any one fat of the fatty acid series be also added, or resin, or borax. On stirring well for some time, a strong thickening of the mass takes place, accompanied by a considerable diminution in volume; without the addition of fat, &c. the mass becomes solid. For cleansing greasy stains a mixture of equal quantities of soft (potash) soap and "benzine" is especially adapted; for gloves, a mixture of 80 parts of "benzine" with 20 of a 20 per cent. solution of soap made from fats which remain liquid at the ordinary temperature of a room.—C. R. A. W.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

New Method of Preparing Chromium Oxide by Ignition. H. Schaeffer. Bull. Soc. Ind. Mulhouse. February—March 1893, 97; and Report on the same. P. Werner, *ibid.* 98.

Two hundred and fifty grms. of powdered bichromate of soda are gradually added to 50 grms. of glycerin. The solution proceeds slowly in the cold, but more quickly on the water-bath, forming a brownish-red syrup. If the reaction proceed too energetically a small quantity of water may be added. On bringing a flame in contact with the mass it takes fire and yields a voluminous residue of oxide of chrome in a very fine state of division and having a greenish-grey colour. The product is washed first with cold and then with hot water, and is then calcined in a nickel or platinum dish. The oxide of chrome thus produced is of a fine green colour with a tinge of olive. From its state of extreme division it is very suitable for use as a pigment for colouring purposes in calico-printing, &c.—W. E. K.

Investigations on Abietic Acid from Rosin. Heinrich Mach. Monatsh. f. Chemie, **14**, 186–201 (April 1893).

Pure abectic acid was obtained from commercial rosin by Maly's process; *i.e.*, treating for a long time with 70 per cent alcohol, and crystallising the undissolved portion from 90 per cent alcohol. After 30 crystallisations a pure white substance was obtained that began to soften at 148°, and had the melting point 153—154° C. From the effect on the boiling point of benzene, the molecular weight was calculated to be 507 to 576 in different experiments, whilst 298 to 311 were the figures similarly deduced with glacial acetic acid. Another sample was prepared from the same rosin by dissolving in 95·5 per cent spirit, and passing in hydrochloric acid gas to saturation (Flückiger's method), finally recrystallising the precipitate four times from methylic alcohol. This exhibited exactly the same melting point as before, and gave almost identical figures on combustion, the molecular weight found by the acetic acid method being 310 to 344. Various other analogous preparations were made of different degrees of purity; from the analytical figures the formula ultimately deduced as the most probable was $C_{19}H_{28}O_2$ (mol. weight = 288), the potassium salt being $C_{19}H_{27}KO_2, 3C_{19}H_{28}O_2$.—C. R. A. W.

Determination of Carbonic Acid in White Lead. School of Mines Quarterly, 14 [4], 318.

See under XXIII., *page* 1060.

PATENTS.

A New or Improved Process for Moulding or Shaping Celluvert, Vulcanised Fibre, and such like Material, and the Manufacture of Moulded Articles therefrom. C. L. G. Moll and H. Esgen, London. Eng. Pat 15,912, September 5, 1892.

The materials known as celluvert or vulcanised fibre have hitherto been regarded as incapable of being moulded. This can, however, be accomplished by cutting out of those materials pieces of a suitable size, soaking them for some minutes in water of about 72° C., and then placing them in moulds, the parts of which are slowly and gradually forced towards each other until they are quite closed. The closed moulds are for about five hours placed in a hot and dry place, the articles subsequently removed therefrom and submitted to a further drying.—C. O. W.

A Process for the Production of Blue Ultramarine from the Material known as Green Ultramarine. R. W. E. MacIvor and A. Cruickshank, London. Eng. Pat. 19,411, October 28, 1892.

Green ultramarine manufactured by any process is converted into blue ultramarine by heating in a pressure boiler with a solution of sulphide of sodium saturated with sulphur; or by mixing with sulphur and heating with sulphide of sodium solution, the proportion between the sulphur in the mixture and the sulphide of sodium in solution being in the ratio of 39 to 64. The tint produced may be varied according to the time of treatment, and the quantity of green ultramarine used; one ton of the latter to 280 gallons of sulphide liquor may be used, forming a thin cream, which is heated for a period not exceeding 14 hours. The strength of the sulphide solution may lie between 1 and 20 per cent. Finally the blue ultramarine is washed with water and dried.—C. R. A. W.

Improvements in Purifying and Clarifying Tannic Liquids. J. M. E. Fontenilles and H. G. J. R. Baguenier-Desormeaux, Paris. Eng. Pat. 23,233, December 16, 1892.

The decoction or infusion of bark (tannic liquid) is precipitated by the addition of oxalic acid. After the precipitate has settled, the liquid is clarified by the introduction of albuminous matter, and stirring. The proportion of oxalic acid varies with the nature of the plant extracted, and may amount to 15 to 20 per cent. of the chemically pure tannin in the liquid. The amount of albuminous matter varies with its composition, and may be as much as 20 per cent. of the pure tannin in the liquid. The clarifying may be accelerated by the use of a centrifugal machine.—A. G. B.

Improved Water Paint or Enamel. D. C. Simpson, Edinburgh. Eng. Pat. 21,299, December 23, 1892.

Lac is dissolved to a treacly consistence in hot water with ammonia (6 oz. lac to a quart of water, and 2 oz. of ammonia); to 15 parts of the liquid is added 1 part of a solution made by dissolving in 6 oz. of spirits of camphor, 4 oz. each of copal gum, juniper gum, mastic gum, Venice turpentine, Canada balsam, and copaiba balsam. The resulting composition mixes with water colours and renders them fast, giving the gloss and properties of oil colours, whilst at the same time it is soluble in water whilst in the liquid state.—C. R. A. W.

Process for Producing a Fundamental Mass from which Varnish and Similar Coatings may be made. M. Becker, Berlin. Eng. Pat. 2626, February 6, 1893.

This is a mass for the manufacture of non-transparent, but durable and adhesive varnishes and other coatings, such as are used for blacking, floor polish, or furniture polish. To prepare this varnish 90 parts of biborate of soda are dissolved in 1,200 parts of water, the solution is heated to boiling point, and 180 parts of vegetable wax, such as carnauba wax, are added. The mixture is kept boiling until it is converted into a thick, mucilaginous mass. Then a suitable quantity of some pigment is added, the mixture well stirred, and subsequently poured into tins.—C. O. W.

Improvements in Fireproof Paint or Composition. R. J. Doyle, Owen Sound, Canada. Eng. Pat. 5938, March 20, 1893.

Equal parts of vinegar and limewater are mixed and kept in a warm place for three days, or longer, with frequent stirring. Half a pound of salt, quarter of a pound of alum, and quarter of a pound of "white vitriol" are added, and the whole boiled, with subsequent addition of a drying oil. Crude petroleum is now added and the whole thickened with clay. The pasty mass is coloured to the desired tint. —C. R. A. W.

An Improved Process for Manufacturing Paint. J. C. Müller, Brunswick. Eng. Pat. 10,303, May 24, 1893.

According to this invention, a paint showing no greasy spots upon the painted surface, and being free from stickiness when dry, is prepared by letting a mixture of varnish and some liquid siccative or drier, with about one-tenth of its volume of ether, stand for 24 hours. To this is then added one-third of the whole volume of oil of turpentine, and the whole is mixed up with the proper quantity of dry colour.—C. O. W.

Improvements in the Method and Apparatus for Cementing or Connecting Pieces of India-rubber. A. Meyenberg, Frankfort-on-the-Main, and J. O. Meix, Berlin. Eng. Pat. 12,439, June 24, 1893.

The construction of an apparatus is claimed by means of which flat india-rubber pieces may be joined together without overlapping seams. The apparatus consists of a steam-heated table with a wooden elongation for the purpose of fixing upon it the materials to be joined, by means of drawing pins. To the iron table a cover-plate is hinged, upon which is arranged a pressing-bar and knife running parallel to each other, and the configuration of which varies according to the shape of the joints to be produced. Both the cover and steam-heated plate are covered with paper to prevent the rubber adhering to their surfaces. The rubber pieces to be connected are placed upon the steam-heated plate, their ends slightly overlapping. By pressing the cover-plate, the knife cuts off the superfluous material, while the pressing-bar firmly unites the two pieces, producing an almost invisible seam.—C. O. W.

Improvements in the Manufacture of Bars of Sealing-Wax with Wicks. G. Kressel, Bregenz. Eng. Pat. 13,027, July 4, 1893.

The invention relates to the manufacture of sealing-wax to be used without a light for melting the wax. For this purpose, loosely woven wicks instead of twisted ones are employed, and by stretching them in the casting frames they are considerably opened, and allow of an easy penetration by the liquid wax. The absorption of the sealing wax by these wicks is facilitated by the addition of camphor oil, and also by employing aniline colours in place of the mineral pigments commonly used.—C. O. W.

Improvements in Titanic Mineral Compositions and Industrial Applications thereof. J. Y. Johnson, London. From the Virginia Phosphate and Paint Co., Washington, U.S.A. Eng. Pat. 15,500, August 15, 1893.

Ores containing titanium, such as mennacanite, rutile anatase, and brookite, are powdered and mixed with asphalt, the quantity of which may vary from 10 to 50 per cent., according to the purpose in view. When the composition is to be used as a paint, turpentine may be added, and, in place of asphalt, copal or other varnish, may be used as a vehicle. The product is said to form a protective coating on iron and steel, which, if heated after painting to about 150° to 250° C., becomes covered with a film resembling magnetic oxide of iron, and very resistant. An alternative manner of producing the protective coating consists in heating the metal to be treated with a layer of titanic mineral mixed with carbonaceous material in a furnace for several hours.—B. B.

XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

Improvements in Dressing Leather Picking Bands for Looms, Leather Driving Belts and Straps, and other Curried Leather Articles. J. Owen, E. Pike, and C. M. Williams, Manchester. Eng. Pat. 23,931, December 28, 1892.

The curried leather article to be dressed is immersed in a heated bath of paraffin wax containing other materials, such as oils, fats, vaseline, other waxes, "resin pitch," rubber, &c., according to the pliability or degree of dryness required in the finished article. The chief advantage of the process is that leather articles so treated are said to be "rendered fit for use almost immediately, instead of taking months to season, as in the ordinary processes."—A. G. B.

XV.—MANURES, Etc.

The Development and Extent of the Fertiliser Industry. C. U. Shepard. Jour. Amer. Chem. Soc. 1893, **15**, No. 6.

The author gives the following dates as corresponding with the stages of development of the phosphate industry. In the middle of last century the value of the bone and ivory clippings from the Sheffield button and knife factories as manure was first recognised. In 1774 Hunter advocated the use of bones as manure, but it was not until after 1820 that his teaching produced any effect of great commercial importance. In 1843 the Duke of Richmond's field experiments proved that it is the phosphate in bones which gives them their great manurial value. In 1840, Liebig recommended the use of dissolved bones, and shortly after Lawes started the manufacture of mineral superphosphate. The search for phosphates then began, and in 1867 the inauguration of the South Carolina phosphate industry occurred, an event which coincides with the development of the Stassfurt potash mines and immediately precedes that of the South American nitrate of soda beds. The exportation of Florida phosphates dates from 1888.

Grandeau (1889) states that the yearly depletion of French soils is—

	Metrical Tons.
Nitrogen	600,000
Phosphoric acid	30,000
Potash	775,000

Supposing none of the farm manure to be wasted, its return to the land in 1892 would have left a deficit of—

Nitrogen	45·4 per cent. of the yearly depletion.			
Phosphoric acid	49·6	„	„	„
Potash	51·2	„	„	„

To restore this deficit there would be required—

	Tons.
Nitrate of soda	1,747,000
Sulphate of ammonia	1,463,000
Tribasic phosphate	876,000
Superphosphate	1,240,000
Potassium chloride	1,985,000
Kainit	3,300,000

If fæcal matter were saved in France to the extent of only 20 per cent. more than is now the case, that country should not be compelled to import in some years 10 million dollars worth of grain; it might, on the contrary, export nearly 20 millions worth per annum.

The next section of the paper deals with the sources of the chief ingredients of commercial fertilisers; these are sufficiently well known, as are also the statistics as to exports and imports, for they appear from time to time in this Journal. It may be noted that very recently another deposit of potash salts has been found in the Wipper Valley, near Sonderhausen, Germany, which promises to prove an important rival to the Stassfurt beds. Difficulty of transportation has heretofore interfered with the utilisation of the East Austrian potash deposits. Extensive beds of nitrate of potash are claimed to have been found in Mashonaland, near Mt. Darwin, in the direction of the Hunyani River; they are said to be from 3 inches to 20 feet in thickness, and to underlie 20 square miles.

There is great difficulty in arriving at an estimate of the quantity of Thomas slag used agriculturally. Voss quotes the quantity used in Germany at over 300,000 tons. It is shown in the report of the International Agricultural and Forestry Congress in Vienna (1891) on the availability of Thomas slag, that this is dependent on the amount of *matière noire* in the soil, which hastens the decomposition of the tetracalcium phosphate both by its property of holding water and by the influence of its ulmic and humic acids. Under favourable conditions it is necessary to employ only 50 per cent. more of the *active* phosphoric acid contained in the Thomas slag, than is commonly used of water-soluble phosphoric acid; but where the soil and conditions are not favourable, it is necessary to use two or three times as much. At recent prices there does not appear to be any great profit in the use of Thomas slag instead of acidified phosphates.

In conclusion the fertiliser industry in Great Britain is reviewed, statistics as to imports and exports of manures in various countries are given, and the world's consumption of commercial manures is summarised as follows:—

		Tons.
The United States		1,550,000
Germany		1,300,000
France		1,000,000
Great Britain		1,000,000
Belgium Holland (estimated)	300,000	650,000
Scandinavia (estimated)	100,000	
Spain, Italy, and Austria		
Total		5,500,000

—A. G. B.

Experiments in Growing and Fermenting Tobacco. Annual Report of the Connecticut Agricultural Experiment Station, 1892, 1—37.

A series of experiments was carried out to ascertain which kind of fertiliser gave the best results in growing. Small plots of ground were dressed with different manures, including some of the well-known brands, and the plant was carefully reared on each, pains being taken to, as far as possible, have all the other conditions equal. Full details and analyses are given, together with the result as to weight of crop, quality of leaf, &c., in each case. One year's experiments, however, are not expected to show conclusive results, as wet and dry, cold and hot summers, have to be taken one with another before the general value of a fertiliser can be fairly judged. Moreover, the value of the leaves cannot be estimated with certainty until they have been fermented or "sweated." It appears, however, that with the same quantities of nitrogen and phosphoric acid, a like quantity of potash, in the form of double sulphate with magnesia, gave a larger total crop than either cotton hull ashes, high grade sulphate of potash, or carbonate of potash. It appears also that a large yield is generally accompanied with a large percentage of wrappers.

Results of analyses are given showing the loss of the various constituents during a trial fermentation, but as they show an apparent loss of mineral matter which can only be explained by errors in weighing or analysis, it is obvious that their general value is somewhat reduced. Keeping this in mind, the results show a loss during fermentation of from one-sixth to nearly one-half of the nicotine, as well as a considerable amount of the albuminoids, amide bodies, nitrogen-free extract, and, slightly, ether extract. There is also an increase of nitrogen in the stalks after fermentation, the explanation of which is inequality in the samples which were drawn, unless it is due, as some say is possible, to a transference from the leaves to the stalks. Many more results are required to compare with the present series before a final decision and explanation of fermentation can be given. An analysis of a new potash salt, which is said to be well suited for use in tobacco culture, is given. It is as follows :—

Potash	18·10
Soda	1·49
Lime	1·20
Magnesia	19·27
Oxide of iron and alumina	2·34
Chlorine	0·15
Carbonic acid	32·55
Water, mostly combined	25·12
	100·22

—A. W.

Estimation of Nitrogen in Nitrates and total Nitrogen in Mixtures of Nitrates and Nitrogenous Substances. V. Schenke. Chem. Zeit. 1893, **17**, 977.

See under XXIII., *page* 1063.

Some Products of Cassava. E. E. Ewell and W. H. Wiley. Amer. Chem. J. **15**, 78.

See under XVIII. A., *page* 1049.

The Preservation of Farmyard Manure. R. Warington. Vinton's Agric. Almanack for 1894.

An instructive article on farmyard manure, from the pen of Mr. R. Warington, appears in Vinton's Agricultural Almanack for 1894. The writer gives the results of the latest investigations as to the losses which occur from the ordinary methods of storing manure, with suggestions as to the best means of preventing the waste of nitrogen and organic matter. It is of no use to tell the farmer that he should cart the manure made in his yards and sheds on to the land direct, as he cannot always do this. The land on which he desires to put the material is often covered with crops in Summer, and is too wet to cart on to in Winter. He might let the manure accumulate where it is constantly trodden on so that it wastes very slightly, but in slack times he needs to economise time and labour for the busy season by carting manure close to or just inside the fields to which he intends to apply it when an opportunity occurs. The best suggestions, therefore, are those which show how waste in manure heaps may be diminished. As far as nitrogen is concerned, loss is prevented to a great extent by spreading a layer of earth over a manure heap occasionally when it is in course of construction. But this does not prevent the waste of organic matter. For that purpose, and for the saving of nitrogen as well, the best plan is to sprinkle over the manure, when it is carted to a heap kainite, in the proportion of 1½ lb. to 2 lb. per beast per day.

PATENT.

An Improvement in Manures. W. C. Currie, Birkdale, and W. E. Rowlands, Liverpool. Eng. Pat. 18,600, October 4, 1893.

Finely pulverised shale is to be applied as a manure, either alone or mixed with other manuring materials.

—A. G. B.

XVI.—SUGAR, STARCH, GUM, Etc.

The Treatment of Beet Juice. Herzfeld D. Zuckerind. 1893, **18**, 225; Chem. Rep. 1893, **17**, 46.

Diffusion juice, if clear and free from suspended matter, contains so little albuminous matter that its content of nitrogen is not perceptibly influenced by coagulation. In practice the juice is generally not quite clear, and the precipitate contains some albiminous matter—but less than is generally supposed, the amount present being 10—20 per cent. of the total dry substance,—which is almost exclusively derived from suspended particles and not from matter in solution. Insoluble salts and pectous substances are also present, the latter yielding fairly strong acids when heated for a long time in aqueous solution, and tending to invert the sugar. The author recommends rapid heating, and states that coagulation should only be produced when the heating is not hindered by the occurrence of a precipitate. The filtration of the latter is stated to be useless, or even injurious under some conditions.—B. B.

XVII.—BREWING, WINES, SPIRITS, Etc.

Investigations on the Chemical Composition of Must and Wine in Prussian Wine Factories. P. Kulisch. Zeits. ang. Chem. 1893, 567—573.

The author has made a large number of analyses of wines from the districts of Main, the Rheingau, Kinzigthal, Nahethal, Glauthal, the Lower Rhine Valley (below the Rheingau), and the Moselle Valley and Nebenthal, together with some from Middle and East Germany, and various red wines. The results are given in tables too lengthy for reproduction. As regards mineral constituents, the proportion found in wine of this class has been hitherto supposed only rarely to fall below 0·14 grm. per 100 cc., but many have now been found to yield notably less, the lowest recorded figure being 0·1074 grm. per 100 cc., and the highest 0·2174, whilst the averages are—

Moselle district	0·1385 grm. per. 100 cc.
Rhine district	0·1359 „ „

Glycerol has hitherto been supposed to be formed by normal fermentation to the extent of at least 7 parts per 100 of alcohol. The present researches practically confirm this, excepting that in a few cases somewhat less than 7 parts were found :—

Maximum glycerol per 100 of alcohol	10·4
Minimum „ „	6·3
Average, Moselle district	7·9
„ Main, Rheingau, and Kinzigthal	8·3
„ Lower Rhine Valley	7·9

The average amount of potash in the whole series was 0·0359 grm. per 100 cc. Boric acid could always be detected (by the turmeric paper test) in the ash from 50 cc. Nitric acid also was usually found in minute quantity by the diphenylamine test, using special precautions to avoid charring.

As regards extract and alcohol, the following figures were obtained (grms. per 100 cc. of wine) :—

——	Extract.	Alcohol.
Maximum	2·9442	9·76
Minimum	1·6084	6·71
Average, Moselle district	2·4842	7·71
„ Main, Rheingau, and Kinzigthal.	2·3606	8·60
„ Lower Rhine Valley	2·0818	8·33

Even after subtracting the unfermented sugar present (varying from 0·0204 to 0·4144 grm. per 100 cc.) the remaining extract always considerably exceeds 1·5 grm. If from the total extract the volatile and non-volatile acids (calculated respectively as acetic and tartaric acids) be subtracted, the residue is usually considerably higher with Rhenish wines than with Moselles, the remainder always lying above 1·5 grm. with the former class, but only lying above 1·0 to 1·1 with the latter.—C. R. A. W.

Analysis of Brewers' Pitch. J. Brand. Zeits. ges. Brauw. 1893, **16**; Chem. Rep. 1893, **17**, 91.

See under XXIII., *page* 1065.

PATENTS.

Improvements relating to the Malting of Grain and to Apparatus therefor. H. H. Lake, London. From J. Henning, Charlottenburg, Berlin, Germany. Eng. Pat. 19,263, October 26, 1892.

Several improvements are claimed in the process of pneumatic malting by the aid of drums. The supply of warm, moist air required for the germinating process is obtained by passing the air through a series of three vertical chambers, which communicate alternately at the bottom and at the top, sprays of water being injected into each from above. A heating apparatus is placed at the opening into the first chamber, and a jet of steam is injected upwards into the second one, the latter serving the double purpose of accelerating the onward movement of the air and of affording an easy method of regulating its temperature.

For the purpose of retarding the germination, chambers are provided in which air and carbonic anhydride are heated, mixed, and dried, a series of baffle plates, carrying hygroscopic material, serving to effect the two latter purposes. These chambers then communicate with the germinating drums by special conduits.

The steeping tanks are provided with air jackets, which freely communicate with the warm air of the germinating room, and hence are apparently utilised for withering the grain also.

The supply of the different amounts of air of different temperatures required for the curing and kilning drums is obtained from a single source, the difference of temperature being obtained by heating the supply of air up to the temperature required for the kilning drum and then mixing part of it with sufficient cold air to reduce its temperature to that suitable for the curing process. A single exhaust-fan, divided vertically into two unequal parts, the larger part acting upon the drying drum and the smaller one upon the kilning drum, effects the supply of different amounts of air to the two drums.—J. G. W.

An Improved Apparatus for use in Malting Grain. H. H. Lake, London. From The Berliner Actiengesellschaft für Eisengiesserei und Maschinenfabrik, vormals J. C. Freund and Co., Charlottenburg, Berlin, Germany. Eng. Pat. 2273, February 1, 1893.

This invention relates to improvements in the drums used in the pneumatic system of malting. In addition to the perforated peripheral air-supply tubes and the central exit one, which are ordinarily used, another set of perforated tubes is placed intermediate between these, and this set is arranged for the supply of air to the grain, while the peripheral and central tubes are all arranged as exit-tubes. As, however, during the slow revolution of the incompletely filled drum, the uppermost, for the time being, of the peripheral and intermediate tubes are above the surface of the grain, and considerable useless circulation of air would take place between these, to the diminution of the circulation through the grain, there is placed at each end of the drum a valve, which is balanced about and swings on a pivot-pin, and which operates to close, at one end, the intermediate tubes, and, at the other, the peripheral ones when they enter the free air space of the drum.

In a modification of the invention, this operation is effected by the peripheral exit-tubes communicating, by radially-arranged tubes, with a circular chamber connected with the main exit-pipe. Within this chamber swings freely a curved shield, which is so balanced as to close the entrances to the tubes which are for the time uppermost.—J. G. W.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

(A.)—CHEMISTRY OF FOODS.

Proteids of the Wheat Kernel. T. B. Osborne and C. G. Voorhees. Amer. Chem. J. **15**, 392—471.

The authors have fully investigated the characters and composition of the proteids contained in the wheat kernel, and find that it contains:—

A *globulin* belonging to the class of vegetable vitellins, soluble in saline solutions, precipitated therefrom by dilution, and also by saturation with magnesium or ammonium sulphate, but not by sodium chloride. Partly precipitated by boiling, but not coagulated below 100° C. The wheat kernel contains 0·6—0·7 per cent. of this globulin.

An *albumin*, coagulating at 52° C., which differs from animal albumen in being precipitated on saturating its solutions with sodium chloride or magnesium sulphate, but not precipitated on completely removing salts by dialysis in distilled water. It was found to form 0·3—0·4 per cent. of the wheat kernel.

A *proteose*, precipitated (after removing the globulin by dialysis, and the albumen by coagulation) by saturating the solution with sodium chloride, or by adding 20 per cent. of sodium chloride and acidifying with acetic acid. On concentrating its solutions by boiling, a coagulum was gradually developed which formed 0·3 per cent. of the wheat kernel, and had the composition given in column III. of the table. The filtrate from this substance still contained a proteose-like body, which was not obtainable in a pure state. Its amount could only be roughly estimated by precipitating the concentrated filtrate with alcohol, and multiplying the nitrogen contained in the precipitate by 6·25. The amount of this proteose was 0·2—0·4 per cent. of the seed. Both these substances are unquestionably derivatives of some other proteid in the seed, presumably the proteose obtained by precipitation with sodium chloride and which was not analysed in its unaltered form.

Gliadin, soluble in dilute alcohol and forming about 4·25 per cent. of the seed. This is the proteid called gliadin by Taddei, and plant gelatin by Dumas and Cahours. In the impure state it has been described by Ritthausen under the name of gluten fibrin, plant gelatin or gliadin, and mucedin, and by Martin has been termed insoluble phytalbumose. The mucin of Berzelius and of De Saussure were impure preparations consisting chiefly of this proteid. It is soluble in distilled water to opalescent solutions, which are precipitated by adding a little sodium chloride. It is completely insoluble in absolute alcohol, but slightly soluble in 90 per cent., and very soluble in 70—80 per cent. alcohol, and is precipitated from these solutions on adding either much water or strong alcohol, especially in the presence of much salts; soluble in very dilute acids and alkalis, and precipitated therefrom on neutralisation. This proteid is one on which the formation of gluten largely depends.

Glutenin, a proteid insoluble in water, saline solutions, and dilute alcohol, which forms the remainder of the proteids of the wheat kernel, generally about 4—4·5 per cent. of the seed. This substance is soluble in dilute acids and alkalis, and reprecipitated on neutralisation. Dissolved in 0·2 per cent. caustic potash, precipitated by neutralisation, and, after thorough extraction with alcohol and ether, again dissolved in caustic potash, the solution filtered *clear*, precipitated by neutralisation, and dried at 110° C., it has the composition given in the table. Unless prepared as above described, the impurities are not removed, and the analyses are discordant. This proteid was first described by Taddei under the name zymom. Liebig, as well as Dumas and Cahours, named it plant fibrin. Ritthausen called it gluten casein. Weyl and Bischoff considered it to be an albuminate form of a myosin-like globulin. Martin named it gluten fibrin, and likewise considered it to be an albuminate form of a myosin-like globulin.

Wheat gluten is composed of gliadin and glutenin. Both these proteids are necessary for its formation. The gliadin, with water, forms a sticky medium, which, by the presence of salts, is prevented from becoming wholly soluble. This medium binds together the particles of flour, rendering the dough and gluten tough and coherent. The glutenin imparts solidity to the gluten, evidently forming a nucleus to which the gliadin adheres, and from which it is consequently not washed away by water. Gliadin and starch, mixed in the proportion 1:10, form a dough, but yield no gluten, the gliadin being washed away with the starch. The flour freed from gliadin gives no gluten, there being no binding material to hold the particles together. Soluble salts are also necessary in forming gluten, as in distilled water gliadin is readily soluble. The mineral constituents of the seeds are sufficient for the purpose, for gluten can be obtained by washing a dough with distilled water.

No ferment action occurs in the formation of gluten, for its constituents are found in the flour, having the same properties and composition as in the gluten, even under those conditions which would be supposed completely to remove antecedent proteids or to prevent ferment-action. All the phenomena which have been attributed to ferment-action are explained by the properties of the proteids themselves as they exist in the seed and in the gluten.

——	Globulin.	Albumin.	Coagulum.	Gliadin.	Glutenin.
C..........	51·03	53·02	51·86	52·72	52·34
H..........	6·85	6·84	6·82	6·86	6·83
N..........	18·39	16·80	17·32	17·66	17·49
S..........	0·69	1·28	24·00	1·14	1·08
O..........	23·04	22·06		21·62	22·26

—J. S.

Sour Bread. L. Briant. The Nation. Assoc. of Master Bakers and Confectioners. "Quarterly Trade Review," 1893, 241—244.

The author has investigated the nature of the acids contained in sour dough, and gives the results of a number of analyses. It appears that the bulk of the acidity of sour dough is due to lactic acid, but that a certain proportion, varying from one-third to one-fifth, consists of acetic acid, whilst in most cases the amount of butyric acid present is very small. In a future paper the author purposes dealing with the causes which lead to the production of sour bread.

—H. T. P.

Some Products of Cassava. E. E. Ewell and W. H. Wiley. J. Amer. Chem. Soc. **15**, 78—82.

The ash of the peeled root and the bark of the root gave the following results on analysis:—

Constituents.	Peeled Root.		Mean.	Bark of Root.		Mean.
	A.	B.		A.	B.	
Carbon..................................	0·30	0·31	0·31	0·79	0·77	0·78
Silica (soluble in solution of Na_2CO_3)............	0·97	0·91	0·94	10·53	11·36	10·94
Silica (insoluble in solution of Na_2CO_3)..........	7·15	7·15	7·15	52·99	52·16	52·58
Ferric oxide (Fe_2O_3)............................	0·66	0·66	0·66	2·46	2·44	2·45
Calcium oxide (CaO)............................	10·63	10·64	10·64	6·58	6·65	6·62
Magnesium oxide (MgO)........................	7·36	7·35	7·36	3·31	3·33	3·32
Sodium oxide (Na_2O)........................	1·12	1·28	1·20	0·84	1·05	0·95
Potassium oxide (K_2O)........................	41·72	41·54	41·63	14·73	14·68	14·70
Phosphoric acid (P_2O_5)........................	15·58	15·59	15·58	2·44	2·46	2·45
Sulphuric acid (SO_3)........................	3·67	3·80	3·73	1·71	1·71	1·71
Carbonic acid (CO_2)........................	9·15	9·12	6·14	2·53	2·50	2·51
Chlorine (Cl)................................	9·76	9·75	2·75	1·41	1·42	1·41
Total..................................	101·07	101·10	101·08	100·32	100·53	100·42
Oxygen equivalent to chlorine........	0·62	0·62	0·62	0·31	0·31	0·31
Difference..............................	100·45	100·48	100·46	100·01	100·22	100·11

Assuming a yield of five tons of roots per acre, the weights of the important fertilising materials removed by such a crop can be readily calculated from the data given.

Peeled root ……	9,780 lb.,	containing	49·88 lb. ash.	
Bark of root…..	220	„	4·44	„
	10,000	„	54·32	„

The more important mineral matters contained therein are :—

——	Ash from Peeled Root.	Ash from Bark.	Total Ash from 5 Tons.
.. ..	Lb. 49·88	Lb. 4·44	Lb. 54·32
Lime (CaO) …………………	5·31	0·29	5·60
Magnesia (MgO)………………	3·67	0·15	3·82
Potash (K_2O)…………………	20·77	0·65	21·42
Phosphoric acid (P_2O_5) ………..	7·77	0·11	7·88
			38 72

The less valuable plant foods—that is, those which are of so little note as to require no conservation or addition—amount to 17·60 lb. per acre.

Among the more important preparations made from the starch of the root may be mentioned the following:—tapioca, glucose, alcohol, cane sugar. The amount of cane sugar, however, is not large enough to warrant its extraction on a commercial scale from the waters used for washing, but is present in sufficient quantity to indicate that in making glucose it is better to use the whole than the extracted root.

—G. H. R.

Proposed Regulation of the U.S. Canning Industry. Standard Agric. Reports, December 19, 1893.

None too soon, a demand has arisen in the United States for the official regulation of the canning industry. Analyses made by the Department of Agriculture showed that every sample of canned food that had remained in the tins for any considerable length of time contained more or less of the tin or lead with which the vessels are coated, and, in pursuit of cheapness, inferior tin plates are commonly used in the canning industry. Such plates are covered with an alloy of lead and tin, the proportion of lead being in some cases as high as 13 per cent. The solder used, too, generally contains 50 to 65 per cent. of lead, which, of course, is distinctly poisonous. Both lead and the tin are readily dissolved by the acids of fruit, which is, therefore, more dangerous than meat. Some of the preservatives used in canning food, again, such as sulphurous acid, dissolve the metals, while others, like salicylic acid, are in themselves injurious. In Germany there are regulations prohibiting the use of tin plates for canning food containing more than 1 per cent. of lead. The best preventative to injury from the consumption of preserved meat, fruit, or vegetables, would be the use of glass or earthenware vessels instead of tinned ones. For fruit glass vessels are particularly desirable.

PATENTS.

Improvements in or relating to the Enriching of Milk and other Beverages. G. Dierking, Mecklenburg, Germany. Eng. Pat. 21,637, November 26, 1892.

This invention relates to a preparation of oil ("artificial cream"), which may be readily and permanently incorporated with any liquid, and is intended to be employed chiefly for enriching skim milk, and render it available as cattle food. The preparation is made by simply mechanically emulsifying any suitable oil with a solution of glue or gelatin, and finally diluting with water to any desired consistency. To 1 kilo. of oil about 50 grms. of glue may be used. "Artificial cream" keeps well, and may be mixed with any liquid by simply stirring it in. It separates again only very slowly, and, in so doing, rises to the surface exactly like natural cream, and it suffices to stir the liquid to obtain as perfect a mixture as before.—H. T. P.

An Improved Process for the Sterilisation of Milk. G. C. Legay, Lille, France. Eng. Pat. 22,189, December 3, 1892.

A process intended for household use. The milk is heated in a bottle fitted with an air-tight stopper, and filled exactly to a certain mark or level. The milk, by its own expansion, is made to indicate when sterilisation is practically complete, a mark being made for this purpose on the neck of the bottle, or on a tube projecting from the stopper, and so determined that the temperature of the milk is 85° C. when it is on a level with the mark. Drawings of two suitable forms of bottle accompany the specification.

—H. T. P.

Improvements in the Manufacture of Butter and in Apparatus therefor. J. H. H. Duncan, London. Eng. Pat. 22,386, December 6, 1892.

This patent relates to an improved churn. It comprises an oblong vessel with a semi-circular bottom, close to which two wooden vertical discs are mounted on a shaft projecting through the walls of the vessel. The top of the vessel projects considerably above the upper edges of the discs, and is fitted with a cover or hood from which are suspended two splash boards, one on each side of the discs. The latter may be rotated from the outside by means of a crank attachable either directly to the shaft, or, when great speed of rotation is desired, to a system of cog-wheels acting on the main shaft. At the commencement of a churning, the discs are rotated at high speed so that the particles of cream may be hurled by centrifugal force against the hood of the vessel, and subjected to rapid individual shocks. The result is that the operation of churning is considerably shortened, and it is claimed that the yield of butter is greater than usual. After churning, the butter-milk is drawn off through apertures in the lower part of the vessel, and the butter granules washed by filling up the apparatus several times with water, the discs being meanwhile rotated at a moderate pace. If desired the butter may be salted by dissolving salt in the last wash water.—H. T. P.

Manufacture of Peptones free from Albuminous Matters. O. Imray, London. From The Farbwerke vormals Meister, Lucius und Brüning, Hoechst am Main, Germany. Eng. Pat. 22,442, December 7, 1892.

The separation of the albumen (always present) by means of ammonium sulphate, from the liquid obtained by the action of enzymes, acids, &c. on albuminous materials, may be accomplished by observing the following general directions:—Precipitation with ammonium sulphate must be effected (1) in dilute solution, (2) successively in neutral alkaline and acid solution, (3) at a boiling heat, followed by energetic refrigeration. The peptones are then purified by crystallising out the ammonium sulphate, removing the remainder of the salt by means of alcohol at a low temperature, and finally treating with barium carbonate, followed by ammonia and ammonium carbonate. Further purification may be effected by repeated precipitation with alcohol.—H. T. P.

Improved Preparation of Flour. W. Jones, Kings Norton, Worcestershire. Eng. Pat. 22,761, December 12, 1892.

In order to render fine white wheaten flour equal in digestive and nutritive value to brown or whole meal, without introducing any of the bad qualities of the latter, the inventor mixes with it one quarter per cent. each of magnesium phosphate and sulphate.—H. T. P.

Improved Process for Sterilising and Preserving Liquids and Perishable Matters, and in Apparatus therefor. C. O. Hartz and G. Deisenhofer, Munich, Germany. Eng. Pat. 24,068, December 30, 1892.

The object of this invention is to sterilise the air passing into the apparatus after the vacuum has been formed. The apparatus consists in a vessel closed by a bell-shaped lid which is sealed by the sterilising liquid, through which the air entering must pass. Or, the lid may be sealed with caoutchouc and have a subsidiary chamber attached containing the sterilising fluid, and furnished with two pipes, one in connection with the main chamber and the other with the atmosphere, and so arranged that air entering bubbles through the sterilising fluid.—J. C. C.

An Improved Method of producing Sterilised Condensed Milk and other Substances. A. Fjelstrup, Copenhagen. Eng. Pat. 13,537, July 12, 1893.

Fresh milk is heated to 68°—70° C. for about 30 minutes, and then concentrated in a vacuum-pan at 40°—50° C. under a pressure of 650—700 mm. to one-third to one-fourth its original volume, and finally transferred to bottles. The whole operation from beginning to end is conducted in an atmosphere of sterilised nitrogen (obtained by passing air over red-hot copper shavings), and it is claimed that by this means the germs of bacteria are prevented from developing, even though they might be able to survive the moderate temperature to which it is possible to expose milk, &c. without altering its properties.—H. T. P.

Improvements in and Apparatus for the Manufacture of Effervescing Beverages. W. Bitter, Bielefeld, Germany. Eng. Pat. 16,301, August 29, 1893.

The apparatus employed consists of a narrow charging cylinder, capable of being rotated on an axis at right angles to its length. This cylinder is filled with fragments of some neutral material, as glass, porcelain, &c., and communicates through the spindle (hollow for the purpose) with a liquid carbonic acid holder, the outside connection to the gas-holder being by a length of rubber tube. The action of the apparatus is as follows:—A bottle containing the liquid to be aërated is pressed against the lower orifice of the cylinder by means of a suitable device; the cylinder is then charged with carbonic acid gas, and, the passage leading to the bottle being opened, the whole apparatus is rotated through half a revolution and then restored to its original position. During this operation the liquid flows from the bottle into the cylinder and back again, and being distributed in a thin stream over the glass, &c., becomes thoroughly charged with gas.—H. T. P.

An Improved Preserving Agent, and Method of Producing the same. M. Ekenberg, Stockholm, Sweden. Eng. Pat. 17,567, September 18, 1893.

The whey, obtained during cheese-making, is boiled with 5—10 per cent. of pure whitening, cooled to 40° to 45° C., inoculated with pure cultivations of the lactic and acetic ferments, and kept for 8—10 days in large flasks at 40° to 45° C. After fermentation, tannin is added and the liquid boiled. The flocculent precipitate of albumen, &c. is filtered off, and sufficient sulphuric or oxalic acid added to precipitate the lime in solution. After filtration the solution, containing lactic and acetic acids, constitutes the improved preservative agent. It usually contains 2—5 per cent. of lactic and 2 per cent. of acetic acid. A stronger product may be obtained by adding to the whey, before fermentation, cane or milk sugar. It is claimed that this preservative may advantageously replace vinegar in the manufacture of sour fruit, and vegetable preserves, &c.; more especially as lactic acid is said to facilitate the digestive process.—H. T. P.

(B.)—SANITARY CHEMISTRY.

Second Report to the Royal Society Water Research Committee. Percy F. Frankland and H. Marshall Ward. Proc. Roy. Soc. **53**, 164—317.

In Part I. of this report experiments by P. Frankland and J. R. Appleyard are described, on the Vitality and Virulence of Sporiferous Anthrax in Potable Waters; and in Part II., similar experiments by M. Ward and G. E. Cartright Wood, on the behaviour of *Bacillus Anthracis* in Water. The authors draw joint conclusions as follows:—

The waters, both of the Thames and of Loch Katrine, normally contain a number of different forms of micro-organisms, some of which have been isolated and described. These bacteria are more numerous in Thames water than in Loch Katrine water. The numbers contained in the former are subject to well-marked seasonable variations, being usually greater in winter than in summer, owing to the greater accession in winter of surface water rich in bacterial life and the organic materials which promote the growth and multiplication of micro-organisms. Hitherto no pathogenic bacteria have been found in Thames water.

Water bacteria, both of the Thames and Loch Katrine, multiply with astounding rapidity when the water is allowed to stand for a few days, a maximum being rapidly reached, followed by a corresponding but less precipitate decline. No adequate explanation of this has been as yet arrived at.

Both Thames and Loch Katrine water have been experimented with under three conditions, viz., in the natural state; sterilised by filtration through porous porcelain; and sterilised by heat (100° C.). Some corresponding experiments have also been made with distilled water. Into these waters were introduced *Bacillus Anthracis* (in the different forms of vegetative bacilli, spores, and as the "asporogenous" variety) in larger and smaller quantities, and in virulent and attenuated or weakened conditions. The results were very different according as the waters were sterilised or not. With sterilised water the behaviour was practically the same whether the water were Thames or Loch Katrine, whether sterilised by heat or by filtration, and whether the temperature were as high as 18°—20° C., or or as low as 4°—9° C. In all cases the spores retained both their vitality and virulence for many months, little diminution in activity being noticeable after seven months on inoculating animals with the water. No difference, moreover, was noticed whether the waters were preserved in absolute darkness, or freely exposed to diffused daylight; on the other hand, direct sunshine was rapidly fatal to the anthrax spores within 84 hours, even in winter, water so insolated being quite unable to infect animals inoculated therewith, and developing nothing on incubation with sterilised broth.

With unsterilised waters, on keeping for some months a more or less perceptible decline in virulence was always observed; this was least marked with Thames water, which still remained virulent to some extent after seven months, whether kept at winter or summer temperature; and was most marked with Loch Katrine water at summer temperature (18°—20°), almost complete destruction of vitality of anthrax spores being brought about in three months. Presumably this is attributable to the formation of bactericidal products by the water bacteria, as it did not occur when the water was sterilised. Little or no differences in the results were observed, whether the waters were kept in the dark or exposed to diffused daylight, but direct sunshine destroyed the anthrax spores rapidly; not more so, however, than in the case of sterilised water similarly treated. Direct experiments on the effect of water bacteria in destroying the vitality of anthrax spores did not give definite results; *Bacillus fluorescens liquefaciens* (Flügge) produced no prejudicial effects when present to approximately the same extent. No evidence was obtained that

Bacillus Anthracis can live and multiply in ordinary waters like a water bacterium, although this is possible in water containing more than the usual amount of organic matter; on the other hand, direct sunshine appears to be by far the most potent natural bactericidal agent so far as this bacillus is concerned.—C. R. A. W.

Purification of Waters by Ferric Salts. A. and J. Buisine. Bull. Soc. Ind. [4], **8**, 308—317.

It is only where the soil is light and porous that irrigation of sewage can be effectively practised, and even then one hectare (= 2·471 acres) must be allowed for every 40,000 cubic metres of sewage per annum. The sewage of Paris at present discharged into the Seine, amounts to some 440,000 cubic metres per diem; some 3,650 hectares would be required in order to dispose of this amount by irrigation.

Aluminium salts are too expensive for application to the purification of sewage. But recent advances in the production of ferric salts from spent pyrites place these compounds within reach for the purpose in question, inasmuch as the sulphate can now be manufactured at a cost of four francs per 100 kilos.

When ferric sulphate is added to a water the alkalis and alkaline earths which the latter contains precipitate gelatinous ferric hydroxide; this carries down suspended matter, decomposes soap, precipitating its fatty acids, combines with albuminoids and colouring matters, and eliminates sulphur; the precipitate is heavy and settles rapidly. The authors found that from 60 to 90 per cent. of the bacteria present in a water are removed by this precipitate.

The process was applied to the sewage of Roubain and Tourcoing, which receives the effluents from wool-washing and dye-houses. The Espierre, into which the sewage flows, is much contaminated, containing up to 10 kilos. of solid matter per cubic metre. Heretofore a lime process of purification has been used, but with ill success.

This sewage was treated with from 400 to 1,000 grms. of ferric sulphate per cubic metre and pumped into settling tanks, from which the clarified effluent could be continuously discharged. The results obtained are indicated by the following table:—

——	Sample taken at 8.30 a.m.		Sample taken at 3 p.m.	
	Sewage.	Sewage treated with 1 kilo. of Ferric Sulphate per Cubic Metre.	Sewage.	Sewage treated with 1 kilo. of Ferric Sulphate per Cubic Metre.
	Grms.	Grms.	Grms.	Grms.
Total solids, per litre.	5·75	2·10	3·20	1·06
Inorganic residue, per litre.	1·95	1·80	1·60	0·91
Fatty matter, per litre.	2·08	0	0·72	0
Organic matter in solution, expressed as crystallised oxalic acid, per litre.	1·35	0·22	1·10	0·12
Dry sludge, per litre	..	4·29	..	1·90

It will be seen that the suspended matter is entirely eliminated and about nine-tenths of the dissolved organic matter. The effluent is clear, colourless, and neutral, and does not putrefy. The sludge contains about 90 per cent. of water, and can be pumped; its composition when desiccated is as follows:—

	Per Cent.
Moisture	20·90
Inorganic residue (sand, clay, F_2O_3)	30·63
Fatty matter	30·00
Nitrogenous matter	18·47
	100·00

When extracted with carbon bisulphide it yields a poudrette containing about 3 per cent. of nitrogen. The fatty matter may be submitted to hydrolysis by sulphuric acid and distilled in superheated steam; the products may be disposed of to the soap and candle makers.

The cost of the process is from two to four centimes per cubic metre.

An experiment was conducted with Paris sewage on a day when it had not rained for the three previous days. The sludge amounted to 1·053 kilos., containing 1·08 per cent. of nitrogen, per cubic metre, and was produced by the addition of 100 grms. of ferric sulphate. The effluent was clear and odourless. The suspended matter was entirely removed, and nine tenths of the dissolved organic matter was eliminated.

Some calculations are given showing the cost of treating the Paris sewage by this method on the basis of the figures quoted above.—A. G. B.

Regulations for the use of Water-Gas in Germany. J. Gasbeleuchtung, 1893, **36**, 31—32.

The German Minister of the Interior has issued a series of regulations with a view to obviating the detrimental action of water-gas and semi-water gas on health, due to the large amount of carbon monoxide it contains; more than 0·3 part in 1,000 parts of air is stated to be dangerous. The precautions recommended are:—

(1.) Plant for making and purifying the gas should be placed in freely ventilated buildings, preferably in open sheds. Workmen should not be permitted to remain in these longer than is necessary, and should not be allowed to take meals in them. These buildings should not be in direct connection with any dwellings, mess-rooms, &c.

(2.) The charging apertures of the producers should be fitted with double doors.

(3.) Greatest care should be taken in making all pipe-joints tight, and all pipes should be tested to from 1 to 1½ atmospheres above working pressure. So far as is possible no mains should be run in, near, or under any dwellings, mess-rooms, &c.

(4.) Underground pipe-lines should be placed at such a depth as to be unaffected by frost.

(5.) Pipe-lines should be tested from time to time for tightness. Several apparatus and the methods of using them are described.

(6.) Care must be taken that the products of combustion of the gases, which may still contain some carbon monoxide, do not pass into any room in which workmen remain for any length of time.

(7.) Motors worked by these gases should be placed in well-ventilated buildings, in which workmen should not be allowed to remain longer than is necessary.

(8.) Small gas-holders should be situated in well-ventilated places, preferably in the open air, and outside the producer house. Large gas-holders should be placed either in the open air or in special buildings, which should not be used for any other purpose at the same time. Special precautions for the protection of neighbouring buildings are also recommended.—R. B. P.

Proposed Regulation of the U. S. Canning Industry. Standard Agric. Reports, December 19, 1893.

See under XVIII. A., *page* 1050.

PATENTS.

Improvements in the Filtration of Impure Waters and Sewage, and in Apparatus and Arrangements and Materials for use therein, and in Apparatus and Arrangements for use in the Precipitation of Sewage. F. P. Candy, Balham, Surrey. Eng. Pat. 18,216, October 12, 1892.

In this specification the inventor claims the following:—

1. The combination, with a layer or layers of coarse filtering material in a filter bed, of ventilating pipes or conduits, by which air under natural pressure is conveyed to and from the said bed.

2. The combination with pipes or conduits, by which air under natural pressure is conveyed to and from filter beds, of cowls for increasing the velocity of the air passing to and from the said filter beds.

3. The connection with a chimney of the exit ends of pipes or conduits by which air is conveyed from the interior of a filter bed.

4. A filter composed in part of a layer or layers of porous material treated or impregnated with iron oxide, to which layer or layers a current of air is supplied.

5. The preparation of a material for use as a filtering agent by soaking coke or other substance having a rough surface in a thick slurry of freshly precipitated hydrated iron oxide.

6. The filtration of water by causing it to flow upward through a vessel or chamber containing a purifying agent in a sufficiently fine state of division to be kept in suspension in the upwardly flowing stream of water.

7. A filter bed, the uppermost layer of which consists of an oxidising agent.

8. The division of filter beds by means of walls or partitions extending only a short distance beneath the surface thereof.

9. The arrangement, in a sewage precipitation tank having a smaller sectional area below the upper part than at the upper part, of means for passing a stream of sewage into the said tank within the part of smaller sectional area.

10. A tank constructed as illustrated.

11. A tank constructed as illustrated.

12. Arrangements for admission of sewage to precipitation tanks at the lower part thereof.

13. The arrangement for conducting sewage into a precipitation tank, which consists of an inclined pipe or conduit communicating with the tank at or near the bottom thereof.—J. C. C.

Apparatus for the Disinfection of Excrement, Urine, and other Infected Matter. W. Warner, Nottingham. Eng. Pat. 1244, January 20, 1893.

This consists in a metal vessel to hold excrement, &c., and is provided with a hinged cover, which can be made steam-tight with hand-screws. The opening is arranged so as to provide a closet seat. A steam pipe, with valve, is connected to the top of the vessel, with dip pipe passing to the bottom, so that the steam may enter into the midst of the excrement, &c. A steam valve, with pipe, is also connected at the top of the vessel, to cause a pressure on the surface of the contents when ready for ejectment. A larger pipe is also passed through the top, with the end near the bottom, for the ejectment of the excrement; this pipe is connected with a cooling tank having a water jacket and cooling pipes. The foul gases are drawn off by an exhauster and may be passed through a furnace.—J. C. C.

(*C.*)—DISINFECTANTS.

Solubility of Cresols in Water. M. Gruber. Zeits. ang. Chem. 1893, 613; from Arch. Hyg. **17**, 618.

The solubility in water of cresol is as follows, in volume percentages:—

	Per Cent.
Ortho cresol	2·5
Meta „	0·53
Para „	1·8
Mixed cresols from toluidine	2·2
„ „ „ tar oils	2·55

A solution of 1 cc. of tar cresol in 100 of water kills *Micr. pyogenes Aureus* within half a minute, whilst a ½ per cent. solution requires 10 to 12 minutes. A 1 per cent. solution is specially fitted for disinfecting wounds.

—C. R. A. W.

PATENTS.

Improvements in Disinfectants. H. Noerdlinger, Frankfort on the Maine, Germany. Eng. Pat. 631, January 11, 1893.

The inventor claims the method of improving the disinfecting action of disinfectants by mixing them with a body that is insoluble in water, and is specifically lighter than the same, such as a light tar oil, and then pouring the mixture upon the surface of the body to be disinfected.

—J. C. C.

Improvements in Preparing and Packing Materials for forming Solutions containing Arsenic, and applicable for dipping Animals, Preserving Skins, for Destroying Germs, Parasites, and Weeds, and for other Uses. A. Blackie, Glasgow. Eng. Pat. 5566, March 15, 1893.

Finely-powdered dry caustic soda or potash is intimately mixed with finely-powdered dry arsenious acid, and in this form is packed in air-tight vessels for sale. The mixture has the advantageous property of easily forming a suitable solution on the addition of a proper quantity of water, this addition of water causing an evolution of heat, which aids the combination of the arsenious acid and the alkali.

—J. C. C.

XIX.—PAPER, PASTEBOARD, Etc.

Studies on so-called Tree-bast Papers. J. Wiesner. Sitzungsb. der K. Akad. der Wiss. in Wien, **126**.

The belief, originating with the ancients (Pliny, Hist. Nat.), and handed down by such writers as Mabillon, Montfaucon, Schwarz, and Fischer, in the existence of tree-bast paper, has survived to the present day. Professor Wiesner, having at his disposal a small fragment cut from an "undoubted tree-bast paper manuscript" (Charta corticea), as described in Nessel's catalogue, submitted it to careful microscopical examination, and found that it is unquestionably a true papyrus. He has proved, moreover, by experiments made with the bast of such trees as the lime, the beech, and the birch, which were said to adapt themselves most conveniently to the process, that it is quite impossible to produce from it an even surface suitable for writing purposes.—E. G. P. T.

Derivatives of Lignin. E. Streeb. Mitth. aus den K. tech. Versuchsanst. zu Berlin, **11**, 1893, 23.

The following are the results of this inaugural dissertation:—

1. The lignin of wood, in the sulphite process, passes into a soluble sulphonate, which is contained in the liquors as a calcium lignin sulphonate.

2. The lignin of wood in the soda process is converted into lignic acid, which is present in the liquors in the form of sodium lignite.

3. Lignin sulphonic acid, on heating with alkalis and alkaline earths, is decomposed into sulphurous and lignic acids, the latter being apparently identical with the lignic acid of wood-soda liquors, and with the lignic acid of Lange.—E. G. P. T.

Researches on the Cellulose Membrane. L. Mangin. Comptes rend. **113**, 1891.

The author begins by pointing out that cellulose is characterised by—

1. Its insolubility in ordinary solvents.

2. Its transformation by oxidising agents, first into oxycellulose, soluble in alkalis, and then into oxalic acid.

3. Its solubility in ammoniacal cupric oxide.

4. Its transformation under the influence of sulphuric acid or zinc chloride into hydrocellulose (amyloid), which is coloured blue by iodine.

This transformation into hydrocellulose the author considers the most important from the structural and botanical standpoints, because in this condition its affinity for colouring matters is the most pronounced. But he

discards the action of sulphuric or phosphoric acids for this purpose as too violent, and also the treatment with zinc chloride as not energetic enough. The best method, according to him, is first to dip the fibre or tissue in absolute alcohol and then to treat it with a saturated alcoholic solution of potassium or sodium hydrate. The application of any suitable colouring matter at once produces the characteristic coloration of cellulose. The colouring matters recommended are iodine and certain azo dyes, dividing themselves into two groups—(*a*) Orseille BB, Brilliant croceine, Naphthol black, &c., which dye cellulose, though feebly, in an acid, and sometimes even in a neutral bath; and (*b*) the benzidine, toluidine, xylidine dyes, such as Congo red, Heliotrope, Benzopurpurin, Azo blue, &c., which impart a deep coloration in an alkaline bath. Only those celluloses in nature which approximate to the condition of hydrocellulose take these dyes readily and without preliminary treatment. Oxycellulose is only feebly if at all coloured by them. But all celluloses become at once intensely dyed after treatment with alkalis.
—E. G. P. T.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

Preliminary Notice on the Arrow Poison of the Wa Nyika and other Tribes of East Equatorial Africa, with Special Reference to the Chemical Properties and Pharmacological Action of the Wood from which it is prepared. T. Fraser and J. Tillie. Proc. Royal Soc. June 1893, 153.

The Wa Nyika arrow-poison has been frequently referred to by Burton, Cameron, and other travellers. It is chiefly composed of an extract prepared from a wood of the Acokanthera genus, species unknown. Both wood and arrow-poison contain a crystalline active principle of glucosidal nature. The crystals apparently have the composition $C_{30}H_{52}O_{11}$, and melt about 184° C. The lethal dose for frogs and rabbits is from 0·00003 to 0·00005 grain per 100 grains of animal weight. The action upon the circulatory, muscular, and nervous systems closely resembles, if it be not identical with, that of strophanthin.—F. W. P.

The Active Principle of Bryonia Alba. Masson. J. Pharm. Chim. 1892, **27**, 300; Chem. Rep. 1893, **17**, 90.

The ordinary methods for the isolation of bryonin from the root of *bryonia alba* do not permit its complete separation from the resin accompanying it. The process devised by the author suffices for the separation of the bryonin and also for the recovery of the resin, to which he gives the name *bryoresin*. The fresh root is cut up, dried, coarsely powdered, and extracted with 3 per cent. hydrochloric acid. The acid liquor is completely precipitated with tannin and the precipitate rubbed down first with 0·3 per cent. hydrochloric acid, then with water, dried, powdered, and dissolved in 90 per cent. alcohol. The solution is filtered, and zinc oxide added. The resulting mass is extracted with cold water and the solution evaporated at a low temperature, the crude bryonin thus obtained being treated with an equal weight of 0·5 per cent. hydrochloric acid and the turbid solution dialysed until perfectly free from acid. The operation is finished when a portion of the liquid in the dialyser, after having been evaporated to dryness, dissolves clear in absolute alcohol and leaves no ash on ignition. The dialysed liquid is filtered and evaporated, the residue dissolved in as little absolute alcohol as possible, and precipitated with an excess of dry ether. The precipitate is washed with ether and dried at 100° C. The quantity of pure bryonin thus obtained is 10—12 grms. per kilo. of dried root taken.

The residue left by the extraction of the root with dilute hydrochloric acid (*v.s.*) is washed with water, dried, and extracted with 95 per cent. alcohol, which dissolves the bryoresin. The crude resin is purified by long treatment with dilute acid, melted under boiling water and repeatedly shaken up therewith, dried, and dissolved in dry ether; the ethereal solution leaves pure bryoresin on evaporation.

Bryonin is a glucoside, has the formula $C_{34}H_{48}O_9$, and is a white, amorphous, very bitter substance, soluble in water and alcohol, but insoluble in dry ether and chloroform. It is dextro-rotatory, and softens at 190°—195° C. without becoming fluid, and begins to darken and decompose at 208° C. It is precipitated by tannin and ammoniacal lead acetate, but not by basic lead acetate. On account of the insolubility of its compounds with alkalis in alcohol, an alcoholic solution of bryonin is made turbid by the addition of a trace of alkali. Pure bryonin dissolves in strong sulphuric acid with the formation of a brown colour, which disappears on the addition of water, a precipitate being thrown down. By boiling with dilute sulphuric acid, bryonin is decomposed, yielding glucose and a resin, called by the author *bryogenin*, which is soluble in alcohol and insoluble in either. The simplest formula for this body is $C_{14}H_{19}O_2$; it is yellowish, amorphous, and dextro-rotatory; it softens at 130° C., melts at 210° C., and decomposes at 250° C.

Bryoresin has a composition corresponding to the formula $C_{37}H_{68}O_{19}$. It is a red, amorphous substance, insoluble in water and soluble in alcohol, ether, chloroform, and alkalis. At 15° C. it is soft, at 60° C. fluid, and at 250° C. it appears to be still undecomposed. At higher temperatures decomposition sets in. It dissolves in sulphuric acid; dilute alkalis appear not to affect it. On saturating a strong solution of bryoresin in absolute alcohol with an alkali, and adding an excess of dry ether, a precipitate of alkaline bryoresinate is formed. This resinate is soluble in water, and gives a precipitate of lead bryoresinate when treated with ammoniacal lead acetate. The alkaline bryoresinates are brick-red powders, soluble in water and alcohol. Bryoresin appears to exist in this form in the fresh sap of the plant.—B. B.

Citronellal (Citronellone). F. W. Semmler. Ber. 1893, **26**, 2254—2258.

The presence of citronellal in many ethereal oils has been shown by Schimmel and Co., Dodge and Kremers (this Journal, 1892, 935), and the author had expressed the opinion that it may be an aldehyde of the following formula; $(CH_3)_2.CH.CH_2.CH=CH.CH(CH_3).CH.COH$, because it yielded isovalerianic acid on oxidation (Ber. 1891, **24**, 209). Further investigations have shown that such isolated evidence is insufficient, and further work is promised to elucidate the right formula. Treated with silver oxide, citronellal actually yields citronellic acid, $C_{10}H_{18}O_2$. Citronellaldehyde belongs to the group of olefine camphors, and is a derivative of the fatty series therefore. It has been isolated from the oil of *Eucalyptus maculata, var. citriodora.*—C. A. K.

Organic Oximides; a Research on their Pharmacology. H. W. Pomfret. Proc. Roy. Soc. **53**, 398-404.

In order to trace whether any pharmacological type can be isolated and referred to the presence of the atomic group $= N.OH$, the author has experimented with ethylaldoxime, $CH_3.CH = N.OH$, and the similarly constituted propylaldoxime, isobutylaldoxime, and œnanthaldoxime; with acetoxime $(CH_3)_2 = C = N.OH$ as a representative of the ketoximes; with benzaldoxime and salicylaldoxime as representatives of the aromatic bodies; and with isonitrosoacetone, $CH_3.CO.CH = N.OH$, as a representative isonitrosoketone. The general conclusion arrived at is that the physiological actions of these substances recal in many respects the properties of nitrites; when oxidised at the body temperature decomposition takes place, and very soon the presence of a nitrite can be demonstrated. This decomposition appears to consist essentially in the separation of hydroxylamine from an aldehyde or a ketone.
—C. R. A. W.

The Decomposition of Chloroform containing Alcohol. D. Brown. Pharm. J. 1893, 321.

In their recent paper (this Journal, 1893, 543--544), Schacht and Biltz confirm the author's observation that pure chloroform, under the influence of light and air, is primarily decomposed into chlorine and carbonyl chloride; but state that in presence of alcohol these bodies interact with the latter, forming harmless products. Consequently, so long as any alcohol remains unconsumed, only hydrochloric acid can be detected in place of free chlorine. Moreover, they attribute the well-known preservative action of alcohol on chloroform to this fact. The author takes exception to these statements and declares them to be contrary to his experience. He quotes experiments to show that free chlorine and carbonyl chloride may be readily detected in chloroform before the added alcohol has been consumed; and further that such chloroform yields only a very faint reaction with silver nitrate, at the time when a very marked one is obtained with zinc iodide and starch. The author concludes, therefore, that the preservative influence of alcohol must be ascribed to some other cause; and that it is folly to attempt to arrest decomposition altogether in chloroform by the excessive addition of alcohol.—H. T. P.

Determination of Alkaloids in Extracts. Ledden-Hülsebosch. Pharm. C.H. N.F. 1893, **14**, 101; Chem. Rep. 1893, **17**, 66.

See under XXIII., *page* 1067.

The Analysis of Ethereal Oils. R. Benedikt and H. Strachs. Monatsh. f. Chem. **14**, 270–277.

See under XXIII., *page* 1066.

PATENTS.

Process for the Preparation of Iodo Compounds of the Phenol Series of the Aromatic Oxycarbon Acids and Pyrrol. A. J. Boult, London. From E. Fröhlich, Charlottenburg, Germany. Eng. Pat. 14,982, August 4, 1893.

Schutzenberger and Sengenwald obtained di- and tri-iodophenol by the action of iodine chloride on phenol and para-iodophenol respectively. The inventor has discovered that by appropriate changes in the conditions of experiment, the body di-iodo-phenol-iodide is obtained instead of the first-named products. Further, the method is adapted not only to the preparation of all possible iodo substitutes of phenol and of the aromatic carboxy acids, but also to the conversion of pyrrol and alkylpyrrol into tetraiodo-pyrrol and tetraiodo-alkyl pyrrol respectively. In place of free iodic chloride, chlor-iodo-hydrochloric acid is used, and with the phenols, &c. the reactions take place at normal temperature, the great technical advantage over other processes claimed being the replacement of half the iodine by the cheaper chlorine.—J. C. C.

An Improved Method of Manufacturing Potassium Salicylate and Salicylic Acid. S. Marasse, Berlin, Germany. Eng. Pat. 17,002, September 9, 1893.

Phenol is intimately mixed with neutral potassium carbonate, and the mixture placed in a closed receptacle and subjected to the action of the necessary quantity of carbonic acid, at a temperature between 130° and 160° C. An excess of potash must be used to prevent the mixture from caking when heated. By using carbonates of other alkalis than potassium, salicylic acid cannot be obtained in this way. —J. C. C.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Influence of the Introduction of a Sulphonic Group upon the Power of a Developer. A. A. Noyes and W. K. Gaylord. Technology Quarterly, April 1893. **6**, 60–61.

Para-amidophenol sulphonic acid acts as a developer, but much less energetically than para-amidophenol; a longer time is requisite, and much weaker negatives are finally obtained, when gelatin dry plates are treated comparatively with developing solutions identical, except that in one para-amidophenol is present, and in the other, the equivalent quantity of its sulphonic acid. By increasing the quantity of sulphonic acid five- or sixfold, fairly good negatives could still be obtained.—C. R. A. W.

Electrolytic Reduction of Benzene in Sulphuric Acid Solution. A. A. Noyes and A. A. Clement. Technology Quarterly, 1893, 62.

See under XI., *page* 1041.

PATENT.

An Improvement in or in connection with Sensitised Photographic Coatings and Films. F. W. Stoddart, Bristol. Eng. Pat. 23,251, December 16, 1892.

This invention consists in the addition to the usual sensitive photographic coating or film of one of the reducing substances commonly used in photographic developers, preferably pyrocatechin, hydroquinone, or pyrogallic acid. About five grains of the reducer to every fluid ounce of emulsion is used, and is first dissolved in the least quantity of water at the temperature of the emulsion before mixing with the latter. The reducer solution may, however, be applied to the plate after coating. The plates after exposure are developed with a solution of sodium carbonate or other alkali, containing about 5 per cent. of dry carbonate of soda or its equivalent in other alkali.—J. C. C.

XXII.—EXPLOSIVES, MATCHES, Etc.

The Determination of the Relative Sensitiveness of Explosive Substances through " Explosions by Influence." C. E. Munroe. J. Amer. Chem. Soc. **15**, 1, 10--18.

In the experiments recorded, the effect of the explosion of the primary mass was conveyed to the secondary mass through a continuous and practically homogeneous medium, and moderate quantities of explosives under constant conditions of confinement were employed, the initial and secondary masses being placed upon wrought-iron armour plates. The initial mass consisted of 100 grms. of explosive, while the secondary mass varied from 30 to 100 grms., it being evident that the weight of the latter had no effect on its sensitiveness, and that it was essential only to have a sufficient quantity for its explosion to produce a visible effect on the iron plate. In the experiments for testing the relative sensitiveness of different explosives when referred to a common standard 100 grms. of United States Service gun-cotton was selected for the initial mass. The results obtained were as follows, and were rather unexpected, as it was supposed that the nitro-substitution explosives would prove much less sensitive than camphorated explosive gelatin and Judson powder, or even than gun-cotton.

Relative Sensitiveness to Detonation by Gun-Cotton.

	C.M.
Gun-cotton	10
Explosive gelatin (camphorated)	20
Judson, R.R.P.	25
Emmensite (No. 259)	30
Rackarock	32
Forcite. No. 1	61
Kieselguhr dynamite, No. 1	64
Atlas, No 1	74

A few experiments were also made to determine the greatest distance at which a unit mass of one substance could affect the explosion of a secondary mass of the same substance.—G. H. R.

Manufacture of Nitro-glycerin. P. G. Sanford. Jour. Anal. and Appl. Chem. 7, 1893, 224—229; and 7, 262—277.

The General Arrangement of the Danger Area. — A perfectly level piece of ground is unsuitable as a site for the manufacture of nitro-glycerol, as a number of buildings are required to be upon different levels, in order to allow of the flow of the liquid nitro-glycerol from one building to another through a system of conduits. The buildings inside the danger area, or that portion of the works which is devoted to the actual manufacture of explosive material, are preferably made of wood, as, in the event of an explosion, this substance offers less resistance and causes less damage than stone or brickwork. In order to confine the force of an explosion, it is also a good plan to surround all danger buildings and conduits with mounds of sand or earth, which should be covered with turf, and of such a height as to be higher than the roof of the adjacent building. The conduits connecting the various buildings are generally made of wood and lined with lead, the space between the woodwork and lead lining (some four or five inches) being filled with cinders; they should also be provided with covers, which should be whitewashed in hot weather and regularly inspected. Whenever it is found that a portion of the lead lining requires repairing, before cutting away the lead it should be very carefully washed, for several feet on either side of the portion it is intended to remove, with a solution of caustic soda or potash in dilute methylated spirit; this treatment decomposes the nitro-glycerol with formation of glycerol and potassium nitrate. The mixed acids attack the lead rather quickly, forming sulphate and nitrate of lead, but chiefly the former. For this reason gutta-percha pipes have been proposed, but the great drawback to their use is that in the case of anything occurring inside the pipes, such as the freezing of the nitro-glycerol in winter, it is far more difficult to find it out.

The buildings which require to be connected by conduits are, beginning with the highest, (1) the nitrating house; (2) the separating house; (3) the filter-house; (4) the secondary separator; (5) the deposit of washings; and (6) the settling or precipitation house. In Great Britain these buildings require to be a specified distance apart, and a license must be obtained for each. They should all be protected by a lightning conductor, or covered with barbed wire, as suggested by Oliver J. Lodge. In order to keep them as cool as possible in summer, they should be made double, and the intervening space filled with cinders; the roof should also be kept whitewashed, and the windows thinly painted over with white paint. A thermometer should be suspended in every house. It is essential that the floors of all the buildings should be washed every day before the workmen leave. If any nitro-glycerol is spilt on the floors it should be sponged up and the place washed with an alcoholic solution of soda. The various houses should be connected with paths laid with cinders or boarded with planks, and any loose sand about the site of the works should be covered over with turf to prevent its blowing about and getting into the buildings. The works throughout should be heated by steam, brought in pipes covered with kieselguhr from a boiler house outside the danger area. A stove, entirely covered in with woodwork, should be placed in the corner of each building, and as small a length of steam pipes as possible should be within the building. Fire-extinguishing apparatus in proper working order should also be provided. The work-people inside the danger area should wear sewn leather shoes, and different clothes, preferably without pockets, from those usually worn, which necessitates the erection of changing houses, one for the men, and another for the girls. Brass nails or wooden pegs should be used in the construction of the buildings, and any necessary tools should be made of phosphor bronze or brass.

Nitration.

The acids used in the manufacture of nitro-glycerol should be as pure as possible. The sulphuric acid should have a specific gravity of 1·84 at 15° C. or contain 97 per cent. sulphuric acid. The nitric acid should be as strong as possible. Nothing with a specific gravity less than 1·52 should ever be used, and the oxides of nitrogen should not exceed 1 per cent. It should also be as free as possible from chlorine. An unsuccessful attempt has been made to free nitric acid from the oxides of nitrogen by blowing compressed air through it. E. Liebert claims that the addition of ammonium sulphate or nitrate to the mixed acids destroys the nitrous acid formed during the process of nitration, thus, $(NH_4)_2SO_4 + 2HNO_2 = H_2SO_4 + 4H_2O + 2N_2$.

The best proportions in which to mix the acids are three parts by weight of nitric acid to five of sulphuric acid. After mixing, the acids should be forced up to the nitrating house in the danger area. They should be stored in a leaden chamber, large enough to hold sufficient acid for four or five nitrations, placed in a wooden house six or seven feet higher than the nitrating house. This house should also contain a smaller lead tank, holding, when filled up to a certain mark, just enough acid for one nitration.

The glycerol should be contained in a small cistern provided with a graduated gauge glass, and fixed on the wall of the nitrating house. A good charge is 16 cwt. of the mixed acids, and 247 lb. of glycerol. The nitration is usually conducted in a lead vessel, cased in woodwork, four feet wide at the bottom and rather less at the top. It is generally about four feet high, but should never be more than two-thirds full. The top of the tank is closed in with a dome of lead, in which is a small glass window through which the progress of the nitrating operation may be watched. A lead pipe is fitted to the top of the dome and carries the acid fumes up through the roof. The interior of the tank contains at least three concentric spirals of 1-inch lead pipe, through which water is made to flow during the *whole* operation. Another lead pipe is carried through the dome as far as the bottom of the tank, where it is bent round in the form of a circle and is pierced with small holes about one inch apart, through which air under a pressure of 60 lb. per square inch is forced in order to keep the liquids in a state of constant agitation. A 2-inch pipe brings the mixed acids and a narrow bore pipe the glycerol. Two thermometers are inserted into the tank, one near the bottom and the other near the top. A large earthenware tap (covered with lead) is fixed just above the bottom of the tank, so that the charge may be run down the conduit to the next house, or if necessary, in cases of decomposition, be discharged into a drowning tank. This is generally 16 feet long, 6 feet wide, and 4 feet deep. It is placed close outside the building, is lined with cement, and contains a large quantity of water. It should only be used as a last resource, as it is troublesome to recover the nitroglycerol from the bottom.

After a charge of the mixed acids has been introduced, water is turned on through the coils and sufficient compressed air to stir up the acid. When the thermometers register 18° C. the glycerol is slowly admitted and the air turned on full. The nitration usually requires about half an hour, but a little extra time should always be allowed. The temperature should be kept as low as possible and should never exceed 25° C. The chief points to attend to during the nitration are: (1.) The temperature of the two thermometers. (2.) The colour of the nitrous fumes given off. (3.) The pressure of the compressed air. (4.) The gauge showing the quantity of glycerol used. If the temperature rises too high the glycerol should be turned off and the air pressure increased until no more red fumes are given off.

Separation.

When the nitration is over the charge is sent down the conduit into the separator. This is a leaden tank somewhat similar to the nitrating vessel, but provided with a window of thick plate glass, which enables the workman to see when the separation is complete. The lead coils may be omitted from the separator, and one thermometer dipping into the nitro-glycerol is sufficient. The separator is connected by a conduit with the filter-house and also with the secondary separator and the drowning tank, as the charge often gets very dangerous in this building. The secondary separator is used to recover a small quantity of nitro-glycerol from the spent acids. Before the nitro-glycerol is run down to the filter-house it is usually washed three or four times in a smaller lead tank, with its own bulk of water, containing about three pounds of carbonate of soda, to neutralise the remaining acid. It is then drawn off into india-rubber buckets, and poured down the conduit to the filter-house.

Filtering and Washing.

Five or six charges are usually washed at the same time. The washing tank is half filled with water, and contains a compressed air pipe for the purpose of stirring. Four or five washings are generally necessary. The nitro-glycerol is then run into the next tank, the top of which is on a level with the bottom of the first one. Across the top of the tank is stretched a piece of flannel to remove dirt and scum. It is filtered again through another piece of flannel, and is finally drawn off into rubber buckets. At this stage it is taken to the laboratory and subjected to the Government heat test (See the Explosives Act, 1875, Eissler's Modern Explosives, 267). If it does not pass this test, it must be re-washed until it does. As five or six charges are often in the filter-house at one time, it is necessary to have as many tanks arranged in tiers, otherwise one or two refractory charges would stop the rest of the plant. The chief causes of the nitro-glycerol not passing the heat test are, either that the acids contained some objectionable impurity, or more frequently the quality of the glycerol used. The glycerol used should conform to the following tests:—

(1.) Minimum specific gravity at 15° C., 1·261.

(2.) Should nitrify well.

(3.) Separation should be sharp within half an hour without the separation of flocculent matter (due to fatty acids), nor should any flocculent matter be formed when the nitro-glycerol is thrown into water and neutralised with carbonate of soda.

(4.) Should be free from lime and chlorine, and contain only traces of arsenic, sulphuric acid, &c.

(5.) Should not leave more than 0·25 per cent. inorganic and organic residue together when evaporated in a platinum dish without ebullition (about 160° C.) or partial decomposition.

(6.) Silver test, should not show more than slight reaction.

(7.) The glycerol, when diluted one-half, should give no deposit or separation of fatty acids when nitrogen peroxide gas is passed through it.

After the nitro-glycerol has passed the heat test, it is allowed to stand for a day or two in conical tanks in order that a small quantity of water may separate. It is then of a pale yellow colour, and quite clear, and should exhibit no acid reaction.

It is *impossible* to run the waste acids away or recover them as long as nitro-glycerol is contained in it. The separation is usually effected in a tank similar to the nitrating tank. The small quantity of nitro-glycerol which is obtained is taken to the filter-house, and treated with another charge. The acid may then be treated by a denitration plant of some kind. The secondary separator requires more attention than any of the other houses, on account of the danger of the decomposition of the small quantities of nitro-glycerol mixed with so much acid and water formed during the process. The composition of the mixed acids after nitration is as follows: Sp. gr., 1·7075 at 15° C.; H_2SO_4, 67·2 per cent.; HNO_3, 11·05 per cent.; and water, 21·7 per cent., with as much as 2 per cent. of nitric oxide and a little nitro-glycerol. The cause of explosions in the secondary separator is either the inattention of the workmen in charge, or the bursting of one of the water pipes, the water mixing with the acids causing a sudden rise of temperature. The author also describes a nitro-glycerol plant which can be used on a smaller scale.

—J. S.

Improvements in the Process and Machinery for Producing a Thread or Filament similar to Silk. F. Lehner, Zürich. Eng. Pat. 22,736, December 10, 1892.

See under V., page 1024.

Improvements in the Manufacture of Gunpowder. H. Kolf, Bonn, Germany. Eng. Pat. 22,739, December 10, 1892.

This invention relates to simplifications in a former patent, Eng. Pat. 8811, June 7, 1890 granted to the author (this Journal 1891, 573), and consists in "the manufacture of gunpowder or blasting explosive by first impregnating a nitrated carbohydrate material (which may be treated if desired, with a solution of an alkaline sulphide) with a solution of an alkaline nitrate, subsequently drying it, and afterwards mixing it with nitro-sugar, nitro treacle, or nitroglycerine, the mass being then heated to about 40° to 60° C. so as to obtain a partially gelatinous mass which is reduced to a completely plastic form by simply rolling, kneading, or pressing it, after which it can be moulded into any desired shape."—W. M.

Improvements in Explosives. A. Kramer, London. Eng. Pat. 22,023, December 1, 1892.

The inventor proposes making a cartridge case of soft metal (such as lead, tin, aluminium, brass, &c.) to contain liquid explosives such as mixtures of strong nitric acid and nitro- and dinitrobenzene.—W. M.

PATENTS.

Process for Manufacturing Powder suitable for Practice, Ammunition, Sporting Cartridges, and similar Purposes. O. Imray, London. From F. C. Glaser, Berlin, Germany. Eng. Pat. 23,105, December 15, 1892.

The object of this invention is to provide means by which any explosive suitable for service ammunition can be made useful if desired for practice ammunition, small shot cartridges, and similar purposes, by making the explosive more voluminous and porous. This end is attained, if the explosive material is nitrocellulose, by incorporating it with 20 to 40 per cent. of a soluble or volatile body, such as potassium nitrate, benzene, or paraffin oil, which has no decomposing or dissolving effect on the explosive. The paste is then made into suitable forms by known means, and then the soluble or volatile body is removed by boiling the grains, &c. in water or other solvent, or by evaporation. In this way the gravimetric density and specific gravity can be greatly lowered.—W. M.

Improvements in and relating to the Manufacture of Smokeless Explosives. F. G. Du Pont and P. S. Du Pont, Wilmington, Del., U.S.A. Eng. Pat. 15,865, August 22, 1893.

This invention describes a method of granulating guncotton by mixing a solvent, such as nitrobenzene, with gun-cotton held in suspension in a fluid, such as water. On agitation, the solvent has a tendency to seize the particles of gun-cotton, forming in the water a more or less coherent mass. By adding the solvent in proper proportion a well-defined granular condition results. These grains afterwards undergo a process of hardening by rotation in a barrel, and removal of water and solvent contained in the grains by heat. The violence of the explosive may be modified by varying the duration of these processes or by dissolving from 2½ to 10 per cent. of a moderating agent, such as nitrated rosin or nitrated turpentine, in the solvent before mixing with the suspended gun-cotton. The specification is illustrated by drawings of the apparatus used in the processes.—W. M.

Improvements in and relating to the Manufacture of Smokeless Explosives. F. G. Du Pont and P. S. Du Pont, Wilmington, Del., U.S.A. Eng. Pat. 15,866, August 22, 1893.

Referring to the preceding patent, the inventors state that increased hardness and consolidation of the grains may be obtained by subjecting the grains to the action of a gentle heat, not sufficient to cause vaporisation of the solvent, but to remove some of the water condensed in the grains, the grain having the property of giving up its contained water before it parts with the solvent used in its preparation, and at a lower heat.—W. M.

Improvements in and relating to the Manufacture of Smokeless Explosives. F. G. Du Pont, Wilmington, Del., U.S.A. Eng. Pat. 15,867, August 22, 1893.

This is an improvement on the two preceding patents, and consists in emulsifying the nitrobenzene or other solvent before adding it to the gun-cotton suspended in water. By this procedure a more uniform granulation and a more complete precipitation of the nitrocellulose is produced than when the unemulsified solvent is used. A solution of soap or sodium carbonate or pure water may be employed for producing the emulsion with the solvent.—W. M.

Improvements in the Manufacture of High Explosives. H. H. Lake, London. From W. Adams, jun., Broken Hill, N.S.W. Eng. Pat. 16,609, September 4, 1893.

The component parts of this new explosive are:—

	Per Cent.
Sulphide of antimony	1
Mercuric oxide	½
Tungstic acid	½
Picric acid	1
Sulphur flowers	13
Nitrate of potassium	54
Infusorial earth, or a like absorbent	20
Water	10

—W. M.

XXIII.—ANALYTICAL CHEMISTRY.

APPARATUS, ETC.

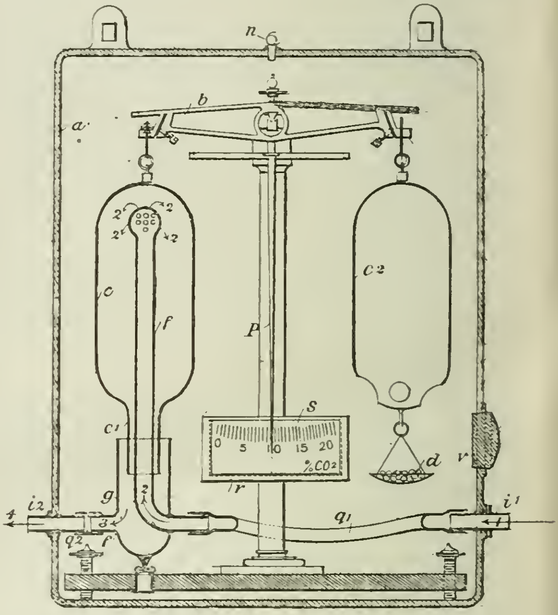
PATENTS.

Improvements in Mercurial Air Pumps. L. Jeyes, Battersea, London. Eng. Pat. 22,214, December 5th, 1892.

The improved air-pump is so constructed that the mercury which collects in the lower receiver is returned to the upper receiver by an automatic process, thus rendering the action of the pump continuous. The general arrangement of the air-pump is shown by Fig. 1 (for illustrations, see next page), while sectional views of the stop-cock controlling the air supply to the lower reservoir are shown by Figs. 2 and 3, also Fig. 4 is a sectional side elevation of the tilting mercury cup. Mercury from the upper container A is allowed to pass into the fall-tube A^2, dropping into the pivoted cup B^1, Fig. 4. The cup, when filled, loses its balance and tilts up, emptying its contents into the spiral down tube C, thereby imprisoning and forcing down air which has expanded into the tube C from the vessel D during process of exhaustion. The mercury subsequently enters the vessel F and the bore of the stop-cock G^1, finally falling into the lower reservoir H. When the mercury in H has risen far enough to cover the wires x, x, an electrical circuit is completed, energising the electro-magnet L, and thereby freeing the ratchet-wheel J connected by a train of wheel-work K to the stop-cock G, and causing the latter to turn through 90° to open up communication with the outer air by means of the orifice G^5 and bye-pass tube G^2. Air then enters the reservoir H and forces the mercury by the pipe J into the upper reservoir A until a circuit is again completed by the mercury covering the wires y, y, causing the stop-cock to again turn through 90° and thereby stop the flow of mercury into the vessel A. Several pumps may be used if desired connected by piping and working continuously after the manner described above; the preliminary exhaustion may be accomplished by a jet pump.—E. G. C.

Apparatus for ascertaining the Volume of a Particular Gas in a Gaseous Mixture, and for ascertaining the Weight of Gases. M. Arndt, Aachen, Germany. Eng. Pat. 23,876, September 27, 1892.

This apparatus is depicted in the accompanying figure, in which a is an airtight casing, b a balance carrying a balanced gas container c, contracted at the bottom to an open neck c^1, and so situated that it can move up and down without contact with the inlet pipe f and the exhaust chamber g. The case is provided with glass sights.



"The source of the gas supply being in communication with inlet i^1, the outlet i^2 is placed in communication with a suction apparatus of any suitable kind, and a portion of the air present in the casing is drawn off, that is to say, this air is exhausted to so much of a vacuum as corresponds to the strength of the suction at i^2. This rarefaction being obtained, the gases to be dealt with can only pass into the apparatus by inlet tube i^1, thence passing through the tube q^1 and tube f out of this latter through perforations 2 at the top into the gas-container, which they fill, and out of the same in the direction shown by the arrows to pass out of the apparatus through outlet i^2 under the influence of suction." The scale p is divided either so as to indicate units of weight by the distance between its dividing lines, or so that these distances shall indicate a particular percentage volume of a certain gas, or of a gaseous mixture.

"The fluctuations in the volume of the gases taking place round fixed tube f by reason of the up and down motion of the gas container c are kept in view on scale s. The gas container c is so balanced either by a compensating vessel c^2 also open at the bottom, and equivalent in its capacity for upward driving, in conjunction with small weights d or wholly by the latter, that the pointer p in the beam moves to zero when atmospheric air is drawn through the apparatus." The block v allows of the adjustment of the weights, and the aperture w is for the occasional admission of air into the apparatus.

"The gas container c being open at the bottom so that the pressure within it is always the same as that without,

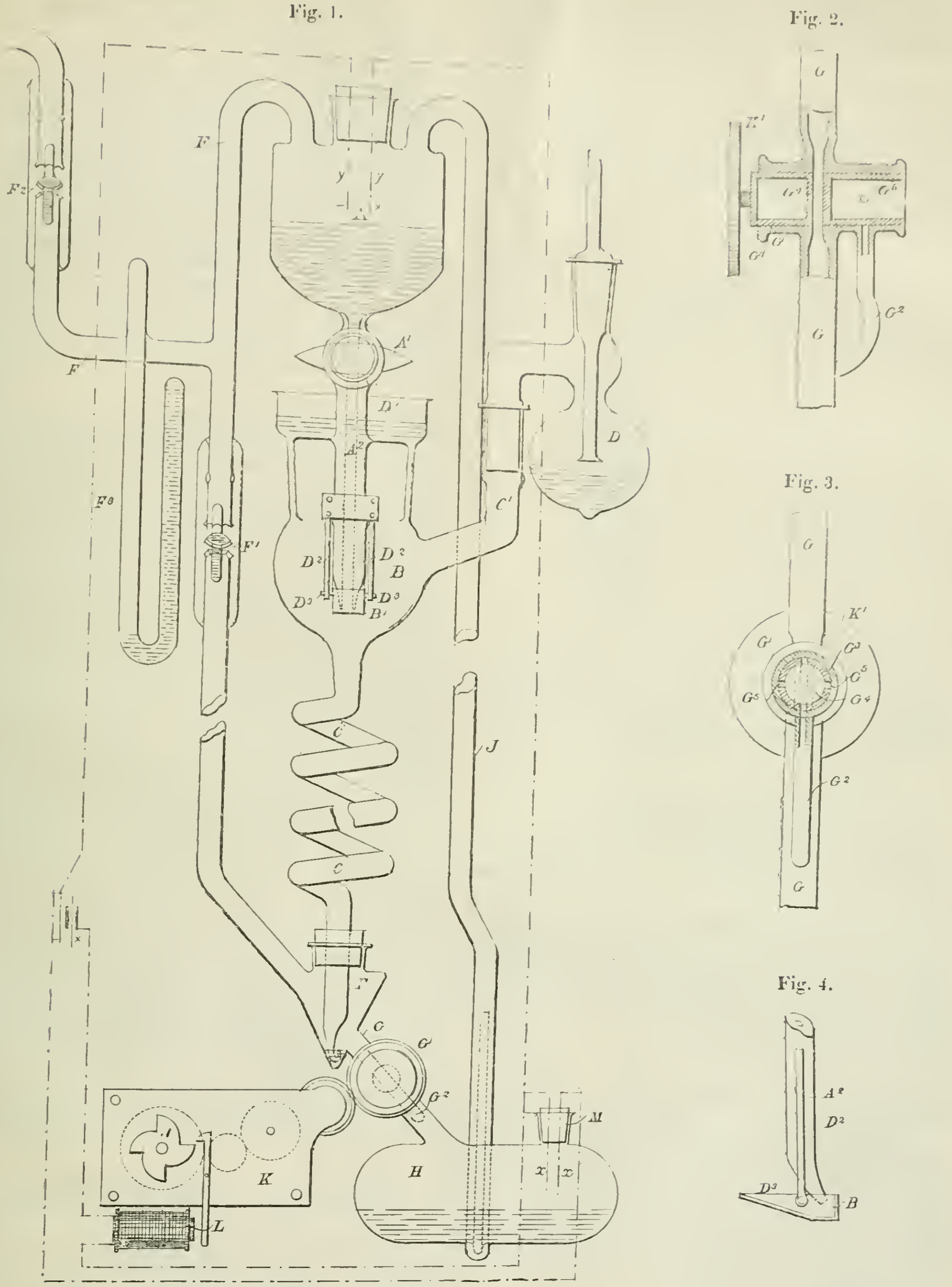


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Improved Mercurial Air Pump.

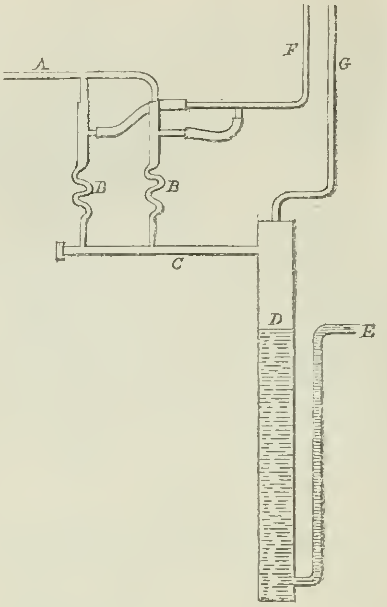
fluctuations of pressure and barometrical readings have not to be considered in the use of this apparatus, likewise fluctuations of temperature do not affect its action, because the gases passing slowly through the apparatus take the temperature prevailing in the small gas passages."

—A. G. B.

A Convenient Agitator. O. Textor. J. Anal. and Appl. Chem. 7, 279.

The author describes an arrangement which will be easily understood by reference to the figure. A is the water-supply pipe to which are connected two Richard's filter pumps B and B. C is a $\frac{3}{4}$-inch iron pipe leading into the 3-inch iron pipe D, in which the water and air separate. The waste water flows off into the sewer by the exit E.

F and G are the suction and blast-pipes, respectively, leading to the laboratory. Its advantages are; that it requires no attention, it continues to work uninterruptedly, and is simple in construction. The blast may be advantageously used to replace the shaking machine employed for facilitating the precipitation of phosphoric acid as phospho-molybdate, &c., and the blast of air from two pumps is generally sufficient to agitate the contents of eight beakers.—J. S.



INORGANIC CHEMISTRY.—QUANTITATIVE.

Extension of Lunge's Tables for the Reduction of Gas Volumes at Various Pressures. A. Lwoff. Zeits. ang. Chem. 1893, 443—445.

Tables for the reduction of gas volumes to normal pressure and temperature have been calculated by the author and published by G. Lunge in his "Handbook of the Soda Industry," the "Chemiker Kalendar," and the "Alkali Makers' Pocketbook." These tables only extend to a pressure of 710 mm.; this additional table extends them further, to 680 mm.—C. R. A. W.

The Determination of Carbonic Acid in White Lead. F. C. A. Meisel. School of Mines Quarterly, **14** (4), 318—322.

When the percentage of neutral lead carbonate and thence that of lead hydroxide in white lead is determined by the estimation of the carbonic anhydride contained by the pigment, small errors in the analysis are seriously multiplied when calculated from CO_2 to $PbCO_3$. The following methods of carrying out the determination were examined by the author:—

(1.) Method by loss on ignition.

(2.) Method by loss, using alkalimeter.

(3.) Method by volume of permanent gas given off on ignition.

(4.) Method by evolution, absorption, and weighing the carbonic anhydride.

The results by the first method, which is very rapid, are always high, from the presence of impurities in the white lead, such as lead acetate and organic matter. The following formula, derived from the known percentages of water and carbonic anhydride in lead hydroxide and neutral lead carbonate respectively, may be used to calculate the percentage of each in white lead:—

Let A = per cent. of total loss; x = per cent. CO_2; y = per cent. H_2O.

Then $x = \frac{13 \cdot 388\ A - 100}{7 \cdot 320}$

and $y = A - x$.

The method depending upon the measurement of the volume of permanent gas given off on heating the white lead was tried in its simplest form, the white lead being heated in a glass bulb connected with a graduated tube coupled to a movable reservoir of mercury. The presence of acetate and organic matter vitiates this method, as well as that already described. An attempt to remedy this by the introduction of oxidants, such as potassium chlorate and red lead, was not successful, as certain samples of white lead still gave inaccurate results. The author, therefore, fell back on the ordinary method of weighing the carbonic anhydride given off on dissolving the lead in acid, and describes a simple form of apparatus which he has found efficient. A table of results by the various methods criticised is appended to the paper.—B. B.

Analysis of Low-grade Impure Tin Ores. R. Peele, jun. School of Mines Quarterly, 1893, **14**, 216.

The author states that hitherto there has been no direct fire-assay possible for low-grade tin ores, as a crucible charge with only a few per cent. of tin will often give no button at all. For ores containing from 0·5 up to 15 per cent. of tin in a siliceous and ferruginous gangue, as also for pyritous ores containing from 2 to 5 per cent. of tin, he has adopted the following method of procedure:—The ore is crushed to pass through a 60-mesh sieve. From 50 to 200 grms. are taken and washed carefully in a small gold-pan or horn-spoon, merely to float off the lighter and finer particles of gangue and iron oxide; no sand is to be washed away. The residue is dried, ground on a porcelain mortar as fine as possible, and then treated in a flask with a mixture of one-fourth nitric and three-fourths hydrochloric acid; gently heated, with frequent stirring, and then evaporated down until the mixture thickens and begins to show signs of sticking. The flask is then filled with water and the fine, disintegrated portion of the ore is run off into a beaker. After a few moments for settlement the muddy water is decanted carefully, the residue from the beaker is added to the residue from the acids, and the acid treatment is repeated as before. It may be a third and even a fourth time until nothing is left but whitish or greyish cassiterite with nearly pure white silica. This residue is washed very carefully to separate the silica—preferably in a conical wooden batea, until nearly pure tin oxide alone is left; this is dried, fused with potassium cyanide in a muffle with a hot fire for 10 to 15 minutes, the crucible withdrawn, gently tapped so as to settle the button, and left to cool. Then the crucible is broken, the slag dissolved out with water so as to liberate any small scattered globules of tin, which are added to the button.

The author remarks that the process is rather long and tedious, but it possesses the advantage of being applicable to the poorest as well as the richest ores.—J. H. C.

Cadmium Chloride as an Absorbent of Hydrogen Sulphide. F. L. Crobaugh. J. Anal. and Appl. Chem. **7**, 280—282.

In the analysis of steel the sulphur, liberated as hydrogen sulphide, is usually passed into from 10 to 30 times the theoretical quantity of cadmium chloride mixed with ammonia before the titration with iodine solution. The author has made a series of preliminary experiments to see how much cadmium chloride was actually necessary, and was astonished to find that on diminishing the cadmium chloride to one-half of the calculated quantity about 90 per cent. of the hydrogen sulphide was absorbed. Experiments with ammonia alone (1 strong ammonia to 2 water) then showed that about 60 per cent. of the hydrogen sulphide was retained in a form capable of liberation and titration. The author proposes to investigate the subject fully.—J. S.

Rapid Determination of Phosphorus in Coal and Coke. F. L. Crobaugh. J. Anal. and Appl. Chem. 7, 223—224.

Five grms. of the finely-powdered material are ignited, with occasional stirring, in a large platinum crucible inclined over a four-tube Bunsen burner, until almost all the carbon has burnt away. When the crucible has cooled down, 5 grms. sodium carbonate and 0·5 grm. potassium nitrate are mixed with the ash and fused for five minutes. After the crucible has cooled it is placed in a beaker containing about 150 cc. nitric acid of sp. gr. 1·135, and gently heated until the melt has dissolved. The liquid is then filtered, heated to 90° C., and 75 cc. of ammonium molybdate solution added. The phospho-molybdate precipitate is washed with 2 per cent. sulphuric acid and treated in the ordinary way.—J. S.

Modification of the Stannous Chloride Method for Iron Titrations. R. W. Mahon. Amer. Chem. J. 15, 360—362.

The author has improved the stannous chloride method of titrating iron by the introduction of an indicator containing 0·05 grm. platinum as platinic chloride and 34·0 grms. mercuric chloride per litre. If this indicator is added to a strongly acid solution of ferric chloride, at or near the boiling point, stannous chloride reduces all the iron first, and the first drops in excess cause the formation of a faint cloud of mercurous chloride darkened and rendered instantly perceptible by finely-divided mercury and platinum, which are precipitated at the same time.

The standard solution of ferric chloride is advantageously made of such strength that 1 cc. contains 0·01 grm. of iron; the stannous chloride of approximately the same strength. In the frequent standardisations of the stannous chloride, which should be kept out of contact with the air as much as possible, it is desirable to employ the same conditions of dilution and acidity, as well as approximately the same quantity of iron as in the estimations. A correction, as in all titrations depending on the production of a certain tint in a solution of definite bulk, is to be made. 0·2 cc. stannous chloride of the strength recommended imparts a distinct tint to 175—200 cc. of solution, and is easily remembered and reproduced. 15 cc. is a suitable quantity of the indicator to be used in each estimation.

The estimation of iron in its ores is performed as follows:—Weigh 1 grm. of ore into a 250 cc. beaker and digest with 20 cc. hydrochloric acid of 1·20 sp. gr. until decomposed; then add 0·3 grm. of potassium chlorate and digest a few moments longer. The watch-glass and the rim of the beaker being washed down into the solution, which should now occupy about 40 cc., it is filtered and washed into a 600 cc. Erlenmeyer flask; 20—30 cc. hydrochloric acid of the above strength and 15 cc. of the indicator are added. On heating, the trace of remaining chlorine escapes, and the solution is titrated at incipient boiling. The residue is prepared for titration by fusing with sodium carbonate, extracting with water and acid, and adding 15 cc. of the indicator. The following test analyses of an iron ore show the accuracy of the method:—

	Per Cent. Fe.
Permanganate method	57·30
Bichromate „	57·26
Stannous chloride with indicator	57·33

—J. S.

Determination of Carbon in Steel. F. Julian. J. Amer. Chem. Soc. 15, 113—114.

The difficulties in the process may be overcome by the use of the following device:—A piece of stiff platinum gauze about 50 mm. in diameter is bent into the form of a shallow dish, and to the edge is soldered a thick platinum wire, which hooks on to the edge of the beaker, suspending the gauze about 40 mm. below. The saturated solution of copper-ammonium-chloride or copper-potassium-chloride is poured on to the drillings in the gauze and the beaker allowed to stand until complete solution has occurred. It is claimed that the ease of filtration and washing compensates for the extra time and solution required by this method.—G. H. R.

New Method for the Quantitative Determination of Carbon in Malleable Iron and Steel. O. Pettersson and A. Smitt. Jernkont. Annaler, 1892, V.; Dingl. Polyt. J. 289 [1], 17—22.

This method has been worked out in the laboratory of the Stockholm University. The authors believe that there are very few methods for determining carbon in iron and steel which render account of all the carbon present They only cite Särnström's modification of Ullgren's method, and Tamm's method, as being exact and suitable for making control analyses. In the former method the metal is dissolved in sulphuric acid and chromic acid or potassium bichromate, and the evolved gases are passed over glowing copper oxide or, after mixture with air, through a red-hot narrow platinum tube, in order to oxidise the small quantity of carbon existing as a hydrocarbon gas that escapes oxidation by the chromic acid, before the final absorption of the carbonic acid contained in the gases; and in the latter method the metal is directly burned in a stream of oxygen.

The authors state that in all methods by which the metal is dissolved in an acid with evolution of hydrogen or in any neutral salt or double salt, as, *e.g.*, cupric sulphate or chloride, or ammonium- or potassium-cupric chloride, &c., there is a loss of carbon by the escape of hydrocarbon gases. This holds also even when iodine is used as solvent. They believe therefore that there is room for new methods giving exact results. Their new method consists in first dissolving the metal in fused potassium bisulphate in the presence of air. Sulphurous acid, carbonic acid, and some hydrocarbon gases are evolved. The mixed gases are then led through a tube filled with chromic anhydride, which retains the sulphurous acid, and then through a tube containing red-hot copper oxide, in which the hydrocarbon gases are decomposed and the carbon converted into carbonic acid.

About 0·5 grm. of the metal in the form of fine shavings or filings are taken, and to decompose this quantity about 35—45 grms. of bisulphate are needed. If the latter quantity be taken, it will serve for a second decomposition. The bisulphate is fused in the bend of a bent glass tube made of combustion tubing, and a stream of air is allowed to bubble through the fused substance. It is then allowed to cool whilst air is being passed through. The metal is then added to it, and the heat again applied.

The purified carbonic acid that is evolved in the process is led into a flask containing an aqueous solution of barium hydrate. The barium carbonate formed is subsequently decomposed in the flask with hydrochloric acid, and the carbonic acid evolved, mixed with air, is drawn into a gas-measuring tube, and from thence into an Orsat's absorption tube, where it is absorbed by potassium hydrate solution. The contraction is observed by passing the residual air back into the gas-measuring tube. The apparatus is so arranged that the carbonic acid is not measured all at once, but is drawn off at intervals, absorbed, and the contraction measured. The evolution flask is finally heated to expel all the carbon dioxide from it. The *modus operandi* of the method is given in very great detail in the original.

When the iron or steel contains graphite, a portion of this remains in the bisulphate tube. The fusion must then be extracted with hydrochloric acid, filtered on asbestos in a platinum filtering tube, dried and weighed, and the graphite determined by the loss of weight on burning the graphite. The authors effect this by allowing air to bubble through fuming nitric acid and then to pass through the platinum filter tube, whilst heat is applied to the shoulder of the tube from a Bunsen burner.—H. S. P.

Determination of Silicon by Drown's Method. A. P. Ford. J. Anal. and Appl. Chem. 7, 277—278.

In a determination of silicon in a sample of steel, the result obtained in the Pennsylvania Railroad Company's laboratory was only one-half of that obtained by another chemist who worked on the same steel. The source of error was traced by Dudley (this Journal, 1893, 379) to the fact that the chemist who had made the analysis in his laboratory had been taken away to attend to some other work, when the silicon determination had been evaporated to dryness and diluted with hot water, and consequently instead of being filtered immediately, was allowed to stand in this condition for 48 hours before being filtered and burned.

The author made duplicate analyses of 10 or 12 different samples of steel and cast iron by the same (Drown's) method. One set of the analyses was made without delay, whilst the other set was allowed to stand 48 hours after evaporating to dryness and diluting. The results which he has obtained do not accord with those of Dudley, for in no instance was the variation more than would be due to the error of manipulation.—J. S.

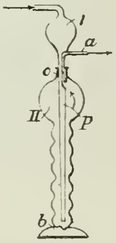
Rapid Method for the Estimation of Phosphorus in Titaniferous Iron Ores. C. Baskerville. J. Anal. and Appl. Chem. 7, 194—196.

To avoid the usual long and tedious process for the determination of phosphorus in titaniferous iron ores, the author recommends the following process. Two grms. of finely pulverised ore, which has been dried at 100° C. by heating for two hours in an air-bath, are thoroughly mixed with about 20 grms. fusion mixture (10 parts sodium carbonate and one part potassium nitrate) and brought to a quiet fusion in a spacious platinum crucible. After heating five minutes longer, the melt is run well up on the sides of the crucible, which is rapidly cooled by alternately dipping and removing it from water in a beaker. The crucible is finally plunged into the water, inverted, and let stand over night. To avoid this delay, the crucible may be filled with distilled water, held over the beaker, and boiled briskly. This is repeated 10 times, and the solution, which now amounts to about 300 cc., is filtered and the residue washed with hot water four of five times. 25 cc. ferric chloride, containing about 0·1 grm. metallic iron is then added. The solution is acidified with hydrochloric acid, brought to boil, and precipitated with ammonia; after filtering, the precipitate is washed twice with hot water and dissolved in 40 cc. nitric acid (sp. gr. 1·43). 25 cc. strong ammonia are then added, and the liquid brought to the temperature 85° C., and precipitated with molybdate solution. The precipitate is well shaken for one minute, allowed to stand in a warm place for five minutes, and then filtered. The phosphorus in the phospho-molybdate precipitate is then determined by titration.

Test experiments showed that this method compares fairly well with the molybdate method when the phosphoric acid is weighed as magnesium pyrophosphate.—J. S.

Estimation of Sulphur in Iron. Zeits. ang. Chem. 1893, 608.

Blom's apparatus for carrying out the bromine process of sulphur estimation in iron is very fragile, and the tube is apt to get blocked by fragments of caoutchouc from the india-rubber cork. The modification shown in the figure is an improved form, the caoutchouc stopper being omitted; the outlet tube, *a*, is fused into the glass; the upper part, I, is ground into the lower II, stopper-wise, and the foot, *b*, is weighted with lead.—C. R. A. W.



The Determination of Sulphur by Eschka's Method. F. Hundeshagen. Chem. Zeit. 1893, 17, 454.

The author refers to a paper of his (Chem. Zeit. 1892, 16, 1070; this Journal, 1893, 465) on the determination of sulphur in certain samples of brown coal by Eschka's method, in which he pointed out that a considerable loss of sulphur might take place, and recommended the replacement of sodium carbonate by the potassium salt. Experiments made by J. O. Handy (Proc. Engineers' Society of Western Pennsylvania, 17) on six samples of ordinary coal, appear to show, however, that the potassium carbonate mixture is not preferable to that containing sodium carbonate. The author therefore repeats that many ordinary coals yield the whole of their sulphur when treated according to Eschka's original prescription—although loss occasionally occurs with richly bituminous samples—and that the use of potassium carbonate is especially necessary with brown coals, the loss of sulphur from which can be recognised by the intense blackening of lead paper held over the crucible at the beginning of the operation.

That the modification is not needless is shown by the figures yielded by three samples of brown coal of the following composition:—

——	I.	II.	III.
Water……………………	8·50	3·55	4·05
Volatile matter……………	54·75	69·79	64·05
Fixed carbon………………	29·85	20·48	23·30
Ash………………………	6·90	6·13	8·60
Volatile sulphur……………	1·80	2·19	2·93
Fixed " ……………	0·30	0·39	0·13
Total " ……………	2·10	2·58	3·06
Sulphur by Eschka's method	1·97	2·43	2·77

The author is disposed to consider that a high content of nitrogen favours loss of sulphur when Eschka's original prescription is adopted.—B. B.

Rapid Method for the Technical Analysis of Blast-Furnace Slag. O. Textor. J. Anal. and Appl. Chem. 7, 257—262.

The author shows that by a judicious application of well-known methods and operations, five of the most important constituents in blast-furnace slag, viz., silica, alumina, lime, magnesia, and sulphur, may be estimated in one or two hours.

In one weighed portion of the slag the silica and alumina are determined in the usual way. As only a small quantity of iron is contained in the slag it is estimated along with the alumina; if necessary, however, it may be determined in a separate portion by titration with permanganate.

From another weighed sample the iron and alumina are precipitated by ammonia and the filtrate divided into two portions. To each or these ammonium oxalate is added. In one the calcium is determined by dissolving in dilute sulphuric acid and titrating with permanganate. From the filtrate from the other the magnesia is precipitated by the addition of sodium phosphate and ammonia, and weighed as pyrophosphate.

The sulphur is determined in a third weighed sample (0·5 grm.) by adding 150 cc. hot water and some starch solution. To this is added about 15 cc. of an iodine solution representing 0·1 per cent. sulphur in each cc., then 15—20 cc. strong hydrochloric acid. On stirring, the slag soon dissolves. The hydrogen sulphide liberated is oxidised by the iodine solution which is then added to the end reaction.—J. S.

Controlling of Fehling's Solution. A. Bornträger. Zeits. ang. Chem. 1893, 600—601.

PURE sugar is inverted in the cold with hydrochloric acid, and a standard solution of invert sugar prepared. 19 grms. of sugar, 10 cc. acid of sp. gr. 1·188 (or 20 of sp. gr. 1·10), and enough water to make up 100 cc., are mixed and allowed to stand all night; next day 25 cc. are neutralised with soda (using a little litmus) and diluted to a litre, furnishing a solution containing 0·5 grm. invert sugar in 100 cc.

—C. R. A. W.

Determination of Nitrogen in Nitrates and Total Nitrogen in Mixtures of Nitrates and Nitrogenous Substances. V. Schenke. Chem. Zeit. 1893, **17**, 977—979.

THE author reviews the numerous methods that have been proposed by the determination of nitrogen in nitrates, and especially recommends Ulsch's method (Chem. Centr. 1890, **2**, 926), which is carried out as follows:—A quantity of nitrate equal to 0·5 grm. of $NaNO_3$, dissolved in 25 cc. of water, is treated in a distillation flask with 4 grms. of iron reduced in hydrogen, and 12 cc. of sulphuric acid, sp. gr. 1·35, and the contents of the flask heated to boiling for a short time. 50 cc. of water and 25 cc. of caustic soda (sp. gr. 1·3) are then added, the ammonia formed from the nitrate distilled over into sulphuric acid and titrated. The reduction is complete in 8—10 minutes, and the distillation in 20 minutes. The author, examining this method, finds that it succeeds when as much as 1 grm. of nitrate is taken.

When nitrates and nitrogen in other forms are to be determined, the process can be combined with that of Kjeldahl, thus:—One or more grms. of the substance, according to its content of nitrogen, are placed in a flask of 300 cc. capacity, sufficient water added to form a paste, and 1—4 grms. of reduced iron introduced, and 5—10 cc. of sulphuric acid (sp. gr. 1·35) (more sulphuric acid is needed for substances rich in lime). The reduction takes place as already described. A little copper oxide and 15 cc. of concentrated sulphuric acid, containing phosphoric anhydride to the extent of 200 grms. P_2O_5 per litre, are added, and heating is continued as in an ordinary Kjeldahl determination. The whole operation should not take longer than 1¼ hour. The subsequent distillation can be completed in half an hour.

The following comparative results were obtained:—

I. Pure dry $NaNO_3$.

—	Schlösing.	Jodlbaur.	Ulsch.
Per cent. N.....	16·30	16·37	16·45

The figures are the mean of several determinations.

II. Commercial sodium nitrate.

—	Schlösing-Wagner.	Ulsch.
Per cent. N.	15·05—15·96	14·46—15·88

The figures are the extreme values of numerous determinations.

III. A mixture of equal parts of pure dry $NaNO_3$ (16·47 per cent. N), ammonium sulphate containing 0·1 per cent. moisture (21·19 per cent. N), and of dried blood (11·54 per cent. N), and therefore containing by calculation 16·40 per per cent. N, gave:—

—	Jodlbaur.	Ulsch-Kjeldahl.
Per cent. N	16·30	16·35

The figures are the means of several determinations

IV. A mixture of guano and nitre gave:—

—	Jodlbaur.	Ulsch-Kjeldahl.
Per cent. N	9·15	9·23

The author concludes that the Ulsch-Kjeldahl method is of general utility, and that it is not affected by the presence of chlorides.—B. B.

Electrolytic separation of Mercury from Bismuth. E. F. Smith and J. B. Moyer. J. Amer. Chem. Soc. **15**, 1, 28—32.

THE authors find that mercury and bismuth when present in a nitric acid solution cannot be separated electrolytically, which is contrary to the statement in the third edition of Classen's Quantitative Analyse durch Electrolyse, p. 147. This confirms the experience of Smith and Salter (this Journal, 1890, 898—899) with regard to the separation of copper and bismuth, and agrees with Classen's own personal observation as recorded in the Berichte (1886) **19**, 325, that bismuth and mercury cannot be separated electrolytically in an acid solution.—G. H. R.

Electrolytic separation of Copper and Antimony. E. F. Smith and D. L. Wallace. J. Amer. Chem. Soc. **15**, 1, 32—33.

THE difficulties connected with this separation were first noticed by Wrightson (Zeit. Anal. Chem. **15**, 297), and have been confirmed by Classen (Quantitative Analyse durch Electrolyse, 3rd Ed., p. 125) who found however, that, provided only a very small quantity of antimony was present, the separation could be effected in a solution of the double oxalates. Muhr and Smith (J. Anal. Appl. Chem. **5**, 488) found that iron, cadmium, copper, nickel, and other metals could be completely separated from ammoniacal tartrate solutions. The authors find that antimony is also deposited quite readily from such a solution, but that after it has been converted into a higher oxide by means of bromine, and its solution then mixed with tartaric acid and ammonia, deposition no longer takes place. By these means the separation of the metals may be effected.

—G. H. R.

Electrolytic Separations. E. F. Smith and J. B. Moyer. J. Anal. and Appl. Chem. **7**, 252—257.

THE authors have studied the electrolytic separation of metals in presence of free nitric acid with the following results:—

Mercury from Lead.—Satisfactory, provided sufficient nitric acid be present.

Mercury from Lead and Bismuth.—Unsatisfactory; bismuth was discovered at both poles.

Silver from Lead.—Satisfactory.

Copper from Cadmium.—Satisfactory.

Copper from Zinc.—Satisfactory.

Copper from Zinc, Cobalt, and Nickel.—Satisfactory.

Copper from Iron and Zinc.—Satisfactory.

Bismuth from Cadmium.—Satisfactory; excess of free acid not necessary.

Bismuth from Zinc.—Satisfactory.

Bismuth from Nickel.—Satisfactory.

Bismuth from Cobalt.—Separation possible.

Bismuth from Zinc, Cobalt, and Nickel.—Unsatisfactory; bismuth always contaminated with cobalt and nickel.

Bismuth from Cobalt and Nickel.—Unsatisfactory; bismuth contained nickel.

Bismuth from Cobalt and Zinc.—Unsatisfactory; cobalt partially precipitated along with the bismuth.

Subsequent experiments showed that the separation of bismuth from cobalt, nickel, and zinc was possible if sufficient nitric acid were present.

In all these experiments the quantities of metal operated on were about a decigram. The nitric acid (sp. gr. 1·3) added varied between 2 and 30 cc. The total dilution

170—200 cc. The strength of current with voltameter and electrolyte in circuit liberated 1·8—0·2 cc. electrolytic gas per minute.

While the separation of bismuth from the various metals mentioned is possible, it is not nearly so satisfactory as when the metals exist as sulphates together with free sulphuric acid (this Journal, 1893, 605).—J. S.

Quantitative Analysis by Electrolysis. F. Rüdorff. Zeits. ang. Chem. 1893, 450.

See under XI., *page* 1041.

ORGANIC CHEMISTRY.—QUALITATIVE.

Detection of Saccharine in Beer. E. Spaeth. Zeits. ang. Chem. 1893, 579—581.

Saccharine is easily detected and determined quantitatively in wine by evaporating with phosphoric acid and sand, treating with ether and petroleum ether (b.p. 60°), evaporating the extract to dryness, and adding very dilute sodium carbonate solution. This dissolves saccharine, giving a sweet solution; the quantity is determined by fusing with sodium carbonate and saltpetre, and weighing as barium sulphate. This process does not answer well with beer, as the bitter principle of the hop is dissolved out too, and prevents the sweet taste of the saccharine from being perceived. By adding a little copper nitrate, however, a compound is formed which gives up no bitter to the ether-petroleum ether; so that the process may be employed successfully. It is not necessary to filter off the copper compound: 500 cc. of beer are treated with a few crystals of copper nitrate and evaporated to a syrup; sand is added and a few cc.'s of phosphoric acid, and the whole treated with ether-petroleum ether. 0·001 per cent. of saccharine is readily found by the sweet taste of the sodium carbonate solution.—C. R. A. W.

ORGANIC CHEMISTRY.—QUANTITATIVE.

The Valuation of Commercial Indigo. F. Stolba. Casopis pro prümysl chemicky, 1892, **2**, 134; Chem. Zeit. Rep. 1893, **17**, 66.

The principle of the method adopted by the author for the valuation of commercial indigo consists in the preparation of approximately pure indigotine by the removal of organic and inorganic impurities, and the determination of any mineral matter still adhering to the product by ignition. It must first be ascertained that no foreign colouring-matter not removable in the process of purification is present, since should it be present, a modification of the process would be necessary.

About 1—2 grms. of the very finely-powdered sample is boiled for 10 minutes with 20 cc. of hydrochloric acid of sp. gr. 1·12. Twenty cc. of distilled water are then added, the mixture boiled for one hour, an equal volume of cold water added, and the solution filtered through a weighed filter-paper of close texture, to prevent indigo passing through. The residue on the filter is washed with water until free from acid and then with a 5 per cent. solution of ammonia until the filtrate is no longer coloured. Washing is then continued, first with 80 per cent. alcohol and finally with 90 per cent. alcohol, after which the filter-paper with its contents is dried at the same temperature as that at which the filter-paper itself was dried before weighing (120° C. is suitable). The filter-paper and precipitate are then burnt and the ash deducted from the original weight, giving the indigo.

The samples of commercial indigo examined by this method varied in contents of indigotin from 60 to 80 per cent. Differences of 1—2 per cent. from the figures obtained by the best methods of estimation were obtained, so that the process is suitable for technical purposes.—B. B.

Contributions to the Analysis of Liquid Fats. W. Fahrion. Chem. Zeit. 1893, **17**, 434—436.

The author considers that, in oils containing unsaturated fatty acids, polymerisation may play a considerable part in the changes which they undergo. He quotes the case of boiled linseed oil, in the preparation of which he considers atmospheric oxidation can have but little effect, as the operation of boiling is performed in deep, covered vessels; remarking, in addition, that boiled linseed oil contains only a small quantity of hydroxy acids. In spite of this limited oxidation, the iodine absorption of boiled linseed oil is considerably less than that of raw linseed oil, and its specific gravity is greater. He further considers that an analogous change occurs in the production of polyricinoleic acid and sulphonated polyricinoleic acids, present according to Juillard, in Turkey-red oil, which the author views as condensation products.

Experiments with fish oils gave results analogous to these. Thus, a sample of sardine oil allowed to stand in a loosely-corked bottle for one year became partly resinified, and gave the following numbers, which are compared with those of the original oil in the following table:—

—	Specific Gravity.	Iodine Absorption.	Acid Number.	Per Cent. of Hydroxy Fatty Acids.
Original oil	0·933	193·2	20·6	0·6
Oil after standing ½ year.	0·936	179·7	25·3	1·1
Oil after standing 1 year.	0·943	163·6	31·7	4·8

The alteration in the iodine absorption is greater than can be accounted for by the quantity of hydroxy acids formed; the author attributes the change to polymerisation.

Further experiments were made on unsaturated fatty acids instead of their glycerides. The former were prepared by extracting the lead, barium or calcium salts of the liquid fatty acids of sardine oil with ether, decomposing the ethereal solution with sulphuric acid, evaporating to dryness, and extracting the residue with petroleum ether, which always left a certain amount of undissolved hydroxy acids, formed during the process of extraction and purification. Several samples of liquid fatty acids thus prepared gave the following analytical figures:—

—	Iodine Absorption.	Acid Number.	Molecular Weight.
I.	229·4	189·4	295·7
II.	219·6	179·8	311·5
III.	198·0	174·7	320·6
IV.	74·4	100·0	560·0

In the case of No. IV. the calcium salts were exposed for some time to the air and were afterwards in contact with ether for a long period.

The effect of saponification upon polymerisation is indicated by the following experiment. An old sample of oleic acid which dissolved clear in petroleum ether and was therefore free from the usual hydroxy acids had an iodine absorption of 75·5 instead of 90·0 and an acid number of 186·7 instead of 198·6 corresponding to a molecular weight of 300 instead of 282. This sample was dissolved three times in alcoholic soda without warming, and the oleic acid separated by the addition of hydrochloric acid by which treatment the iodine absorption was brought to 80·4, and the molecular weight to 287·3. In a second trial in which the solution of oleic acid in alcoholic soda was taken to complete dryness, and the residue twice dissolved in alcohol and twice evaporated, the fatty acid finally liberated by hydrochloric acid and dissolved out with petroleum ether, had a molecular weight of 282·8 and an iodine absorption of 81·7. The author deduces from these results that unsaturated fatty acids exist unpolymerised in alkaline solution, but begin to polymerise on liberation with a mineral acid. It might, therefore, be anticipated that a constant saponification value would be obtained by saponifying with excess of alkali and titrating back with acid, but this conclusion is not borne out by further experiments. Thus, oleic acid dissolved in alcoholic soda and the excess of alkali immediately titrated, had a saponification number of 170·1, whilst after the alkali had been allowed to act for 20 minutes, the values 200·5 and 200·7, in place of the theoretical figure 198·6, were obtained. Still longer contact with the alkali, involving in some cases evaporation to dryness and re-solution in neutral alcohol, gave the figures 206·3, 212·2, 215·1, and 218·3. In order to ascertain whether these irregularities could be ascribed to the alcohol, further experiments were made with an aqueous solution of alkali, and the value 163·3 obtained by dissolving the acid and immediately titrating the solution; when the solution was allowed to stand for a quarter of an hour before titration the sponification number was 191·2, and after half an hour, 200·2. When the oleic acid was dissolved, allowed to stand for a night, and then heated for one hour before titrating, it gave the value 255·6, which, on extending the time of contact to two days, rose to 346·2. Corresponding variations in the saponification number of sardine oil (ranging from 185·5 to 199·4) were observed; the liquid fatty acids from the same oil gave figures varying from 159·5 to 417·2. The author deduces from these results that the action of alkali de-polymerises the fatty acids, but that other changes take place, raising instead of depressing the saponification number. These changes consist in the oxidation of fatty acid or neutral oil with the production of volatile acids of low molecular weight, needing, therefore, much alkali for neutralisation. That such acids can be formed by oxidation with potassium permanganate in alkaline solution is well-known. The author, treating oleic acid and sardine oil in this manner, obtained in the first case a mixture of volatile acids with a mean molecular weight of 73, and in the second, one with a mean molecular weight of 54. Small quantities of similar acids were isolated from the product of lengthy saponification of oleic acid and sardine oil, confirming in the author's opinion, his hypothesis of the formation of volatile acids of low molecular weight by oxidation.

An investigation was also made of the iodine absorption of various oils in the form of neutral soaps instead of as glycerides or free fatty acids. For this purpose 0·15—0·25 grm. of the oil or fatty acid was saponified with alcoholic soda and the alkaline solution neutralised with $\frac{n}{2}$ HCl, using phenolphthalein as an indicator. This neutral solution was treated with Hübl's reagent in the ordinary way, the addition of chloroform being omitted. The time allowed for absorption was 2 hours. The following figures were obtained :—

——	Ordinary Method.	Oil in Solution as Neutral Soap.
Old samples:—		
Cotton-seed oil	104·8	150·0
Walnut oil	138·8	159·3
Poppy oil	125·7	163·7
Linseed oil	166·4	218·7
Japan fish oil	96·0	138·7
Cod oil	147·9	195·7
Sardine oil	193·2	216·6
Castor oil	82·9	102·9
Oleic acid	75·5	102·2—107·0
Liquid fatty acids from sardine oil.	229·4	240·7

No explanation of these variations is given but one can be readily surmised.

In the determination of insoluble fatty acids of oils with a high iodine absorption, Hehner's method cannot, according to the author, be recommended, as it involves heating for several hours to 100° C., whereby change by oxidation and other agencies may occur. The following alternative method is considered preferable :—About 3 grms. of the oil are saponified with 8 per cent. alcoholic soda, the alcohol evaporated, the soap dissolved in water, and transferred to a 500 cc. separating funnel. After the solution has cooled thoroughly, hydrochloric acid is added in slight excess, and the fatty acids extracted by 100 cc. of petroleum ether, which is completely volatile at 75° C. The solutions are allowed to separate by standing overnight, the aqueous layer run off, and the petroleum ether solution poured off from the hydroxy fatty acids, which remain in the funnel and are washed with a further quantity of petroleum ether, after which they are dissolved in warm alcohol, dried on a briskly-boiling water-bath, and weighed. The method is to be recommended even for oils with a low iodine absorption, as even these may contain small quantities of hydroxy fatty acids.

Thus the author found in a sample of olive-oil, several years old, 1·0 and 1·1 per cent. of hydroxy fatty acids and 94·1 and 94·3 per cent. of unoxidised fatty acids in two consecutive experiments. Should methylalcohol have been used for saponification, the glycerin of the oil can be determined in the aqueous solution by the Benedikt-Zsigmondy method. This method gives, with fish-oils, results which are too high, viz., 10·2 per cent. of glycerin for the oil when fresh, and 12·0 per cent. when six months old, instead of the calculated value, 9·8 per cent. It therefore appears that fish-oils contain small quantities of substances which yield oxalic acid when oxidised with potassium permanganate, the amount increasing with the age of the oil. This view is confirmed by the observation that the aqueous extract of a fish-oil one year old contained a substance which yielded oxalic acid when oxidised with permanganate in the same way as is adopted for the determination of glycerin in oils.—B. B.

Analysis of Brewers' Pitch for lining Casks. J. Brand. Zeits. ger. Brauw. 1893, **16**. Chem. Rep. 1893, **17**, 91—92.

The presence of fats, fatty oils, rosin oil, paraffin, &c. in brewers' pitch is often objectionable from the fact that such bodies communicate a taste to the beer. It is therefore necessary to examine this substance analytically, the following being the points of most importance.

Solubility in alcohol.—100 grms. of the powdered substance are well agitated with 200 cc. of 95 per cent. alcohol. Paraffin and waxes are recognised by the separation of a flocculent precipitate, while mineral impurities collect for the most part at the bottom of the flask containing the solution. The liquid is filtered through a tared filter-paper and the residue washed on with alcohol. The residue is then extracted with boiling alcohol, and from this solution the paraffin or wax separates, on cooling, almost pure. The insoluble portion, which is generally yellow or brown in colour, usually consists of such substances as ferric oxide and lead chromate, which are added to the factitious brewers' pitch in order to give it the cloudy opalescent appearance characteristic of genuine pine rosin.

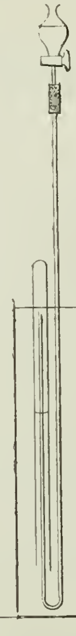
Melting point.—In order to obtain comparable figures, the following method is used. The pitch is powdered as finely as possible, and a portion placed in a thin-walled tube for the melting point determination. Soft samples may be cooled before powdering so as to make them brittle. The point at which the pitch becomes clear and agglomerates is very definite and can be taken at the melting point.

Detection of rosin oil.—5 grms. of pitch are dissolved in 10 cc. of 95 per cent. alcohol under an inverted condenser, the insoluble matter removed by filtration, the clear solution treated with 10 cc. of 10 per cent. alcoholic potash, and again boiled under the condenser for five minutes. The liquid is allowed to cool and 50 cc. of water added. A marked milky turbidity is formed if rosin oil be present. The milky liquid is kept in a water-bath at 30°—50° C. for 4—6 hours when the bulk of the rosin oil separates in large drops which can be collected and washed with water. Pure brewers' pitch examined in this manner gives only a slight turbidity and no oily drops. Colophony and its mixtures with fatty oils give clear solutions.

Detection of fats and fatty oils.—An approximate determination of these adulterants can be made by Twitchell's method (this Journal, 1892, 804). Another method, not involving any saponification or esterification of the fats and oils can also be used. Mixtures of colophony with fatty oils give a clear concentrated solution with methylalcohol, as the solution of the resin keeps the fat dissolved. On adding excess of methyl alcohol however, the greater part of the oil is precipitated. These facts are utilised by dissolving 10 grms. of finely powdered brewers' pitch in 100 cc. of methyl alcohol, when the oil collects at the bottom of the liquid and the resin remains in solution.—B. B.

The Analysis of Ethereal Oils. R. Benedikt and H. Strache. Monatsh f. Chemie, **14**, 270—277 (April 1893).

A quantitative separation of the constituents of an essential oil (hydrocarbons of different ranks, phenolic ethers, aldehydes, ketones, camphoraceous bodies, and so on) is usually impracticable, so that indirect tests of purity must be resorted to. For this purpose determinations of the "free acid number," the "saponification number," the "iodine number," and the "methyl number" are useful in certain cases, the last giving the proportion of methoxyl-containing ingredient present. An analogous value, termed by the authors the "carbonyl number," giving the proportion of aldehydic or ketonic ingredient present, can be deduced by determining the quantity of hydrazone formed by treating an alcoholic solution of a known quantity of oil with phenylhydrazin hydrochloride and sodium acetate, used in quantity roughly proportionate to the amount present of the constituent of aldehydic or ketonic character. If the carbonyl number is above 40, from 0·5 to 1·2 grms. of substance is taken, together with a quantity of phenylhydrazine hydrochloride varying from an equal weight to 1½ times the weight of substance. With a carbonyl number lying between 10 and 40, from 1 to 2 grms. of substance is employed, and from one-half its weight to an equal weight of phenylhydrazine hydrochloride. With a carbonyl number below 10, from 2 to 5 grms. of substance and 0·5 grm. of phenylhydrazine hydrochloride are used. In each case a quantity of sodium acetate is added equal to one and a half times the weight of phenylhydrazine hydrochloride, preferably in the form of a 10 per cent. solution. The mixture is warmed on the water-bath for a quarter of an hour in a flask holding about 100 cc., and filled with about two-thirds full of the alcoholic fluid, whereby too vigorous ebullition is avoided; after cooling, water is added to 100 cc., the insoluble portion filtered off through a dry filter, and 50 cc. of the filtrate oxidised with Fehling's solution. The nitrogen thereby evolved is collected and measured, so as to determine the amount of unaltered phenylhydrazine in the fluid, and thus obtain the data for determining the quantity precipitated as hydrazone. For this purpose a standard solution of phenylhydrazine may be conveniently used in the first instance, containing about 5 per cent., the precise titre being determined by treating a known volume with Fehling's solution; the salt must be free from aniline. The purification of the nitrogen is effected by means of the arrangement shown in the figure; the longer end of the U-tube is fixed to a stoppered reservoir, the shorter end being drawn out to a fine point and placed inside the tube containing the nitrogen to be purified. About 200 cc. of alcohol are now allowed to run down from the reservoir so as to spirt upwards in a fine jet into the nitrogen tube; this absorbs all benzene vapour present in the nitrogen. In turn, some 400 cc. of water are similarly passed down from the reservoir to absorb alcohol vapour, after which the measuring tube is removed to another vessel containing water, and the volume of the nitrogen read off. A number of direct observations with nitrogen to which benzene was added after measurement, showed that this method of treatment sufficed to remove all benzene vapour within the limits of reading-error.



Duplicate determinations made in this way usually do not differ more than at most one or two units in the value of the carbonyl number deduced. The following figures were obtained with different samples of oils containing large proportions of aldehydic or ketonic constituents:—

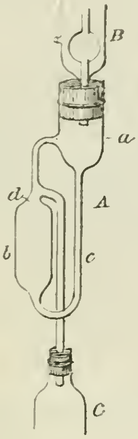
Oil.	Carbonyl Number.	Aldehyde or Ketone Present.	Per Cent. of Aldehyde or Ketone.
Cummin	51·8	Cuminol, $C_{10}H_{12}O$	47·9
"	45·2	"	41·8
"	96·7	"	89·4
Kümmel...........	42·0	Carvol, $C_{10}H_{14}O$	39·3
"	33·6	"	31·5
"	38·3	"	35·9
"	61·1	"	57·3
Carvol	81·0	"	78·8
Bitter almond	147·5	Benzaldehyde, C_7H_6O	97·7
" " free from hydrocyanic acid.	147·7	"	97·8
Bitter almond, artificial.	145·3	"	96·2
Cinnamon	92·7	Cinnaldehyde, C_9H_8O	76·5
"	77·4	"	63·9
Cassia	94·3	"	77·8
"	79·9	"	66·0
"	77·9	"	64·3
"	77·3	"	63·8
"	93·8	"	77·0

A number of other oils were also examined, mostly yielding only small carbonyl numbers, *e.g.*, the oils of anise,

angelica, bergamotte, citronella (carbonyl number 9·9—15·5), cubebs, lemon, mace, peppermint (carbonyl number 6·8—35·6), rue, rosemary, sandalwood, &c., &c.
—C. R. A. W.

The Determination of Alkaloids in Extracts. Ledden-Hülsebosch. Pharm. C.H., N.F. 1893, **14**, 101. Chem. Rep. 1893, **17**, 66.

The author recommends the following apparatus and process, which have been tried for *Extr. Chinæ liquid.*, as simple and reliable. 1 grm. of the extract is weighed exactly into a beaker, diluted with 10 cc. of water, and transferred to the extractor shown in the figure, being introduced at *a*. 10 cc. of ether are poured into the weighed flask C, which is then attached to the extractor, the latter being connected with the condenser B. C is gently heated and as soon as the ether begins to boil, 6 drops of caustic soda of sp. gr. 1·35 added by being allowed to flow down the condenser, and then 5 cc. of water and about 15 cc. of of ether, until the level of the ether in the tube *b* rises to its upper contracted part. As the extraction proceeds the ether drops from the condenser back into A, and forces its way upwards through the solution to be extracted, dissolving out the alkaloid and flowing over the bend at *a*, back into the flask C.



Complete extraction is effected in about 2 hours. The alkaloid obtained by evaporating its ethereal solution in the flask C is almost pure and snow-white. The apparatus is a modification of that of Smetham, and is made by W. Geisler, of Amsterdam.—B. B.

ANALYTICAL AND SCIENTIFIC NOTES.

Solubility of Salts of the Heavy Metals in Sugar Solution. J. Stern and J. Fränkel. Zeits. ang. Chem. 1893, 579.

Sodium carbonate solution added to a lead salt in presence of cane-sugar or grape sugar forms a precipitate insoluble in excess, whereas if invert sugar be used instead, the precipitate first formed dissolves. Copper salts dissolve in the cold in invert sugar solution, cuprous oxide being thrown down on boiling. Iron, nickel, cobalt, chromium, and manganese salts behave as lead with alkaline invert sugar solution; silver, mercury, and platinum salts dissolve, but are reduced to metals on boiling. Gold salts are reduced in the cold.—C. R. A. W.

A Rule concerning the Number of Saturated Solutions possible in Systems of Double Salts. W. Meyerhoffer. Monatsh. J. Chemie, **14**, 165—175 (March 1893).

In continuation of his previous experiments, the author has investigated the two double salts formed by the combination of tetrethylammonium chloride and cupric chloride, containing respectively 2 molecules of the former to 1 and to 5 molecules of the latter. From the results he formulates the rule that if *n* double salts can exist at a given temperature produced by the combination of two salts with similar ions, at least $n + 1$, and at most $2n + 1$, saturated stable solutions of different compositions can be produced at this temperature containing the components of these salts.—C. R. A. W.

Distillation Products of Santonin. J. Klein. Ber. 1893, **26**, 2506—2508.

When santonin is distilled, a naphthol melting at 97°—98° is produced in much smaller quantity than the theoretical amount; similarly, when oxysantogenenic acid, $C_{15}H_{22}O_3$, is distilled, another naphthol melting at 111°—112° is produced, apparently identical with Cannizzaro's hydromethyl-naphthol. These two naphthols are respectively indicated by the formulæ $(C_{12}H_{13}O)_2$ and $C_{12}H_{14}O$.

When oxysantogenenic acid is heated to about 360° it forms an anhydride, $(C_{15}H_2O_2)_2O$, soluble in chloroform; whilst α-santogenedilactone, $(C_{15}H_{18}O_2)_2$, on distillation breaks up into carbon dioxide and a hydrocarbon, $(C_{14}H_{18})_2$, melting at 93°.—C. R. A. W.

New Books.

Chemiker-Kalendar, 1894. Ein Hülfsbuch für Chemiker, Physiker, Mineralogen, Industrielle, Pharmaceuten, Hüttenmänner. Von Dr. Rudolf Biedermann. Fünfzehnter Jahrgang. Mit einer Beilage. Berlin: Verlag von Julius Springer, 1894. London: H. Grevel and Co., 33, King Street, Covent Garden. 4s.

In form and dimensions arranged as a pocket-book, and bound strongly in cloth. It contains almanack for 1894 inside the cover, and also a table of frequently used atomic weights and their multiples.

Additions have been made to the tables of specific gravities and solubilities; also in the chapter on Technological Investigations, a section is introduced on the Bacteriological Investigation of Water, on Milk Testing, as well as new data on Explosives, Textile Fibres, Paper, and Photography. There is a Chronological Table of the principal events in the History of Physical Sciences. A Notebook Calendar with blank pages is further arranged for the different days of the year, in which observations, facts, &c., may be recorded. Then follows tabulated matter of Specific Gravities, of Gases and Liquids, Salts, Alcohols, Tables of Solubility, Properties of Chemical Substances, Analysis, Volumetric Analysis, Spectrum Analysis, Gas Analysis, Physiological Chemical Analysis, Technological Investigations relating to — I. Water. II. Assaying. III. Fuels. IV. Sulphuric Acid. V. Alkali. VI. Bleaching Powder. VII. Nitre and Explosives. VIII. Textile Fibres, Paper. IX. Photography. X. Starch and Sugar. XI. Colours, &c. XII. Fats and Oils. XIII. Tanning Materials. XIV. Ceramics. XV. Glass. XVI. Mortars and Cements, Mineralogy.

Beilage zum Chemiker-Kalendar, 1894. This is a supplement of useful tables of a more technological character:—I. Leading Foreign Money Currencies. II. A Series of Mathematical Tables. III. Weights and Measures. IV. Tables of Heat and Cold Measurements. V. Expansion and Contraction. VI. Tension of Vapours. VII. Barometry. VIII. Sound. IX. Light. X. Electricity. XI. Magnetism. XII. Diffusion and Capillarity. XIII. Elasticity, &c. XIV. Specific Gravity.

ANIMAL AND VEGETABLE FIXED OILS, FATS, BUTTERS, AND WAXES: their Preparation and Properties, and the Manufacture therefrom of Candles, Soaps, and other Products. By C. R. ALDER WRIGHT, D.Sc., F.R.S., Lecturer on Chemistry in St. Mary's Hospital Medical School, London, &c. With 144 Illustrations. 1894. London: Chas. Griffin and Co., Limited, Exeter Street, Strand. 28*s*.

BOTH the chemistry and technology of the above subject are represented in this treatise, the object of the author being "To give general descriptions of the methods whereby Animal and Vegetable Oils and Fats are obtained from natural sources, of their leading practical applications and uses, and of their chief physical and chemical properties and reactions, rather than to enter into special details, and discuss minutely the analytical tests and processes applicable in each separate case for the detection of adulterants."

The book is strongly bound in cloth, is of 8vo. size, and contains 524 pages of subject-matter, well illustrated with 144 wood engravings, and terminating with a copious Alphabetical Index.

The matters treated of in the text are as follows:—GENERAL COMPOSITION AND NATURE OF OILS, BUTTERS, FATS, WAXES, AND ALLIED SUBSTANCES. I. Sources and General Nature of Natural and Artificial Oils. II. Alcoholiform Saponification Products of Oils, Fats, Waxes, &c. III. Acid Saponification Products of Oils, Fats, Waxes, &c.

PHYSICAL PROPERTIES OF OILS, FATS, WAXES, &C. IV. General Physical Characters. V. Specific Gravity and Viscosity.

CHEMICAL PROPERTIES OF OILS, FATS, BUTTERS, AND WAXES. VI. Proximate Constituents and the Methods used for their Examination and Determination. VII. Chemical Reactions of Oils, Fats, &c., and their Uses as Tests of Purity, &c. VIII. Quantitative Reactions of Oils. PROCESSES USED FOR EXTRACTING, RENDERING, REFINING, AND BLEACHING OILS, FATS, &C. CLASSIFICATION AND USES OF FIXED OILS, FATS, WAXES, &C. ADULTERATIONS. THE CANDLE INDUSTRY. THE SOAP INDUSTRY.

MICRO-ORGANISMS AND FERMENTATION. By ALFRED JÖRGENSEN, Director of the Laboratory for the Physiology and Technology of Fermentation at Copenhagen. New Edition. Translated from the re-written and much enlarged Third Edition in German, by Alex. K. Miller, Ph. D., F.I.C., and E. A. Lennholm, and revised by the Author. With 56 illustrations. 1893. London: F. W. Lyon, Eastcheap Buildings, E.C. 10*s*. Post free, 10*s*. 6*d*.

OCTAVO volume bound in cloth and containing, besides the Preface and Table of Contents, 227 pages of Subject-Matter, illustrated with 56 wood engravings, and concluding with 23 pages of Bibliography. The work terminates with an Alphabetical Index. The following subjects are treated of and discussed in the text:—I. Microscopic and Physiological Examination. II. Examination of Air and Water. III. Bacteria. IV. The Mould Fungi. V. Alcoholic Ferments. VI. Application of the Results of Scientific Research in Practice.

CHEMISCH TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der Technischen und Industriellen Chemie. Mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von DR. EMIL JACOBSON. 1893. Erstes Halbjahr. Erste Hälfte. Berlin: R. Gaertner's Verlagsbuchhandlung. Hermann Heyfelder, Schönebergerstrasse 26, S.W. London: H. Grevel and Co., 33, King Street, Covent Garden.

THE first issue for the first half of 1893. It contains 176 pages of subject-matter, plentifully illustrated with wood engravings. In the text the following subjects are treated of: — Building Materials, Cements, and Artificial Stone. Colouring Matters, Dyeing, and Calico printing. Fats. Oils. Illuminating and Heating Materials. Fermented Liquors. Tanning. Leather and Glue Manufacture. Textiles. Glass and Earthenware. Wood and Horn. India-rubber. Cements. Plasters and Artificial Stone. Lakes. Varnishes and Paints. Metals.

PRACTICAL AGRICULTURAL CHEMISTRY FOR ELEMENTARY STUDENTS. Adapted for Use in Agricultural Classes and Colleges. By J. BERNARD COLEMAN and FRANK T. ADDYMAN, Lecturers on Agricultural Chemistry in University College, Nottingham. London: Longmans, Green, and Co. New York: 15, East 16th Street. 1893. 1*s*. 6*d*.

SMALL 8vo. volume, bound in cloth, containing 83 pages of text, an alphabetical index, and illustrated by 24 woodcuts. The course of instruction given in this little book is that followed for some years at University College, Nottingham. The matter is divided into the following sections: — Section I.—Simple Chemical Manipulation and the Preparation of Apparatus. Section II.—The Preparation and Properties of the Constituents of Air and Water. Section III. — Experiments illustrating the Properties of Soils, Manures, Feeding Materials, and Dairy Produce. Section IV.—Chemical Tests for the Bodies commonly occurring in Soils, Manures, and Ashes of Plants. There is also described here the Qualitative Analysis of these Bodies. Section V.—List of Apparatus and Chemicals required for performing the experiments described in the book, with instructions for preparing the solutions.

Trade Report.

TARIFF CHANGES AND CUSTOMS REGULATIONS.

CUSTOMS TARIFF OF WESTERN AUSTRALIA.

The following is a statement of duties now levied on goods imported into Western Australia:—

(*Note.*—n.o.e. signifies "not otherwise enumerated.")

Articles.	Rate of Duty.	£	*s.*	*d.*
Ale, beer, or stout, in wood	Per gall.	0	1	3
„ in bottles	„	0	1	6
Arrowroot, cornflour, &c.	Per lb.	0	0	1
Beeswax	„	0	0	2
Brandy colouring	Per gall.	0	16	0
Candles	Per lb.	0	0	2
Cement	Per barrel	0	2	0
Cocoa and chocolate, n.o.e.	Per lb.	0	0	3
„ in slabs	„	0	0	1
Essences, being spirituous compounds	Per gall.	0	16	0
Glue	Per lb.	0	0	1
Glucose	Per cwt.	0	2	0
Oil cake	Per ton	0	10	0
Oil: fish, vegetable, and turpentine, n.o.e.	Per gall.	0	0	6
„ mineral	„	0	0	4½
Plaster of Paris	Per cwt.	0	2	0

Customs Tariff of Western Australia—*continued.*

Articles.	Rate of Duty.	£	s.	d.
Powder (gun and sporting)	Per lb.	0	0	4
„ blasting	„	0	0	7
„ baking	„	0	0	3
Salt, n.o.e.	Per ton	1	0	0
Soap, n.o.e.	Per cwt.	0	5	0
Soda crystals	„	0	2	0
Spirits, not over proof	Per gall.	0	16	0
Spirits of wine, as above, destroyed in bond under regulations to be framed.	„	0	5	0
Spirits, methylated	„	0	2	0
Sugar	Per cwt.	0	4	0
Vinegar	Per gall.	0	0	6
Whiting	Per cwt.	0	1	0

The following pay 5 per cent. *ad val.*:—

Alkalis, of all kinds, n.o.e.; asbestos; bark for tanning; bluestone; brewery and distilling plant; cod liver oil (refined): dyers' materials; harness oil, leather dressing, and composition; inks of all kinds, n.o.e.; iron sulphate; leather, n.o.e.; metals, n.o.e.; oil (cod in bulk); paper, n.o.e.; paraffin wax; pitch; quicksilver; resin; salt rock; sheep dip; shellac; smelting material, n.o.e.; soda ash and saltpetre; sulphur; tanning materials; tar; tin; zinc.

The following pay 10 per cent. *ad val.*:—

Asphalt; explosives, n.o.e.; filters; glass in sheets; instruments (scientific); lead (red and white); paints, colours, and varnish, n.o.e.; photographic materials; tallow; thermometers; waterproof material in the piece.

The following pay 15 per cent. *ad val.*:—

Acids, n.o.e.; apothecaries' wares, n.o.e.; artists' materials; brassware, n.o.e.; castor oil (refined); copperware, n.o.e.; drugs and druggists' sundries, n.o.e.; earthen-, stone-, and chinaware; galvanised ware, n.o e.; glassware, n.o.e.; gum, n.o e.; leather kip and sole; matches; medicines (patent), n.o.e.; paper (wall) starch.

The following pay 20 per cent *ad val.*:—

Aërated and mineral waters; cordials (not spirituous); eucalyptus oil; fireworks; lime juice; perfumes and pomades; saccharine; sandalwood oil; soap, fancy; soap powder and extract; tinware, n.o.e.

The following are free of duty:—

Disinfectants; glass (coloured) for church windows; manures; printing paper for newspapers and posters; stearine; metal sheathing.

United States.

The Proposed New Tariff Bill.

The *Engineering and Mining Journal* of December 2nd states that on November 27th, Chairman Wilson, of the Ways and Means Committee, gave to the press the text of the Bill prepared by the committee for submission to Congress. We give below that portion of the schedules of the Bill which affects the chemical industries. The comparisons made with the old rates of the existing tariff law, generally known as the McKinley law, are from the New York *Times*. It will be remembered, of course, that these schedules are those proposed by the committee, and have still to pass the ordeal of the debates in Congress.

Article.	McKinley Bill.		Wilson Bill.			
	Rate.	*Ad Val.* Equivalent.	Rate.	*Ad Val.* Equivalent.	Decrease.	Increase.
		Dols. cts.		Dols. cts.	Dols. cts.	
Boracic acid	5 cents per lb.	89·00	.. ..	.. ..	..	..
Chromic acid	6 cents per lb.	16·37	10 per cent.	10·00	6·37	..
Sulphuric acid, not otherwise provided for	¼ cent per lb.	4·33	Free	.. ..	..	..
Tartaric acid	10 cents per lb.	20·00	20 per cent.	20·00	..	..
Alumina and alum compounds	6/10 of 1 cent per lb.	41·87	20 per cent.	20·00	21·87	..
Carbonate of ammonia	1¾ cents per lb.	26·41	.. ..	.. ..	..	..
Muriate of ammonia	¾ cent per lb.	14·23	.. ..	.. ..	..	..
Sulphate of ammonia	½ cent per lb.	20·98	.. ..	.. ..	..	..
Blue vitriol	2 cents per lb.	28·06	.. ..	.. ..	..	..
Bonechar	25 per cent.	25·00	.. ..	.. ..	..	..
Borax, crude, borates of soda and lime	3 cents per lb.	20·00	.. ..	.. ..	..	..
Borax, refined	5 cents per lb.	46·00	20 per cent.	20·00	26·00	..
Camphor, refined	4 cents per lb.	13·00	.. ..	.. ..	..	..
Chalk, prepared, French and red	1 cent per lb.	33·06	20 per cent.	20·00	13·06	..
Chalk, not specially provided for	20 per cent.	20·00	.. ..	.. ..	..	..
Chloroform	25 cents per lb.	58·33	25 cents per lb.	58·33	15·00	..
Coal tar colours or dyes	35 per cent.	35·00	20 per cent.	20·00	..	..
Coal tar preparations, not colours or dyes	20 per cent.	20·00	20 per cent.	20·00	..	..
Cobalt oxide	30 cents per lb.	15·41	.. ..	.. ..	..	..
Copperas, or sulphate of iron	3/10 of 1 cent per lb.	57·25	.. ..	.. ..	..	..
Ether, sulphuric	40 cents per lb.	141·33	25 cents per lb.	88·45	52·88	..
Ether, nitrous, spirits of	25 cents per lb.	..	.. ..	.. ..	..	..
Gelatin, glue, and isinglass, not above 7 cents per pound.	1½ cents per lb.	27·68	25 per cent.	25·00	2·68	..

The Proposed New Tariff Bill—cont.

Article.	McKinley Bill.		Wilson Bill.			
	Rate.	*Ad Val.* Equivalent.	Rate.	*Ad Val.* Equivalent.	Decrease.	Increase.
		Dols. cts.		Dols. cts.	Dols. cts.	
Gelatin, glue, and isinglass, above 7 and not above 30 cents per pound.	25 per cent.	25·00	25 per cent.	25·80	..	..
Gelatin, glue, and isinglass, above 30 cents	30 per cent.	30·00	25 per cent.	25·00	5·00	..
Glycerin, crude	1¾ cents per lb.	31·84	1 cent per lb.	18·20	13·64	..
Glycerin, refined	4½ cents per lb.	50·48	3 cents per lb.	33·66	16·82	..
Iodine, resublimed	30 cents per lb.	8·57	.. ..	.. ..	..	..
Iodoform	1 dol. 50 cents per lb.	4·11	1 dol. per lb.	2·74	1·37	..
Magnesia, carbonate of	4 cents per lb.	52·48	3 cents per lb.	39·36	13·12	..
Magnesia, calcined	8 cents per lb.	30·91	7 cents per lb.	37·05	3·86	..
Magnesia, sulphate of	3 10 of 1 cent per lb.	26·40	.. ..	.. ..	..	..
Morphia, morphine, and salts	50 cents per oz.	45·81	50 cents per oz.	45·81	..	..
Paints, colours, and varnishes:—						
Baryta sulphate and barytes, unmanufactured	1 dol. 12 cents per ton	36·42	.. ..	.. ..	..	..
Baryta sulphate and barytes, manufactured	6 dols. 62 cents per ton	62·94	3 dols. per ton	.. ..	..	..
Blues, con. ferrocyanide of iron	6 cents per lb.	18·91	6 cents per lb.	18·91	..	..
Blanc-fixe, or satin white	¾ cent per lb.	51·90	25 per cent.	25·00	26·90	..
Black: bone, ivory, or veg.	25 per cent.	25·00	20 per cent.	20·00	5·00	..
Chrome yellow and comp. of chrome, in oil	4½ cents per lb.	27·89	25 per cent.	25·00	2·89	..
Ochre and ochrey earths	¼ cent per lb.	24·72	¼ cent per lb.	24·72	..	..
Ochre and ochrey earths ground in oil	1½ cents per lb.	13·44	1¼ cents per lb.	11·20	2·24	..
Ultramarine blue	4½ cents per lb.	46·05	20 per cent.	20·00	26·05	..
Varnishes, including Japan	35 per cent.	35·00	25 per cent.	25·00	10·00	..
Spirit varnishes	1 dol. 32 cents per gall. and 35 per cent.	89·65	1 dol. 32 cents plus 25 per cent.	80·68	8·96	..
Vermilion red	12 cents per lb.	24·48	20 per cent.	20·00	4·48	..
Wash blue	3 cents per lb.	19·80	.. ..	.. ..	..	..
Whiting and Paris white, dry	½ cent per lb.	83·83	25 per cent.	25·00	58·83	..
Whiting and Paris white, ground in oil	1 cent per lb.	27 15	25 per cent.	25·00	2·15	..
Zinc, oxide of, and paint, dry	1¼ cents per lb.	25·68	20 per cent.	20·00	5·68	..
Zinc, oxide of, and paint, ground in oil	1¾ cents per lb.	28·83	.20 per cent.	20·00	8·83	..
Other paints	25 per cent.	25·00	25 per cent.	25·00	..	..
Artists' water colours	30 per cent.	30·00	.. ..	.. ..	..	..
Lead products:—						
Acetate of lead, white	5½ cents per lb.	66·44	30 per cent.	30·00	36·44	..
Acetate of lead, brown	3½ cents per lb.	82·58	.. ..	.. ..	..	..
Litharge	3 cents per lb.	92·57	.. ..	.. ..	..	..
Nitrate of lead	3 cents per lb.	59·56	30 per cent.	30·00	29·56	..
Orange mineral	3½ cents per lb.	75·94	35 per cent.	35·00	40·94	..
Red lead	3 cents per lb.	82·66	35 per cent.	35·00	47·66	..
White lead and white lead paint	3 cents per lb.	54·33	30 per cent.	30·00	24·33	..
Potash:—						
Hydriodate iodate, &c.	50 cents per lb.	18·41	25 cents per lb.	9·20	9·21	..
Nitrate	1 cent per lb.	20·95	½ cent per lb.	10·47	10·47	..
Bichromate and chromate	3 cents per lb.	39·07	20 per cent.	20·00	19·07	..
Prussiate red	10 cents per lb.	32·24	20 per cent.	.. ..	..	..
Prussiate yellow	5 cents per lb.	28·07	20 per cent.	.. ..	..	..
Phosphorus	20 cents per lb.	54·12	25 per cent.	25·00	29·12	..
Bicarbonate of soda, saleratus	1 cent per lb.	57·39	½ cent per lb.	28·69	28·69	..
Hydrate of soda	1 cent per lb.	40·67	½ cent per lb.	20·33	20·33	..
Chromate and bichromate of soda	3 cents per lb.	47·85	20 per cent.	20·00	27·85	..

The Proposed New Tariff Bill—cont.

Article.	McKinley Bill.		Wilson Bill.			
	Rate.	*Ad Val.* Equivalent.	Rate.	*Ad Val* Equivalent.	Decrease.	Increase.
		Dols. cts.		Dols. cts.	Dols. cts.	
Sal-soda	¼ cent per lb.	24·84	⅛ cent per lb.	12·42	12·42	..
Soda ash	¼ cent per lb.	18·73	¼ cent per lb.	.. ..	..	..
Silicate of soda	½ cent per lb.	40·28	¼ cent per lb.	20·14	20·14	..
Sulphate of soda	1 dol. 25 cents per ton	5·01	.. ..	.. ..	..	..
Sulphur, refined	8 dols. per ton	.. ..	20 per cent.	2·0	..	..
Sulphur, sublimed	10 dols. per ton	27·15	20 per cent.	20·00	7·15	..
Sumac	4/10 cent per lb.	19·16	10 per cent.	10·00	9·16	..
Cream of tartar	6 cents per lb.	48·59	25 per cent.	25·00	23·59	..
Tartars and lees crystals	4 cents per lb.	26·50	25 per cent.	25·00	1·50	..
Tartrate of soda and potassa	3 cents per lb.	17·35	10 per cent.	10·00	7·35	..
SCHEDULE B.—EARTHS, EARTHENWARE, AND GLASSWARE.						
Brick and Tile:—						
Fire brick, not glazed	1 dol. 25 cents per ton	29·88	20 per cent.	20·00	9·88	..
Fire brick, glazed	40 per cent.	45·00	30 per cent.	30·00	15·00	..
Tiles and brick other than fire, not glazed	25 per cent.	25·00	25 per cent.	25·00	..	..
Tiles and brick other than fire, glazed	45 per cent.	45·00	40 per cent.	40·00	5·00	..
Roman cement, &c., in barrels	8 cents per cwt.	21·99	8 cents per cwt.	21·99	..	..
Roman cement, &c., in bulk	7 cents per cwt.	.. ..	7 cents per cwt.	.. ..	..	..
All other cement	20 per cent.	20·00	10 per cent.	10·00	10·00	..
Lime	6 cents per cwt.	29·54	10 per cent.	10·00	19·54	..
Plaster of Paris, ground	1 dol. per ton	7·84	10 per cent.	.. ..	..	..
Plaster of Paris, calcined	1 dol. 75 cents per ton	24·75	15 per cent.	15·00	9·75	..
Clays, unmanufactured, not otherwise provided for.	1 dol. 50 cents per ton	2 ·43	.. ..	.. ..	..	..
Clays, wrought	3 dols. per ton	26·43	2 dols. per ton	17·62	8·81	..
China clay, kaolin	3 dols. per ton	39·59	2 dols. per ton	26·40	13·19	..
Gas retorts	3 dols. each	21·02	20 per cent.	20·00	1·02	..
Chemical glassware	45 per cent.	45·00	.. ..	.. ..	..	..
SCHEDULE C.—METALS AND MANUFACTURES OF.						
Iron and Steel:—						
Chromate of iron	15 per cent.	15·00	.. ..	.. ..	..	..
All other iron ore	75 cents per ton	30·40	.. ..	.. ..	..	..
Iron in pigs, kentledge, spiegeleisen, ferro-manganese.	3/10 cent per lb.	30·48	.. ..	.. ..	..	..
Ferro silicon	3/10 cent per lb.	34·51	22·5 per cent.	22·50	12·01	..
Scrap iron and scrap steel	3/10 cent per lb.	47·89	22·5 per cent.	22·50	25·39	..
Aluminium, crude and alloys	15 cents per lb.	20·00	15 per cent.	15·00	5·00	..
Antimony	¾ cent per lb.	.. ..	.. ..	.. ..	..	..
Argentine, or German silver, unmanufactured.	25 per cent.	25·00	.. ..	.. ..	..	..
Brass, in bars, pigs, or clippings	1½ cents. per lb.	15·43	10 per cent.	10·00	0·43	..
Bronze powder	12 cents per lb.	36·11	30 per cent.	30·00	6·11	..
Bronze or Dutch metal	8 cents per package	104·48	.. ..	.. ..	..	..
Copper ore	½ cent per lb.	6·17	.. ..	.. ..	..	..
Old copper, clippings, &c.	1 cent per lb.	13·68	.. ..	.. ..	..	..
Regulus of copper and copper cement	1 cent per lb.	10·62	.. ..	.. ..	..	..
Copper plates, bars, ingots, unmanufactured	1¼ cents per lb.	.. ..	30 per cent.	30·00	..	..
Copper rolled plates, sheets, rods, and copper bottoms.	35 per cent.	35·00	20 per cent.	20·00	15·00	..

The Proposed New Tariff Bill—cont.

Article.	McKinley Bill.		Wilson Bill.			
	Rate.	*Ad Val.* Equivalent.	Rate.	*Ad Val.* Equivalent.	Decrease.	Increase.
		Dols. cts.		Dols. cts.	Dols. cts.	
Lead:—						
Ore and dross	1½ cents per lb.	19·55	15 per cent.	15·00	4·55	..
Lead, in pigs and refuse	2 cents per lb.	59·83	1 cent per lb.	29·91	29·92	..
Lead, in sheets, pipes, shots, &c.	2½ cents per lb.	50·57	1 cent per lb.	20·32	30·25	..
Metallic mineral substances, crude and unwrought metals.	20 per cent.	20·00	.. ..	.. ..	..	..
Mica	35 per cent.	35·00	.. ..	.. ..	..	..
Nickel:—						
Nickel oxide and alloy	10 cents per lb.	21·84	.. ..	.. ..	..	..
Pens, except gold	12 cents per gross	44·77	35 per cent.	35·00	14·77	..
Penholder tips and gold pens	30 per cent.	30·00	25 per cent.	25·00	5·00	..
Pins, including hair and hat pins	30 per cent.	30·00	20 per cent.	20·00	10·00	..
Quicksilver	10 cents per lb.	21·38	.. ..	.. ..	..	..
Tin, black oxide of, bar and block tin	4 cents per lb.	.. ..	.. ..	.. ..	..	..
Chronometers, box or ships'	10 per cent.	10·00	10 per cent.	10·00	..	..
Watches, cases, movements, and glasses	25 per cent.	25·00	25 per cent.	25·00	..	..
Zinc, in blocks or pigs	1¾ cents per lb.	34·27	20 per cent.	20·00	14·27	..
Zinc, in sheets	2½ cents per lb.	35·20	25 per cent.	25·00	10·20	..
Zinc, old and worn, for remanufacture	1¼ cents per lb.	26·70	15 per cent.	15·00	11·70	..
Miscellaneous articles of iron, steel, lead, copper, nickel, &c., not specially enumerated.	45 per cent.	45·00	35 per cent.	35·00	10·00	..
SCHEDULE M.—PULP, PAPERS, AND BOOKS.						
Pulp:—						
Mechanically ground	2 dols. 50 cents per ton.	15·02	10 per cent.	10·00	5·02	..
Chemical wood pulp, unbleached	6 dols. per ton.	12·26	10 per cent.	10·00	2·26	..
Chemical wood pulp, bleached	7 dols. per ton	10·51	10 per cent.	10·00	0·51	..
Sheathing paper	10 per cent.	10·00	10 per cent.	10·00	..	..
Printing paper, for books and newspapers	15 per cent.	15·00	12 per cent.	12·00	3·00	..
Printing paper, sized or glued	20 per cent.	20·00	15 per cent.	15·00	5·00	..
SCHEDULE N.—SUNDRIES.						
Coal:—						
Bituminous and shale	75 cents per ton	22·57	.. ..	.. ..	..	..
Slack or culm	30 cents per ton	33·35	.. ..	.. ..	..	..
Coke	20 per cent.	20·00	.. ..	.. ..	..	..
Fulminates	30 per cent.	30·00	30 per cent.	30·00	..	..
Gunpowder and Explosives:—						
Valued at 20 cents or less per lb.	5 cents per lb.	25·54	5 cents per lb.	25·54	..	..
Valued at more than 20 cents	8 cents per lb.	8·35	8 cents per lb.	8·35	..	..
Band or belting leather	10 per cent.	10·00	10 per cent.	10·00	..	..
Alabaster, amber, coral, catgut, jet, spar	25 per cent.	25·00	25 per cent.	25·00	..	..

The above rates show duties which it is proposed to levy. Below we give the free list, which, it will be seen, has been greatly extended, and has been made to include coal, iron ore, and other important items.

THE FREE LIST.

Section 2.—On and after 1st day of March 1894, the following articles, when imported, shall be exempt from duty:—

Acids used for medicinal, chemical, or manufacturing purposes. Agates, unmanufactured. Albumen. Amber, unmanufactured. Ambergris. Ammonia. Aniline salts. Antimony. Apatite. Argal, or crude tartar. Anseniate of aniline. Asbestos, unmanufactured. Asphaltum and bitumen, crude. Assafœtida.

Baryta, including barytes earth. Bauxite. Bells, broken and bell metal, broken and fit only to be remanufactured, Bismuth. Blood, dried. Blue vitriol, or sulphate of copper. Bones, crude, or not burned, calcined, ground, steamed, or otherwise manufactured, and bone dust or animal carbon and bone ash fit only for fertilising purposes. Bone char, suitable for use in decolourising sugars. Publications containing observations of scientific pheomena, and the results of scientific observations. Borax, crude. Breccia, in block or slabs. Bromine. Bullion, gold or silver. Burgundy pitch.

Cadmium. Calamine. Camphor. Cerium. Chalk, unmanufactured. Charcoal. Chromate of iron or chromic ore. Clay—common blue clay, in casks, suitable for the manufacture of crucibles; clays or earths, unmanufactured, not specially provided for. Coal, anthracite, bituminous, and shale, and coal, slack, or culm. Coke. Coal tar, crude, and all preparations and products of coal tar, not colours or dyes, not specially provided for. Cobalt and cobalt ore, and oxide of cobalt. Copper imported in the form of ores. Old copper, fit only for manufacture. Regulus of copper and black or coarse copper, and copper cement. Copper in plates, bars, ingots, or pigs, and other forms not manufactured. Copperas, or sulphate of iron. Cryolite. Dragons' blood. Emery ore. Feldspar. Fossils. Glass, broken, and old glass which cannot be cut for use, and fit only to be remanufactured. Glass plates or discs, rough cut or unwrought, for use in the manufacture of optical instruments, spectacles, and eye-glasses, and suitable only for such use. Gold beaters' moulds and gold beaters' skins. Guano, manures, and all substances expressly used for manure. Hones and whetstones. India-rubber, crude, and milk of, and old scrap or refuse india-rubber, fit only for remanufacture. Iodine, crude and resublimed. Iridium. Iron ore, including manganiferous iron ore; also the dross or residuum from burned pyrites and sulphur ore, as pyrites or sulphuret of iron in its natural state. Jet, unmanufactured. Kieserite. Kyanite, or cayanite and kainite. Lava, unmanufactured. Lime, citrate of. Lime, chloride of, or bleaching powder. Lithographic stones, not engraved. Litmus, prepared or not prepared.

Magnesia, sulphate of, or Epsom salts. Magnesite, or native mineral carbonate of magnesia. Magnesium. Manganese, oxide and ore. Mica and metallic mineral substances in a crude state, and metals unwrought, not specially provided for in this Act. Meerschaum, crude or manufactured. Mineral waters, all not artificial. Minerals, crude or not advanced in value or condition by refining or grinding, or by other processes of manufacture, not specially provided for in this Act. Models of inventions and of other improvements. Newspapers and periodicals. Nickel, nickel oxide.

Ochre and ochrey earths, sienna and sienna earths, umber and umber earths, not specially provided for in this Act; dry. Ores of gold, silver, and nickel, and nickel matte. Osmium. Palladium. Paraffin. Pewter and Britannia metal, old, and fit only to be remanufactured. Philosophical and scientific apparatus, instruments, and preparations. Phosphates, crude or native. Plaster of Paris and sulphate of lime, unground. Platina, in ingots, bars, sheets, and wire. Platinum, manufactured, and vases, retorts, and other apparatus, vessels, and parts thereof, composed of platinum, for chemical uses. Plumbago. Polishing stones. Potash, crude, carbonate of, or "black salts." Caustic potash or hydrate of, including refined in sticks or rolls. Nitrate of potash, or saltpetre, crude. Sulphate of potash, crude or refined. Chlorate of potash. Muriate of potash. Professional books, implements, instruments, and tools of trade, occupation, or employment, in the actual possession at the time of persons arriving in the United States. Pumice.

Quicksilver. Salacine. Salt in bulk and salt in bags, sacks, barrels, or other packages, but the coverings shall pay the same rate of duty as if imported separately. Provided, that if salt is imported from any country which imposes a duty upon salt exported from the United States, then there shall be levied, paid, and collected upon such salt the rate of duty now provided by law. Soap, all not otherwise specially provided for in this Act. Soda, nitrate of or cubic nitrate, chlorate of, and sulphate of, or salt cake or nitre cake. Sodium.

Storax, or styrax. Strontia, oxide of, and propoxide of strontian, and strontianite, or mineral carbonate of strontia. Sulphur, refined, lac, or precipitated, and sulphur or brimstone, crude, in bulk, sulphur ore, as pyrites, or sulphuret of iron in its natural state, containing in excess of 25 per cent. of sulphur, and sulphur not otherwise provided for. Sulphuric acid. Sweepings of silver and gold.

Tar and pitch of wood, and pitch of coal tar. Terra alba. Terra Japonica. Tin ore, cassiterite, or black oxide of tin, and tin in bars, blocks, pigs, or grain or granulated. Tripoli. Types, old, and fit only to be remanufactured. Uranium, oxide and salts of. Verdigris, or subacetate of copper. Wax, vegetable or mineral. Whalebone, unmanufactured.

Works of art, drawings, engravings, photographic pictures, and philosophical and scientific apparatus brought by professional artists, lecturers, or scientists arriving from abroad, for use by them, temporarily, for exhibition and in illustration. Works of art, collections in illustration of the progress of the arts, sciences, or manufactures, photographs, works in terra cotta, parian marble, pottery, or porcelain, and artistic copies of antiquities in metal or other material, hereafter imported in good faith for permanent exhibition at a fixed place by any society or association for the purpose of erecting a public monument. Zaffer.

EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

Formation of a Russian Naphtha Union.

An agreement has been recently signed at St. Petersburg whereby as many as 60 per cent. of the naphtha producers of the Apscheron Peninsula have formed a union with a view to put an end to the crisis in the petroleum export trade. The agreement is to the following effect:—

The export of kerosene and its sale in foreign markets is to be carried on by members of the union not otherwise than through a committee to be formed of five persons and elected commercial agents. A producer violating this condition has to pay a fine of 15 copecks for every pood of kerosene exported abroad without the intervention of such agents.

The extent of the participation of a producer in the export and sale of kerosene is to be defined by the number of shares which he holds in proportion to the number of thousands of poods of kerosene actually carried away from Baku by the Trans-Caucasian Railway during the year 1892. A sub-committee, under the presidency of Mr. I. Lazareff, has been selected for the purpose of making an accurate apportionment in reference to the above arrangement.

All the quantity of kerosene intended for exportation by each manufacturer is to be handed over to a committee, which shall sell the kerosene in its own name. The manufacturer is obliged to furnish all the quantity of kerosene that he is called upon to export; in the event of the contrary, he will have to pay whatever damages may accrue in consequence of the quantity short furnished by him. The agreement relieves a manufacturer from this responsibility if the non-delivery of the proper quantity of kerosene has been caused through fires, strikes, and other unfortunate circumstances at any given works, which rendered the production of the oil a matter of impossibility.

All contracts concluded by manufacturers at an earlier date than the signing of this agreement are to be handed over through the committee to the commercial agency.

In the event of the proved unsuccessful and unremunerative operations of the commercial agents or committee members, by a decision of a general meeting of all the interested parties, they may be removed and replaced by others previous to the expiration of the term of the concluded agreement.

The committee is to regulate the actions of its commercial agents and separate members of the union, it is to establish the quality of the kerosene that is being delivered by the refiners for exportation, to define and verify the extent of the expenses connected with the operations of the commercial agents, to control the regularity of their actions and reckonings (not, however, to interfere in their immediate arrangements), to attend to the precise execution by the manufacturers of the obligations that they have accepted, both in respect to the quality and quantity of kerosene they have to furnish for exportation abroad, to make final settlements with the parties that have signed the agreement, and so forth.—*Board of Trade Journal.*

PRICES OF WOOD PULP IN SWEDEN.

Mr. J. Duff, Her Majesty's Consul at Gothenburg, in a report to the Foreign Office, dated the 28th November, states that at the general meeting, held in the preceding week, of the Scandinavian Wood Pulp Association, the price of moist wood pulp was fixed at 2*l.* 6*s.* 8*d.* to 2*l.* 10*s.*, and of dry wood pulp at 5*l.* to 5*l.* 5*s.* 7*d.* per ton delivered free on board.—*Ibid.*

GENERAL TRADE NOTES.

COPPER AND ZINC PRODUCTION IN CAUCASIA.

The following particulars are extracted from the Russian journal of the Ministry of Finance :—

The extraction of copper ore in Transcaucasia amounted in 1892 to 2,339,470 pouds (poud = 36 lb. avoirdupois), which, reduced in 12 works, have yielded 103,545 pouds of metal. The most important establishments of the country, Kalakentsk and Khedabek, both belonging to the Siemens firm of Berlin, produced 65,207 pouds of copper in ingots ; Ouzourtchaïsk, 7,757 pouds ; Galisoursk, 8,406 pouds. The other eight works have supplied the rest, or 22,435 pouds.

The same journal announces the commencement of the exportation of zinc ore *viâ* the port of Novorossisk ; 12,100 pouds were placed on board in 1892, and on the 1st January 1893 there was in the place a stock or 60,000 pouds. The ore comes from a locality called Sadok, situated 70 verstes distant from the Dary-Kokh station, on the Vladicaucasus-Rostoff line.

FRENCH BEER PRODUCTION.

The following particulars of the production of beer in France are obtained from the *Monde Economique* for the 4th November :—

The production of beer, which attained from 1880 to 1884 an annual average of 8,500,000 hectolitres, then fell off and dropped in 1888 to 7,900,000 hectolitres, but since then this production has increased, and the figures since 1889 are as follows :—1892, 8,937,416 hectolitres ; 1891, 8,305,730 hectolitres ; 1890, 8,490,528 hectolitres ; 1889, 8,382,954 hectolitres.

This progress is largely due to the improved processes introduced into the brewing of French beer and the abandonment by the consumers of foreign beers, and especially of German beers.

The production of beer in France during the last two years is as follows :—

—	1892.	1891.
	Hectol.	Hectol.
Strong beer………… …………	5.115,588	4,759,591
Mild beer……………………	3,809,674	3,533,351
Beer brewed at home …………	12,154	12,788
Hectolitres………	8,937,416	8,305,730

The quantities of beer imported and delivered for consumption in France in 1892, together with the principal countries of origin, are as follows :—

England, 1,616,500 kilos. ; Germany, 16,045,200 kilos. : Austria, 253,200 kilos ; other countries, 3,371,000 kilos. Total, 21,287,000 kilos.

Passing now to the amount of the exports of beer of French production for the same year, there appears a total of 5,178,121 kilos., representing a value of 3,106,872 francs.

As regards value, the following figures show the progress of the exports of French beers in three years :—1890, 2,151,600 francs ; 1891, 2,435,400 francs ; 1892, 3,106,872 francs.

PRODUCTION OF VALONIA AT SMYRNA.

The *Moniteur Officiel du Commerce* for the 9th November, in an article on the production of valonia at Smyrna, gives the following particulars :—

Valonia fruit of the oak-tree (*quercus Oegilops*), employed in tanning leathers and as a black dye, is one of the most important articles of export from Smyrna. Its production in the Smyrna region reaches an average of 55,000 tons, representing a value of from 480,000*l.* to 600,000*l.*

The valonia harvest is commenced in the month of August and is continued until October. The nuts are dried in the sun, stripped of their husks, and sent to Smyrna, where they are carefully sorted and classed according to their value. This operation increases by about 10 per cent., waste included, the cost of the merchandise. The chief producing districts are the following :—

Gundai, Pergamos, Dikili, Aidin, Bordo, Demirdjik, which supply the best qualities.

Giordes, Coula, Dardanelles, Metelin, and Crete, which also yield fine qualities, but not so rich in tannin as the preceding. Then come Ouschak, Alacheïr, &c., whose products are not so highly valued.

The Smyrna stock is supplied by successive consignments from these places to keep pace with shipments to Europe. Carriage is sometimes effected by camel caravans, but more often by the railways, Smyrna being at the head of a line, one branch going to the east and the other to the south of Anatolia.

Large quantities of valonia are also received by sea, small craft loading either in the islands of the Archipelago or in the small coast ports.

The first quality is that known under the name of "Superior Trieste." The Italian tanners in the north of the peninsula take this description and use it largely. The production of this kind of valonia is limited, and does not represent more than 1,000 tons, that is to say, about 2 per cent. of the total crop.

Then comes the quality known as "screened," which is much appreciated, and largely consumed in Germany, Austria, and Italy.

The third quality, that known as "natural," is the most abundant, and is easily and regularly sold in all the countries of Europe. This kind is subdivided into two qualities, first and second, according to the size and care brought to bear in sorting. The valonia exported to England forms a special class, which is connected with the preceding, and is also subdivided into two categories, first and second quality. This class represents at least half of the crop.

The fourth class is that called valonia waste, which includes the refuse from other classes. In spite of its inferiority it still gives from 17 to 19 degrees of tannin, and some well-chosen lots yielding as much as 22 degrees. This kind is bought by the Sicilian tanners, sometimes also by the tanners of northern France, because of its relative cheapness. England takes it when the price has reached its lowest limit. The production of valonia waste is estimated at 5,000 tons yearly, which may increase to 10,000 tons when the rains have spoiled the crop at drying time.

With the exception of the fourth class just mentioned all valonia contains a proportion of from 30 to 40 per cent of breakings called in Turkish *tirnak.*

INDIA-RUBBER TRADE OF THE CONGO FREE STATE.

The *Independance Belge* for the 21st November alludes to the rapid development recently attained in the Congo trade in india-rubber. India-rubber is obtained by incisions in the liane *Londolphia Florida*, which exists in all the territories of the Free State, and it is chiefly found in the districts of Oubangi, Ouellé, Mongalla, and Kassaï. The following statement shows the quantities of caoutchouc produced in the Free State, and exported from the Independent State of the Congo, since the 1st July 1886 up to the 30th June 1893 :—

1886 (six months only), 18,069 kilos., valued at 3,000*l.* ; 1887, 30,050 kilos., valued at 4,600*l.* ; 1888, 74,294 kilos., valued at 10,000*l.* ; 1889, 131,113 kilos., valued at 18,000*l.* ;

1890, 123,666 kilos., valued at 22,000*l.*; 1891, 81,680 kilos., valued at 13,000*l.*; 1892, 156,339 kilos., valued at 25,000*l.*; 1893 (six months), 116,301 kilos., valued at 18,000*l.*

Lead in Burmah.

The *Calcutta Statesman* states that in a short note, Dr. F. Noetling, of the Geographical Survey, draws attention to the lead deposits of Burmah. There are two localities where the Shan settlers in the Maingthong Hill tract have been extracting lead ore for a considerable time past, namely, Kaydwin and Mawkwin. Kaydwin is situated in the ravine of the Nammaw, a feeder of the Yu River, about six miles up stream, namely, east from the small village of Mawteik. Mawkwin lies in a south-westerly direction at a distance of six miles in a straight line from the above place. At Kaydwin several large and deep holes may be seen, which have been driven from the river bank into the hill side. Work has, however, been stopped for some time. The holes, or rude galleries, are now nearly filled up with *dèbris*. So far as can be noticed, the ore occurs in the cracks of a dyke of an igneous rock belonging to the aphanite group, of considerable thickness; at one place the estimated thickness is not less than 20 ft. The ore is found in stringers up to ¼ in. of thickness, filling the cracks of the rocks throughout. On assay it yielded 69·1 per cent. of lead and 33 oz. 16 dwts. 4 grs. of silver to the ton of lead. At Mawkwin the dyke is considerably thinner and the old workings are less extensive; the occurrence of the ore being, however, exactly the same as at Kaydwin. So far as can be judged from the examination of these two localities without extensive diggings being undertaken, the diggings at Kaydwin and Mawkwin are situated on one and the same dyke, running approximately south-west—north-east serpentine rock. If the dyke should contain an equal quantity of ore strings at intermediate places, such an occurrence of this lead ore would certainly have a considerable value; but the question can only be settled by extensive surface diggings.

Antimony Mining and Smelting in Japan.

The most important antimony mine in Japan is at Ichinokawa, in Ojoimmura-Nii-gori, Iyo Province, on the island of Shikoku. It is a little more than two miles from the town of Saijo, and three miles from the sea coast. The mine is said to have been discovered 11 centuries ago, but there are no records of early operations in it. At present it is worked by Kawabata Kumasuke and 50 other persons as a private concern.

The country rock of the district in which this mine is situated is graphitic sericite schist, belonging to the Archaean. The ore deposits occur in the form of veins, of which there are three principal ones. Two of them, the Tsurubi and Kamebi, are parallel to each other, striking east and west, and dipping south at an angle of about 75°. They often unite, in which case they are very wide and rich. The third principal vein, known as the Yokobi, also strikes east and west and dips south, but at a moderate angle, never more than 38°, and sometimes only 10°. It is thought that the Yokobi vein intersects the Tsurubi and Kamebi veins at a greater depth than has yet been explored. These veins vary from 1 in. to 3 ft. in width. There are also many workable veins in the district besides those mentioned. All the veins are worked by shafts and levels, the former being from 50 to 150 feet deep, and the latter from 300 to 2,000 feet long. The cost of mining averages 5·877 yen (5·88 dollars) per 100 kin (60 kilos.) of ore.

The ore, which is stibnite of high grade, is smelted at works on the sea coast at Sanchoba, three miles from the Ichinokawa mine and only one half mile from Saijo. The method of smelting employed is very simple. A crucible with a small hole bored through its bottom is set upon another crucible. The upper is filled with powdered ore covered and heated from below, coal being used as fuel. The sulphide of antimony in the ore is melted and drains away from the gangue into the lower crucible, whence it is ladled into moulds. The monthly production of ore averages 200,000 lb. and that of antimony sulphide from 150,000 to 160,000 lb. The sulphide of antimony is reduced to metal and shipped in boxes to Osaka and Kobe, which are the principal markets for the product, both being within 200 miles of the mines. The cost of smelting is 0·385 yen ($38\frac{1}{2}$ cents) per 100 kin (60 kilos.) of antimony sulphide, and 2·5 yen (2·50 dols.) per 100 kin of refined antimony.

—*Engineering and Mining Journal.*

Congress of Applied Chemistry.

The International Congress which is to be held in Brussels on August 4, 1894, is to be divided into four sections. The first of these deals with sugar chemistry, and here analytical questions will chiefly be discussed. In the second section, agricultural chemistry, attention will be paid to soils, manures, especially to the determination of phosphoric acid, and the analysis of milk. Section III., food and public hygiene, is rather general in its aims, but the Congress will endeavour to settle the minima of impurity allowable in distilled liquors, and the best process for fixing the melting-points of fats. The micrographic analysis of pepper will also be discussed here. The fourth section will deal with biological chemistry. The general secretaries are MM. Sachs, 63 Rue d'Allemagne, and Van Laer, 15 Rue de Hollande, Brussels.

—*Chemist and Druggist.*

Where Cotton-seed Oil Goes.

The disposal of the immense output of cotton-seed oil will interest those who are not familiar with this rapidly-growing industry and the many uses that have been found for this most useful of all vegetable oils.

The question is frequently asked, "What is cotton-seed oil used for?" Last year there were probably 1,250,000 tons of seed crushed. Out of this seed there were obtained about 1,000,000 barrels of oil.

At Chicago not less than 300,000 barrels are used for making lard. At St. Louis, Kansas City, and Omaha about 200,000 barrels are used in making lard.

The lard is made by mixing beef suet with cotton-seed oil, the degree of hardness of the product being determined by the relative proportions of the oil and suet. It is notable that in much of the lard there is no hog product at all.

About 20,000 barrels are used on the coast of Maine to pack sardines.

Probably 50,000 to 100,000 barrels are used by the soap-makers for making toilet soaps.

Some 200,000 to 300,000 barrels go to Rotterdam, Holland, for making butter. Large quantities go to Marseilles, France; Trieste, Austria; and various points on the Mediterranean coast, especially in Italy, for mixing with olive oil.

The poorer grades are used for illuminating purposes in mines, as a lubricant in cutting threads on pipes and bolts, and other purposes.

It is not a good lubricating oil, because it contains too much gum. Much money has been expended trying to find a process of refining that will eliminate the gum.

Of late years much oil has been shipped to Mexico and South America. In these Latin countries it is used as a cooking grease, without the necessity of disguising it as lard by using beef suet with it. In fact, most of the people of the earth prefer a clean vegetable oil for cooking to American fats. The Anglo-Saxons and Germans are notable exceptions.

Its use in an unadulterated condition in America as a cooking grease is rapidly increasing, especially in Texas and New England. All the restaurants in Houston, Galveston, and other south-western cities, and in Boston, Providence, and other New England cities, keep pure refined cotton oil on hand at all times. In Boston the physicians uniformly prescribe food cooked in cotton oil as a remedy for indigestion, and the idea has grown very popular, especially in Boston and the adjacent towns and cities.

—*Chemical Trade Journal.*

Sulphuric Acid at Mount Morgan.

In a book descriptive of the Mount Morgan gold mine, recently issued by the authority of the board of directors, it is stated that steps have been taken to provide for the home-supplies of acid required in the treatment of the ore. In 1887 the company paid 6*l.* per ton for acid, which, with costs in Sydney, freight to Rockhampton, and carriage to Mount Morgan, together with breakages, cost over 20*l.* per ton laid down at the mine. The company had previously made a trial of dry acid, in which the acid is absorbed by infusorial earth, but this article was not found to be satisfactory. It was accordingly decided to make the acid at the mine, and thus, it was hoped, save something like near 9,000*l.* a year. A twelvemonth ago four acid chambers measuring 40, 50, 80, and 100 ft. by 20 ft., and two coke-towers had been built. Twenty tons of sulphur per month were burned. The Upper Works consume about 45 tons of acid per month, and in 1890 as much as 80 tons per month was required; the Lower Works consume about 22 tons per month. The capacity of the acid plant is equal to 100 tons per month. The acid manufactured is of 1·600 sp. gr., the cost of manufacture varying from 5*l.* to 7*l.*, according to the fluctuations in the price of material. A foreman and four labourers form the staff of the acid works. The company has lately established a laboratory with balance-room. The intention of the directors is to ascertain with scientific accuracy the impurities retained in the charcoal-filters in which the gold is precipitated, and thus find a basis for future treatment. All the residues and waste products will be examined, and the whole series of processes is to be, as far as possible, on a thoroughly scientific footing.

—*Chemist and Druggist.*

Report from the Departmental Committee on the Various Lead Industries. Appointed April 1893.

The committee were directed by the Secretary of State to enquire (1) into the conditions under which lead smelting, the working of blue lead, and the production of white, red, and yellow lead and litharge are conducted, with the object of diminishing any proved ill effects on the health of the workpeople engaged therein; (2) as to whether the special rules which already exist for the manufacture of white lead are sufficient; and (3) to suggest any precautions for the protection of life and health. They were further directed to enquire into the tinning and enamelling of iron hollow-ware and plates, the death of Harriet Walters, and the use of red lead in electric accumulator works.

The committee visited 46 works in England, Scotland, and Wales, and examined 184 witnesses.

I. White Lead.

There are three processes by which white lead is produced: (*a*) the old Dutch process; (*b*) the chamber process; (*c*) precipitation. The first is the commonest, and the committee saw only three of the second and one of the third.

In the *old Dutch process* the desilverised metallic lead is melted and cast, sometimes into gratings, sometimes into thin oblong plates, with two holes and a central rib. In most works the casting is done by hand, women being often employed; in some, however, by machinery, which not only casts the lead but delivers it at a convenient place some distance off. In the latter case, the only hand labour involved consists in putting the pig lead into the melting-pot and regulating the flow of the molten lead. The gratings are next put into stacks, large cubical spaces built of bricks, the floor of which is just covered with a layer of tan. On this are arranged, as closely as possible, stoneware pots filled with dilute acetic acid, and on the top of these are placed four or five gratings, one on top of the other. Boards are then laid on the top of the gratings so as to form a new floor, on which tan, pots, and gratings are laid in the same order as before, and this is in its turn covered in the same way, and so on until the stack is full, as many as 10 or more layers going into one stack. The filling is done through a vertical opening in one of the sides of the stack, which is closed by boards as the stack fills up. As the floors rise the various materials must be lifted up to them. This is generally done by women, who have to carry on their heads from 30 to 50 pounds of lead at a time up ladders 10 to 15 feet high. In some works the material is passed from hand to hand up stages or lifted by hoists worked by machinery. When full it is covered in, a ventilating shaft in each corner is provided, and the stack is then left to itself for from 10 to 15 weeks. The tan soon heats, evolves carbonic acid, and volatilises the acetic acid. An interaction then takes place between the lead, acetic acid, carbonic acid, and the oxygen of the air, leading to the ultimate production of amorphous basic carbonate of lead or white lead. The action goes on until all the lead is corroded, until there is no more carbonic acid evolved, or until all the acetic acid is volatilised. There is always some acetate of lead left in the final product. Then the stack is opened, and the white lead, which retains the shape of the lead grating, is taken out. It used to be taken out dry, but according to present regulations it is wetted first, to stop dust flying about. It is then carried in trays, generally by women, to corrugated rollers, over which passes a constant stream of water, and tipped down in front of them to be crushed, so as to detach any metallic lead left uncorroded. Before this is done the crates are either dipped in water or well watered to prevent dust rising, and even then some dust comes off. The crushed mass next passes into a shallow tank, with a perforated bottom, in which it is raked about to separate the pieces of blue lead from the white lead, which latter passes away with the current of water to grinding mills. Here it is ground up and then run into a series of tanks (washbecks) to settle. The water is then drawn off, and the white lead is removed, put into earthenware or copper pans, and placed in drying stoves. In some works the wet mud is run through a filter press, and the press-cake put into the stove. This pressing not only greatly reduces the time necessary for drying, but renders the whole process more cleanly and free from dust. When thoroughly dry, which takes from three to five days, the pans are taken from the ovens by hand labour, and the white lead is either packed directly into casks or thrown into bins for subsequent conversion into paint. The above operations give rise to a good deal of dust, and in order to obviate it mechanical drying stoves have been invented for carrying in the wet white lead and discharging the dry into barrels by machinery. No perfectly satisfactory mechanical stove has yet been devised; they are also very costly.

The *Chamber process* is also one of corrosion, but a chamber is used instead of the stack, and the strips of lead are hung saddle-fashion on sets of parallel bars. The chamber is heated by steam to a regulated temperature and the carbonic acid is supplied from burning charcoal by a flue, while pans of acetic acid are laid on the floor. The corrosion in this process only takes four or five weeks. The subsequent treatment is the same as the old Dutch process.

The quantity of white lead produced by *precipitation* is as yet very small.

Effects of Lead.—If lead, in however small quantities, enters the system, symptoms are developed, the most frequent of which is colic. Nearly all those who work in factories on lead or its compounds look pale and anæmic and show a blue line on the gums. Lead palsy occasionally affects their hands. There is also a very sudden and fatal form of lead poisoning, most frequently met with in young women, which begins with headache followed by convulsions and unconsciousness. Death often occurs within three days, and in some cases of recovery from convulsions total blindness remains.

There is some doubt as to how the poison enters the system. The committee think (*a*) that it may be absorbed through the pores, particularly during perspiration or where there is friction between the skin and the clothing; (*b*) that it may get into the stomach by touching food with dirty hands; (*c*) but that the most usual manner is by inhaling the dust. Some of this dissolves in the mouth and is swallowed, and some gets to the lungs and is absorbed by the blood.

Rules.—The existing special rules under the Factory and Workshops Act, 1891, for white lead works are then cited, and approved so far as they go.

Danger of Working.—The committee find that the dangerous parts of the *old Dutch process* are: (1) the stripping of the stacks; (2) the rollers; (3) the washbecks but (4) chiefly in the stoves and packing. The committee find that (*a*) women are more liable to lead poisoning than men, and (*b*) young girls than full grown women.

Recommendations.—Lead was found as acetate and sub-acetate in the washbecks of certain works, and in one the quantity was large. The workers have to plunge their hands in these washbecks. The committee enjoin manufacturers either to treat the washwater so as to separate the lead or to discontinue letting the workers put their hands in the water.

The committee report that the special rules issued in 1892, as to cleanliness, medical inspection, and sufficiency of good food, have been of great benefit. Certain firms give their workers some food either before beginning work, at 11 o'clock, or at the dinner hour, and the committee trust that this will become universal in the trade. They recommend also that a new rule be added, whereby no female should be employed without examination, and a medical certificate that she is of the required age and fit for the employment; and further that no worker, after absence through illness, should be re-employed without a medical certificate that he or she has recovered. Also that no girl under 20 be employed in the old Dutch process, and that every woman be compelled to produce a certificate either of birth or baptism before she can be employed. Also that the stacks, rollers, washbecks, stoves, and packing be worked in future by adult male labour alone. The further use of mechanical appliances is also strongly urged, and recommendations as to clothing are made. In regard to the inhalation of lead dust, reference is made to Dr. Duprè's experiments, and the necessity of enforcing the use of respirators is recognised, of which the best form is considered to be a cambric bag made to fit over the nose. Workers are urged to co-operate with their employers in enforcing the regulations. No packing or storing of dry white lead is to be carried on except under a hood connected with a fan or other device for creating a draught, whereby the dust shall be carried away. A dining room must be provided, and no one is to take any food elsewhere in the works. Every stack is to be fitted with an adequate supply of water for damping the contents of the stack previous to stripping it, and water is not to be fetched from a distance. No stack is to be stripped before it is "mature."

II.—*Sulphate of Lead.*

This is manufactured directly from galena by throwing small shovelfuls into a coke furnace highly heated. The galena is volatilised and oxidised directly into sulphate. This is collected in chambers and then washed and dried much as in the case of white lead. There is not much danger in this process, as the sulphate of lead is less poisonous than the carbonate, but it does not possess either the colour or the covering power of the latter. Mr. A. P. Laurie has recommended an experimental trial of white lead substitutes, but the committee think it better left to be settled by competition in the open market. The price of sulphate is from 3*l.* to 4*l.* a ton under that of white lead.

III.—*Substitutes for White Lead.*

Several compounds have been mentioned to the committee as being equal to white lead. One of these is oxide of zinc. This has been used with success for internal work, but it does not bear exposure to heat, cold and rain, nor does it possess the covering power of white lead. Moreover, it is more expensive. All the other substitutes proposed have also proved to be in some respects inferior.

The committee have come to the conclusion that there is at present no substitute for white lead made by the old Dutch process. Also that this process may be rendered sufficiently free from danger to warrant its continuance with proper and efficient safe-guards.

IV.—*Red and Orange Leads.*

Orange lead is simply white lead heated in furnaces. Red lead works are frequently in connection with white lead works and call for similar special rules.

Red lead proper is blue lead oxidised at a low temperature. Pig lead is placed in a furnace, a large surface of which is exposed to heat and air. The metal when melted is not more than an inch or two thick on the bed. It is raked about by men through a door from which lead fumes escape. These are caught by a draught chimney and carried away. The safety of the furnace men thus depends on the efficiency of these chimneys. The lead is first oxidised to massicot, and in this state is raked out preliminary to a further treatment which is not described.

The committee recommend that instead of raking the massicot on to the floor, it should be shovelled into waggons, and that all packing should be forbidden in the place of making, but be carried on elsewhere under a hood with an effective draught. This also applies to orange lead. Baths and lavatories are enjoined, as well as medical inspection. Special drinks are also ordered.

V.—*Litharge.*

No recommendations are made with regard to litharge.

VI.—*Colours.*

In regard to the manufacture of Milan red, vermilionette, Persian red, &c., the committee consider that the present rules for paint and colour works will suffice, if respirators be made compulsory whenever dust is generated, and baths be provided in addition to the ordinary washing arrangements. No young male or female, however, is to be employed in such manufactures.

VII.—*Lead Smelting.*

The ore is treated in a furnace and the metal extracted from it. The same precautions as to carrying off the fumes escaping from the door are used as in the case of red lead.

The committee recommend that only adult male labour shall be employed, with precautions as to respirators, clothing, length of work, and washing accommodation.

VIII.—*Blue Lead.*

No recommendations are made in the case of working and desilverising metallic lead.

In regard to pipe and sheet making, inspectors of factories are enjoined to take note of and report any cases of poisoning, which are stated to be rare.

Bullet and shot-making are considered safe.

Plumbing and house painting are not included in the reference to the committee.

IX.—*Yellow Lead.*

This colour is made by mixing bichromate of sodium or potassium with lead salts. Reference is made to Dr. Scott's evidence, and the enforcement of the provisions he advocates is recommended. These are ventilation, use of respirators, and certain drinks, with abundant washing accommodation. No ill-effects have been traced to the use of articles dyed or painted with yellow lead.

X.—*Electric Accumulator Works.*

Red lead or litharge, previously damped with dilute sulphuric acid, is rubbed on to both sides of embossed or perforated leaden plates, so as to fill the interstices and produce an even surface. One man mixes the dry red lead and sulphuric acid, while others rub the mud into the plates. Gloves are used, but do not last long. Another method is to fit a piece of lead with projections into a mould and push in red lead enough to fill up the spaces. When pushed in tightly the whole readily comes away from the mould, which can be then used again. The red lead mud is also made into square cakes. In all these processes the hands of the workers come in frequent contact with the material, and in some cases gloves are not worn.

The compulsory use and inspection of gloves is recommended, with ample washing accommodation. The increased use of machinery is also considered desirable.

XI.—Enamelling of Iron Plates.

The iron plate, having been cleaned, is first smeared with a little gum and water, and then a fine powder, which may contain up to 25 per cent. of lead, is sifted over it. The plate is then heated in a furnace until the powder melts, forming the first coating of enamel. Another way is to put on the powder, previously wetted, with a ladle. The next process, known as "swilling," is to brush colour, which nearly always contains lead, carefully over the plates. This is gone over with finer and finer brushes to secure an even surface, and the plate is then dried. Up to this point not much danger attaches to the industry, but it is in the next operation that most of the danger lies. The workers (women) place a stencil on the plate and rub off the exposed colour with a nail brush. This comes off as a thick dust, and although they work on perforated tables, some dust is inhaled. When the upper layer of colour is rubbed through and the pattern appears clear and sharp the plate is again fired. The process may be repeated several times, according to the number of colours required. The lead used in the enamels is chiefly red lead, and the manufacture is a trade secret.

The existing special rules under the Factory and Workshop Act, 1891, for enamelled-iron plate works are then cited and approved, so far as they go.

The committee find that severe and sometimes fatal illness results to the workers in the stencilling process.

Frequent medical inspection is insisted on, no girl under 20 is to be employed, and no female without previous examination and medical certificate that she is of the required age and fit for the work, as in the case of white lead works. Enamelling firms are also recommended to give each female worker half a pint of milk and a biscuit before beginning work. The perforated bench is also to be boxed in below and supplied with a fan to draw down the dust. A separate dining room is also to be provided.

XII.—The Death of Harriet Walters.

This girl, aged 16, was employed in an enamelling works at Bilston, and the circumstances attending her death are detailed. She died of lead poisoning, a typical case. The committee criticise the medical evidence.

XIII.—The Tinning and Enamelling of Iron Hollow-Ware.

This industry of preparing kettles, saucepans, frying pans, &c., is largely carried on at Wolverhampton, Bilston, Dudley, and the neighbourhood. The article in the rough, previously cleaned with dilute hydrochloric acid and chloride of zinc, is dipped into a "pit" containing a mixture of melted tin and lead in varying proportions, according to the quality of the goods. The leading firms use no lead for culinary utensils, but only when the article is to be japanned also. Such vessels are generally slop pails, coal scuttles, baths, &c.

The committee commends the suggestion of H.M. Inspector of Factories that the use of lead and arsenic in the enamelling and tinning of culinary utensils should be absolutely prohibited.

Washing accommodation, with compulsory use thereof, and prohibition of eating, except in a specially provided room, are to be extended to this industry.

XIV.—Remarks applicable to all the foregoing Trades.

The duty of employers and workers is discussed in relation to the existing and proposed rules, and penalties for contravention are proposed; while the duty of reporting lead poisoning is placed on the same footing as that of reporting accidents. A summary of all the foregoing recommendations and suggestions is given, and after some remarks on the probable effect of these upon the lead industries, the committee record their conviction that lead and all its compounds are more or less poisonous and that the use of each or all of them is attended by danger.

THE DUTY ON PETROLEUM JELLY IN FRANCE.

The question has been raised in France, for duty charging purposes, whether the tariff rates of 32f. or 28f. per 100 kilogs. for vaseline apply not only to petroleum-jelly for pharmacy and perfumery purposes, but also to more or less imperfect petroleum-jellies used for lubricating machines and other analogous purposes. The Consultative Committee of Arts and Manufactures, having considered the question, has given the opinion that the tariff rates above referred to apply only to pure vaseline (also called "natural vaseline"), to the exclusion of greases, heavy oils, and residues intended for lubricating, these being admissible under the heading of "lubricating oils." Ministerial ratification has been accorded to these distinctions, and they will therefore govern the application of the import duties.—*Chemist and Druggist.*

THE CHEMICAL INDUSTRY IN JAMAICA.

The West Indies Chemical Works (Limited) is the title of a new enterprise about to be established at Spanish Town, Jamaica, the object being the extraction of dye from logwood cashaw, and other vegetable substances.—*Chemist and Druggist.*

THE METRIC SYSTEM IN RUSSIA.

The first step towards the introduction of the decimal system into Russia will be made with the new year (January 13, old style), when, by order of the Tsar, the chemists of the Empire will begin to use decimal weights and measures. —*Ibid.*

MINERAL-WATER MAKING IN GERMANY.

The police in Posen, Germany, have issued an order prohibiting the use in the manufacture of artificial mineral-waters of any other than distilled water or of chemicals which do not hold the pharmacopœial tests. The penalty for infringing the order is 30*s.* for each offence. —*Ibid.*

THE BIRMINGHAM CORPORATION SEWAGE FARM.

"*Standard*" *Agricultural Reports, December* 19, 1893.

ONE of the most discouraging of the unsolved problems relating to agriculture is that of the profitable utilisation of the immense amount of fertilising matter contained in the sewage of great towns. There is probably no better-managed or more productive sewage farm in the world than that of the Birmingham Corporation, and yet it is carried on at a heavy annual loss. It is 1,400 acres in extent, and, according to the *North British Agriculturist*, the value of produce sold off the land is invariably over 20,000*l.* per annum. The manager is Mr. David Tough, who, when in charge of the Warwick sewage farm, gained the price of 100*l.* offered by the Royal Agricultural Society for the best managed sewage farm in the country. Enormous crops are grown, and a herd of 200 dairy cows yield a great quantity of milk for sale. Yet the annual loss exceeds 30,000*l.*, of which the sum of 12,000*l.* is put down as actual loss on the working of the farm, 18,000*l.* representing interest on the cost of the land, buildings, and plant. It is only fair to point out, however, that there are two special causes of heavy expenditure which go far towards accounting for the unprofitableness of this sewage farm. In consequence of the large quantities of acids carried into the sewage from the numerous factories of Birmingham, it is necessary to use about 11 tons of lime a day to neutralise them, or they would destroy vegetation, and this lime costs 3,000*l.* per annum. Again, owing to the want of a sufficient fall for the sewage on the farm, settling ponds had to be provided for the precipitation of the sludge, 500 tons of which have to be raised daily by means of dredgers, and pushed along a moveable duct for deposition on the nearest fields, where it has to be trenched in. The cost of this work is about 9,000*l.* per annum. With respect to the heavy amount put down for interest, it is to be borne in mind that land in the neighbourhood of Birmingham is valuable, so that the purchase-money of the farm was a very large amount. The disposal of the sewage of a town of 650,000 inhabitants is, necessarily, a costly business, and great as the loss on the sewage farm is, it is made much smaller than it might have been by excellent management.

THE WORLD'S CHEMICAL EXPORTS TO THE UNITED STATES FOR 1892.

United States Department of State, 1893.

Articles.	Consular District.	Amount.
		Dols.
Acid, oxalic	Christiania	18,090
Aloes	Dutch West Indies	3,047
Amber and imitation amber	Köningsberg	33,712
Antimony	London	204,726
,,	Newcastle	131,399
,, (regulus)	Oporto	26,864
Argols and cream of tartar	Barcelona	213,618
,, ,,	Basle	19,374
,, ,,	Bordeaux	96,000
,, ,,	Cape Town	10,083
,, ,,	Leghorn	126,365
,, ,,	Lyons	243,090
,, ,,	Marseilles	93,000
,, ,,	Messina	336,376
,, ,,	Naples	752,912
,, ,,	Oporto	131,8[illegible]5
Arsenic	Falmouth	34,658
,,	Plymouth	65,715
Asbestos	Athabasca (Canada)	27,419
Asphalt	Basle	41,509
,,	Brunswick	82,893
,, nine months ended 31st March 1893.	Cardenas (Cuba)	7,860
,,	Catania	43,504
,,	Trinidad	375,536
Attar of roses	Constantinople	141,929
Balsam	Bahia	30,696
,, copaiba, nine months ended 31st March 1893.	,,	12,026
,,	Barranquilla (Columbia).	12,616
,, copaiba	Para	13,932
Bark, hemlock	Fredericton (N.B.)	12,121
,, tanning	La Paz (Mexico)	12,269
,, hemlock	McAdam Junction (N.B.).	30,641
,, ,,	Moncton (N.B.)	26,304
,,	San José (Mexico)	5,875
,,	St. Hyacinthe	38,863
,, nine months ended 31st December 1892.	Valparaiso	744
Bitumen	Beyrout	19,959
Bones, nine months ended 31st March 1893.	Buenos Ayres	139,043
,, six months ended 30th September 1892.	Cape Verde Islands	497
,,	Egypt	40.970
,, and bone-ash	Paysandu (Uruguay).	56,581
,,	Rosario	7,936
,, (buffalo)	Winnipeg	33,290
Brazil wood	Mazatlan (Mexico)	4,892
,,	Bahia	10,730
Bronze powder and leaf metal	Fürth	368,031
,, ,, ,,	Nuremberg	282,306
Camphor	Osaka and Hiogo	522,172
Cassia	Hong Kong	79,170
,,	Dutch Indies	26,593
,,	Canton	164,497
Cement	Antwerp	154,197
,,	Brunswick	415,0[illegible]9
,,	Brussels	272,665
,,	Charleroi	101,947
,,	Frankfort	52,607
,,	Hamburg	397,193
,,	London	1,228,880
,,	Mannheim	317,366
,,	Mayence	202,578
,,	Newcastle	41,233
,,	Stettin	268,938
Chocolate and cocoa	Amsterdam	593,257
,, ,,	Caracas (Venezuela).	35,480
,,	Carupano (Venezuela).	66,395
,,	Cologne	10,098
,,	La Guayra (Venezuela).	10,058
,,	Kingston (Jamaica)	26,719
,, cacao	Maracaibo (Venezuela).	18,495
,, ,,	Trinidad	1,384,247
Cinchona	Ceylon	73,185
Citrate (*see also* lemon juice)	Palermo	33,990
Clay, china	Falmouth	154,439
,,	Plymouth	259,116
Coca leaves and elixir, nine months ended 31st March 1893.	Callao	5.239
Cochineal, six months ended 31st December 1892.	Grand Canary	13,526
,, nine months ended 30th September 1892.	Teneriffe	3,956
Cocoa	Bahia	616,874
,,	Bristol	38,894
,,	Lisbon	8,709
,, and chocolate	London	304,402
,,	Para (Brazil)	17,321
Cocoa butter	Amsterdam	197,639
Copper	Quebec	221,447
,, regulus	Puerto Cabello (Venezuela).	98,860
,, bullion and matte	Saltillo (Mexico)	133,170
Copra	Ceylon	20.963
,, nine months ended 31st December 1893.	Samoa	2,299
,, six months ended 31st December 1893.	Tahiti	25,762
Dextrine, glucose, &c.	Stettin	27,700
Drugs, chemicals, dyes, paints, and colours:—		
Drugs	Calcutta	4,272,076
,,	Dresden	60,704
,, (other than opium)	Hong Kong	51,418
,, and medicines	Paris	163,000
,, chemicals and paints	Sonneberg	49,493

THE WORLD'S CHEMICAL EXPORTS, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Drugs, chemicals, dyes, paints, and colours—*cont.*		
Chemicals	Aix la Chapelle	141,003
„	Berlin	183,031
„	Birmingham	158,042
„	Bordeaux	94,000
„	Bremen	59,615
„	Breslau	14,948
„	Bristol	40,021
„	Brunswick	206,703
„	Cette	188,000
„	Glasgow	344,332
„	Lille	214,143
„	Liverpool	8,527,046
„	London	1,939,469
„	Manchester	657,819
„	Marseilles	247,000
„	Newcastle	375,041
„	Rouen	22,000
„	Stuttgart	130.967
„	Vienna	95,978
Dyes and drugs	Amsterdam	168,831
„ and chemicals	Basle	201,196
„ colours, and chemicals	Barmen	760.003
„ and drugs	Cologne	104,025
„ and chemicals	Dusseldorf	77,742
„ drugs, and chemicals	Frankfort	1,426,763
„ „ „	Hamburg	480,153
„ and chemicals	Huddersfield	115,001
„ and drugs	Kehl	181,754
„ „	Leeds	54,543
„ „ and chemicals	Mannheim	2,687,014
„ „	Mayence	528,181
„ „ and medicines	Nuremberg	57,271
„ (anilines)	Basle	238,322
„ (colours)	Berlin	105,963
„ (anilines)	Cologne	157,338
„	Havre	104,000
„ colours, and washing blue	Hull	47,909
„	Lyons	41,000
„ (colours)	Nottingham	109,110
Essences	Messina	464,581
„	Palermo	21,417
Ferro manganese	Cardiff	6,284
„	Swansea	87,123
Fertilisers	Dublin	38,153
„	Toronto	19,564
Floor cloth (*see also* linoleum)	Dunfermline	5,296
Fustic	Puerto Plata (S. Domingo).	20,981
Fustic	St. Ann's Bay (Jamaica).	7,444
„	Tampico (Mexico).	87,759
„	Vera Cruz (Mexico).	43,154
Gall nuts	Hankow	5,730
Gambier, six months ended 31st December 1892.	Singapore	733,855
Gelatin	Leith	161,727
Glass and glassware	Aix la Chapelle	33,382
„ plate	Amsterdam	130,445
„ and earthenware.	Bamberg	55,600
„	Berlin	105,985
„	Bremen	84,200
„ and porcelain	Breslau	116,467
„ plate	Brussels	477,304
„ window	„	137,593
„ plate	Charleroi	44,700
„ window	„	1,385,595
„	Dresden	157,038
„ bottles	Dusseldorf	96,441
„	Erfurt	*See* Porcelain.
„ plate, mirror, and window.	Fürth	1,692.529
„	Kehl	138,385
„	Kidderminster	49,408
„	Liège and Verviers	120,506
„ porcelain and pottery.	Paris	318,000
„	Reichenberg (Austria).	597,307
„ and porcelain.	Rheims	219,000
„	Venice	24,753
Glucose	Stettin	*See* Dextrin.
Glue	Dublin	19,391
„	Lyons	59,000
„	Prague	*See* Gum
„	Sheffield	66,951
Glue stock	Rio Grande de Sul (Brazil).	16,463
Glycerin	Barcelona	194,172
„	Genoa	41,828
„	Grao (Portugal)	11,623
Grease	Brunswick	57,447
„ and oil	Huddersfield	70,591
Guano	Paysandu (Uruguay).	25,508
Gum, chicle, nine months ended 31st March 1893.	Belize	4,604
„ Senegal	Bordeaux	68,000
„ Tragacanth	Constantinople	55,620
„ Damar and copal	Dutch India	95.181
„ spruce	Kempt (N.S.)	3,700
„	London	341,725
„ spruce	Megantic (Quebec)	2,765
„ Kauri	New Zealand	1,997,607
„ and glue	Prague	128,354

The World's Chemical Exports, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Gum, copal, six months ended 31st December 1892.	Singapore	119,493
„ mastic or chicle	Tuxpan (Mexico)	115,815
„ „	Vera Cruz „	59,850
„ copal	Zanzibar	51,836
Gutta-percha	Dutch West Indies	2,865
„ six months ended 31st December 1892.	Singapore	49,803
„	Trinidad	8,314
Hennequen fibre, six months ended 31st December 1892.	Merida (Mexico)	2,489,283
India-rubber	Amsterdam	82,778
„	Bahia	60,628
„	Barranguilla (Columbia).	7,354
„ nine months ended 31st March 1893.	Belize	9,913
„	Bluefields (Nicaragua).	71,768
„ (Balata)	British Guiana	1,083
„	Carthagena (Columbia).	66,000
„	Carupano (Venezula).	506
„ (Balata)	Ceara (Brazil)	24,496
„	Colon (Columbia)	4,147
„ (Balata)	Dutch Guiana	11,081
„	Esmeralda (Ecuador).	43,274
„ nine months ended 31st March 1893.	Guayaquil (Ecuador).	129,543
„	Hamburg	518,212
„	Havre	224,000
„	Lisbon	683,957
„	Liverpool	1,779,865
„	Madagascar	99,845
„	Managua (Nicaragua).	26,465
„ and hides	Natal (Brazil)	3,725
„ elastic	Nottingham	204,922
„	Panama	108,687
„	Para (Brazil)	13,888,057
„	Puerto Cortez (Honduras).	4,502
„	Rotterdam	91,467
„	Ruatan (Honduras).	2,862
„	San Blas (Mexico)	4,362
„ six months ended 31st December 1892.	S. Jose de Guatemala.	20,368
„	S. Juan del Norte (Nicaragua).	87,476
„ six months ended 31st December 1892.	Singapore	35,241
„	Truxillo (Honduras).	1,823
„	Tuxpan (Mexico)	9,827
„	Zanzibar	11,349
„ goods	Brunswick	41,385
Indigo	London	312,405
„	Philippine Islands	16,369
„	San Juan del Norte (Nicaragua).	6,103
„	Vera Cruz	9,850
Insect powders	Trieste	71,884
Iodine	Iquique	579,313

The World's Chemical Exports, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Kainit	Magdeburg	432,067
Lead	Malaga	19,253
„ bars and argentiferous, nine months ended 31st March 1893.	Nuevo Laredo (Mexico).	3,117,948
„	Paso del Norte (Mexico).	11,025
„ six months ended 30th September 1892.	San Luis Potosi (Mexico).	580,741
Leather, glove	Annaberg	291,492
„	Bristol	92,755
„ saddlery	Birmingham	197,653
„ and leather goods	Cologne	174,408
„ seal	Dundee	73,705
„ and hides and skins	Frankfort	556,266
„	Geneva	90,707
„	Kehl	231,846
„	Leeds	26,731
„ and hides and skins	Liverpool	1,416,010
„	London	624,128
„ and skins and hides	Lyons	151,000
„ and hides and skins	Mannheim	1,271,087
„ and skins and hides	Marseilles	271,000
„	Mayence	141,278
„ hides, and skins	Nottingham	714,346
„ and skins and hides	Paris	1,894,000
„ and calf skins	St. Petersburg	10,136
„	Trieste	110,867
„	Vienna	84,002
„ goods	Cologne	*See* Leather.
„ „	Vienna	57,584
Lemon juice	Messina	92,196
Linoleum	Dunfermline	35,792
Logwood and logwood roots	Falmouth (Jamaica).	18,760
„ „	Montego Bay (Jamaica).	24,079
„ „	Port au Prince (Haiti).	38,335
„ „	Port Maria (Jamaica).	14,847
„ „	Puerto Plata (St. Domingo).	8,673
„ „	St. Domingo	2,890
„ „	Savannah-la-Mar (Jamaica).	132,945
„ „	St. Ann's Bay (Jamaica).	3,613
„ „	Zara (Cuba)	63,615
Magnesia	Cork	2,729
Manure salt	Magdeburg	273,140
Matches	Gothenburg	98,198
Menthol	Kanagawa (Japan)	23,391
Metal (leaf)	Fürth	*See* Bronze.
„ „	Nuremberg	„
„ (type)	Bristol	15,618
Metals (other than iron and steel)	London	294,068
Milk, condensed	Geneva	105,071
„	Lucerne	73,621

The World's Chemical Exports, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Mineral waters	Barcelona	11,376
,,	Buda-Pesth	78,040
,,	Cologne	394,635
,,	Frankfort	62,571
Mustard	London	218,008
Nickel	Havre	46,000
,, matte, nine months ended 31st March 1893.	Prescott (Canada).	364,602
Nitrate of soda	Iquique	2,880,643
Oil, cod liver	Bergen	82,055
,, cod	Cape Canso (N.S.)	2,476
,, cocoanut	Ceylon	937,331
,, essential	,,	73,015
,, rape-seed	Copenhagen	38,661
,, whale	Hawaii	33,310
,,	Hong Kong	278,539
,,	Huddersfield	*See* Grease
,, essential, and chemicals	Leipsic	254,158
,, and soap	Liverpool	192,801
,,	London	226,565
,, sulphur	Naples	26,320
,, ylang ylang	Philippine Islands	10,002
,,	Port Stanley (Canada).	11,718
,, palm	Sierra Leone	1,892
,, linseed cake	Stratford (Canada)	73,741
,,	Vera Cruz	11,762
,, fish	Yarmouth (N.S.)	7,178
,, cake	Stratford (Canada)	73,741
Ore, iron	Athens	70,442
,, magnesite	Athens	20,519
,, manganese	Batoum	310,326
,, iron	Algiers	126,091
,, gold-bearing	British Columbia	340,818
,, iron	Carthagena	289,710
,, silver	Chihuahua (Mexico).	981,066
,, ,,	Durango (Mexico)	342,418
,, gold	Ensenada (Mexico)	18,208
,, iron	Leghorn	615,375
,, silver	Guaymas (Mexico)	88,863
,, manganese	Kempt (N.S.)	10,642
,, iron	Lisbon	19,014
,, ,,	Liverpool	219,951
,, silver	Mazatlan (Mexico)	665,740
,, free ore	Mexico	61,200
,, and silver	Nogales (Mexico)	937,462
,, gold	Nogales (Mexico)	621,891
,, silver	Nuevo Laredo (Mexico).	45,799
,, iron	Ottawa	14,431
,, silver	Paso del Norte (Mexico).	1,381,050

The World's Chemical Exports, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Ore, silver and silver lead	Piedras Negras (Mexico).	298,895
,, silver	Saltillo (Mexico)	1,041,151
,, ,,	San Blas (Mexico)	76,946
,, ,,	S. Luis Potosi (Mexico).	205,220
,, silver and silver lead	Sierra Mojada	1,079,484
,, manganese and iron, nine months ended 31st December 1893.	Santiago de Cuba	690,708
,, product of the mines, nine months ended 31st December 1893.	Sherbrooke (Quebec).	26,161
,, silver	Vera Cruz	85,609
,, manganese	Windsor (N.S.)	2,034
,, oxide of iron	Three Rivers (Canada).	3,427
,, silver	Winnipeg	187,380
,, gold and silver	Zacatecas	..
Orris root	Leghorn	22,792
Paper	Aberdeen	59,674
,,	Aix la Chapelle	168,201
,,	Annaberg (Germany).	54,808
,,	Antwerp	54,242
,, and ware	Berlin	151,328
,, photographic	Dresden	283,722
,, other	,,	58,044
,, coloured, photographic, and fancy.	Frankfort	144,622
,, and goods	Kanagawa (Japan).	41,049
,, fancy	Leipsic	78,511
,, goods	Nuremberg	46,887
,, wall	Paris	671,000
Paper stock:—		
Wood pulp	Annapolis (N.S.)	6,906
,,	Bergen	113,250
,,	Breslau	114,202
,,	Buda Pesth	26,996
,,	Carleton Place (Canada).	14,397
,,	Christiania	519,576
,,	Clifton (Canada)	26,684
,,	Gothenburg	296,705
,,	Helsingfors (Finland).	2,056
,,	Hull	25,285
,,	New Brunswick	63,308
,,	Ottawa	121,390
,,	Prague	122,899
,,	Stockholm	22,085
Rags	Amsterdam	98,427
,,	Berlin	86,881
,,	Bordeaux	85,000
,,	Catania	17,246
,,	Dresden	68,785
,,	Egypt	69,462
,,	Ghent	715,794

The World's Chemical Exports, &c.—*cont.*

Articles.	Consular District.	Amount.
Paper Stock—*cont.*		Dols.
Rags	Hamburg	358,667
„	Koningsberg	148,038
„	Manchester	794,239
„	Rotterdam	123,808
„	Osaka and Hisgo	105,507
„	Stettin	196,072
„	Three Rivers (Canada).	172,970
„	Vienna	56,966
Paper waste	Cornwall (Canada)	1,494
„ stock	Dundee	140,937
„ „	Leghorn	144,921
„ „	Liverpool	348,300
„ „	London	415,940
Perfumery, civet, six months ended 31st December 1892.	Aden	4,898
„	Nice	193,000
„	Paris	491,000
Phosphate	Antwerp	44,300
Pitch and tar	London	229,489
Platinum and ware	Frankfort	318,679
„	Köningsberg	21,450
„	St. Petersburg	145,669
Plumbago	Ceylon	795,095
„	Nogales (Mexico)	12,975
„ and lead pencils	Nuremberg	97,155
Porcelain, pottery, china, earthenware	Breslau	*See* Glass
„ „ „	Cologne	94,148
„ „ „	Dresden	154,653
„ „ „ & glass	Erfurt	98,892
„ „ „	Glauchau	39,669
„ „ „	Kidderminster	69,034
„ „ „ & bricks	Leeds	123,369
„ „ „	Limoges	1,229,000
„ „ „	Magdeburg	61,924
„ „ „	Nuremberg	56,741
„ „ „	Paris	*See* Glass
„ „ „	Prague	577,538
„ „ „	Reichenberg (Austria).	84,834
„ „ „	Rheims	*See* Glass
„ „ „	Sonneberg (Germany)	917,317
„ „ (& tiles)	Tunstall	3,849,052
Potash, potassic chloride	Brunswick	209,389
„	Cologne	215,939
„ chloride and sulphate	Magdeburg	918,933
Quicksilver	London	376,759
Saffron	Gras (Portugal)	15,025
Salt	Liverpool	570,846
Saltpetre	Calcutta	518,845
Soap	Leghorn	181,868

The World's Chemical Exports, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Soap	Liverpool	*See* Oils.
„	London	260,790
Soap stock	Palermo	25,541
Squills, cumin seed, &c.	Malta	2,829
Starch	Fredericton	12,050
Sugar (beet)	Antwerp	1,497,845
„ „	Breslau	53,698
„ „	Brunswick	316,931
„ „	Dantzic	106,000
„ „	Fiume	*See* Trieste.
„ „	Hamburg	1,661,688
„ „	Leipsic	152,567
„ „	Magdeburg	668,825
„ „	Prague	1,827,355
„ „	Trieste	98,224
Sugar (cane) too long to abstract.	..	..
Sulphides of silver	Chihuahua	15,117
„ „	Guaymas	213,773
„ „	Mazatlan	310,857
Sulphate of potash	Magdeburg	254,618
Sulphur, iron pyrites	Cadiz	94,122
„ ore	„	256,778
„	Catama	260,738
„	Quebec	12,664
„	Girgenti	1,295,980
„ ore, iron pyrites, and manganese ore.	Huelva	364,855
„	Kanagawa (Japan).	226,025
Sumac	Palermo	295,391
Tiles, chemicals, cycles, hardware, &c.	Wolverhampton	232,390
Tin (Banca and Billiton)	Amsterdam	282.618
„	London	3,319,156
„ quarter ended 30th September 1892.	Penang	330,197
„ six months ended 31st December 1892.	Singapore	2,697,164
„ nine months ended 31st March 1892.	Sydney, N.S.W.	535,431
Tin foil	Breslau	12,156
Tin plates	Bristol	19,189
„ and terne	Cardiff	25,290
„	Liverpool	8,159,260
„ and black plates and tin slabs.	Llanelly	1,602,149
„ and terne and black	Newport	1,205,013
Tin, terne, and black plates	Swansea	6,938,000
Ultramarine	Dusseldorf	30,169
Vanilla	Tuxpan (Mexico)	432,714
„	Vera Cruz (Mexico)	277,683
„ beans	Guadaloupe	1,660
„ „ six months ended 31st December 1892.	Tahiti	4,025
Wax, bees'	Cardenas (Cuba)	2,620
„ „	Lisbon	7,061

THE WORLD'S CHEMICAL EXPORTS, &c.—*cont.*

Articles.	Consular District.	Amount.
		Dols.
Wax, bees'	Santiago de Cuba	4,918
„ nine months ended 31st March 1893.	San Domingo	3,289
Wines and malt liquors:—		
Malt liquors	Bamberg	14,321
„	Bremen	147,703
Porter	Cork	2,732
„	Dublin	788,293
Wines and malt liquors	Frankfort	127,366
Ale	Leith	33,119
Malt liquors	London	812,052
Wines and malt liquors	Manuheim	275,967
Malt liquors	Munich	46,455
Ale........................	London (Ont.)	2,699
Wine, gin, and malt liquors	Plymouth	9,145
Wine lecs........................	Bari	43,381
„	Naples	39,235
„	Messina	39,770
Wines, spirituous liquors, and liqueurs (too long to abstract).	..	..
Zinc, zinc dust....................	Breslau	19,571
„	Liège and Verviers	35,532

BOARD OF TRADE RETURNS.

SUMMARY OF IMPORTS.

Articles.	Month ending November 30th.	
	1892.	1893.
	£	£
Metals............................	1,563,767	1,670,249
Chemicals and dyestuffs............	474,322	474,816
Oils............................	658,992	552,965
Raw materials for non-textile industries.	3,562,296	3,299,044
Total value of all imports	38,898,373	35,800,856

SUMMARY OF EXPORTS.

Articles.	Month ending November 30th.	
	1892.	1893.
	£	£
Metals (other than machinery)	2,649,483	2,162,042
Chemicals and medicines	716,487	674,972
Miscellaneous articles..............	2,512,962	2,357,699
Total value of all exports.....	18,549,340	17,653,759

IMPORTS OF METALS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Copper:—				
Ore .... Tons	6,891	9,892	35,233	62,373
Regulus .... „	9,575	8,106	253,700	188,192
Unwrought .... „	2,486	5,042	120,589	220,008
Iron:—				
Ore............. „	277,855	221,592	190,097	164,296
Bolt, bar, &c.... „	6,524	7,172	57,857	66,576
Steel, unwrought.. „	768	708	7,578	6,046
Lead, pig and sheet „	18,506	13,101	188,176	131,550
Pyrites .... „	39,959	35,586	72,872	63,491
Quicksilver....... Lb.	75,380	8,000	6,533	600
Silver ore....... Value £	..	..	171,741	260,585
Tin .... Cwt.	39,913	77,835	186,477	305,368
Zinc .... Tons	8,999	5,569	174,162	99,303
Other articles ...Value £	..	..	98,752	101,861
Total value of metals	..	..	1,563,767	1,670,249

IMPORTS OF OILS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Cocoa-nut......... Cwt.	6,880	11,152	7,517	14,488
Olive .... Tuns	1,243	556	45,206	21,653
Palm .... Cwt.	85,581	93,484	86,857	113,829
Petroleum .... Gall.	14,472,116	13,048,560	267,512	208,085
Seed .... Tons	2,068	2,668	54,145	63,647
Train, &c.......... Tuns	1,978	2,359	38,389	44,848
Turpentine .... Cwt.	75,467	19,940	83,724	21,382
Other articles .. Value £	..	..	75,642	65,033
Total value of oils...	..	..	658,992	552,965

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Bark, Peruvian .. Cwt.	9,125	2,634	19,607	5,956
Bristles.......... Lb.	192,769	164,883	28,959	20,414
Caoutchouc...... Cwt.	27,557	29,141	338,281	331,527
Gum:—				
Arabic......... „	7,816	5,401	21,439	21,162
Lac, &c......... „	2,789	10,594	11,606	50,291
Gutta-percha .... „	3,083	3,618	26,270	29,601

IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH NOVEMBER—*continued.*

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
Hides, raw:—			£	£
Dry............ Cwt.	21,982	20,463	54,628	50,332
Wet........... „	60,963	40,672	111,731	87,860
Ivory............ „	1,041	190	49,155	10,299
Manure:—				
Guano......... Tons	1,890	1,502	11,856	7,184
Bones.......... „	5,628	3,566	25,046	17,081
Nitrate of soda... „	6,425	673	57,052	6,061
Phosphate of lime „	19,111	15,767	33,666	27,950
Paraffin.......... Cwt.	62,816	75,897	71,582	79,314
Linen rags....... Tons	250	1,096	2,841	10,601
Esparto.......... „	13,591	8,095	71,169	36,180
Pulp of wood .... „	17,229	19,366	90,220	99,126
Rosin............ Cwt.	177,931	43,551	42,893	9,544
Tallow and stearin „	84,428	62,695	108,549	83,172
Tar..............Barrels	215	3,390	68	3,539
Wood:—				
Hewn .... Loads	161,679	162,170	333,521	303,989
Sawn .... „	466,708	466,232	1,036,107	936,193
Staves .... „	11,259	19,047	56,014	72,041
Mahogany ..... Tons	4,139	6,847	35,307	57,337
Other articles....Value £	..	..	924,729	892,290
Total value	..	..	3,562,296	3,299,044

Besides the above, drugs to the value of 62,198*l.* were imported, as against 73,351*l.* in November 1892.

IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	6,633	9,698	4,640	9,174
Bark (tanners', &c.) „	17,785	20,657	5,974	6,547
Brimstone........ „	31,448	13,083	10,308	3,485
Chemicals...... Value £	..	..	154,870	128,129
Cochineal .... Cwt.	1,098	484	6,764	3,015
Cutch and gambier Tons	2,350	3,738	48,376	70,889
Dyes:—				
Aniline .... Value £	..	..	12,642	19,277
Alizarin ...... „	..	..	38,466	26,312
Other .... „	..	..	417	2,406
Indigo .... Cwt.	3,223	3,865	48,928	74,309
Nitrate of potash . „	28,822	18,888	25,292	18,217
Valonia .... Tons	1,483	1,344	19,212	16,975
Other articles... Value £	..	..	98,433	96,081
Total value of chemicals	..	..	474,322	474,816

EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Brass........... Cwt.	9,291	9,781	37,706	36,585
Copper:—				
Unwrought ..... „	69,601	24,290	168,772	55,993
Wrought........ „	26,494	26,010	76,349	72,513
Mixed metal .... „	29,529	23,777	69,503	51,985
Hardware ..... Valne £	..	..	192,260	163,242
Implements....... „	..	..	108,405	102,045
Iron and steel..... Tons	230,618	184,835	1,753,669	1,460,013
Lead .... „	2,788	3,355	33,708	38,161
Plated wares... Value £	..	..	34,561	34,359
Telegraph wires „	..	..	39,903	19,529
Tin .... Cwt.	9,453	10,336	45,803	43,294
Zinc .... „	16,881	16,443	13,675	12,469
Other articles .. Value £	..	..	75,019	71,863
Total value	..	..	2,649,483	2,162,042

EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH NOVEMBER.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Gunpowder...... Lb.	869,100	595,400	21,227	16,103
Military stores.. Value £	..	..	121,774	87,288
Candles.......... Lb.	1,693,800	1,550,200	30,961	28,918
Caoutchouc ..... Value £	..	..	107,565	97,042
Cement.......... Tons	39,084	32,898	69,271	55,210
Products of coal Value £	..	..	110,299	100,879
Earthenware ... „	..	..	179,157	146,790
Stoneware ...... „	..	..	9,924	11,662
Glass:—				
Plate........... Sq. Ft.	193,021	118,549	10,613	6,524
Flint........... Cwt.	7,467	7,073	19,779	19,206
Bottles......... „	55,629	46,550	26,146	22,420
Other kinds.... „	24,538	13,537	20,242	11,407
Leather:—				
Unwrought .... „	12,028	12,385	107,280	111,118
Wrought ..... Value £	..	..	26,603	29,768
Seed oil.......... Tons	5,723	4,743	106,375	103,864
Floorcloth ..... Sq. Yds.	1,181,800	1,126,800	50,355	46,906
Painters' materials Val. £	..	..	126,393	108,036
Paper .... Cwt.	67,675	71,940	118,271	117,485
Rags.............. Tons	5,914	3,730	42,747	29,547
Soap.............. Cwt.	42,937	58,296	48,796	60,593
Total value	..	..	2,512,962	2,357,699

Exports of Drugs and Chemicals for Month ending 30th November.

Articles.	Quantities.		Values.	
	1892.	1893.	1892.	1893.
			£	£
Alkali............ Cwt.	543,747	477,014	183,848	134,640
Bleaching materials „	131,747	68,747	53,338	28,575
Chemical manures. Tons	25,150	20,240	152,208	162,587
Medicines....... Value £	..	..	86,566	82,715
Other articles ... „	..	..	240,527	266,455
Total value	..	..	716,487	674,972

Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

Applications.

21,850. H. A. Naber. Improvements in voltameters. Complete Specification. November 15.

21,854. C. A. Hussey. Improvements in rheostats. November 15.

21,858. G. E. O. Lange. Improvements in apparatus for cooling milk and other fluids. Complete Specification. November 15.

21,876. G. Dean. Improved Hoffman's kiln. November 16.

21,890. A. Lupton. A safety covering for metallic storage cylinders, cases, or bottles in which compressed or liquefied gas or air is stored, such as those used for storing oxygen and hydrogen at high pressures for the oxyhydrogen limelight-burners and for storing condensed carbonic acid gas, oil gas, coal gas, and other gas. November 16.

21,891. A. Lupton. An improvement in iron or steel storage cylinders for hydrogen gas, marsh gas, coal gas, oxygen gas, oil gas, and other gas. November 16.

21,910. G. Craig. Improvement in glass apparatus for concentrating, distilling, or evaporating. November 16.

21,987. A. Lupton. A safety shield for metallic storage cylinders, cases, or bottles in which compressed or liquefied gas or air is stored at high pressures. November 17.

22,176. H. Collet. Apparatus for regulating the flow of liquids. Complete Specification. November 20.

22,323. H. A. Allport and G. Little. Apparatus for charging coke ovens and furnaces. November 22.

22,327. J. Bradbury. *See* Class VII.

22,489. J. I. Vaughan. An improved method and apparatus for the securing and treatment of vapours, gases, and liquids. November 23.

22,681. G. Axdorfer and C. F. H. Sass. Improvements in apparatus for mixing gas and air for gas furnaces. November 25.

22,736. A. F. Beyer and A. G. Beyer. A new or improved apparatus for solidifying and drying substances in a liquid or viscous state. Complete Specification. November 27.

23,045. R. Haddan.—From F. D. Cummer, United States. Improvements relating to mechanical drying apparatus. Complete Specification. November 30.

23,069. R. Cunliffe. *See* Class XVII.

23,124. G. Dasse and C. Fettweis. Improvements relating to drying and carbonising apparatus for textile and other matters. December 1.

23,235. G. Oulton. Improvements in or connected with valves and apparatus for regulating the flow and controlling the pressure of fluids. December 4.

23,367. L. Wagner and J. Marr. *See* Class XVII.

23,560. J. Makin. *See* Class XIX.

23,595. J. Y. Johnson.—From C. Gounelle, France. Improvements in and connected with oil and other like presses. December 7.

23,915. W. B. Silverlock. Improvements in apparatus for purifying and separating lime from the water used for feeding steam boilers. December 12.

24,165. E. Stern. A new method of closing receivers charged with compressed or liquefied gases. Complete Specification. December 15.

24,266. H. S. Keating. An improvement in hydrometers, saccharometers, and such like instruments. December 16.

Complete Specifications Accepted.*

1893.

1676. W. Webster. Improvements in apparatus for filtering and purifying water. December 13.

1708. E. B. Harlock. Improvements in apparatus or vessels for the continuous evaporation or concentration of liquids. November 22.

2340. E. G. Scott and F. W. Scott, jun. Improvements in apparatus for evaporating and cooling liquids. December 6.

2400. J. Parks. Improvements in or applicable to brine evaporating pans. December 13.

3057. A. Shiels. Improvements in thermostats. December 20.

18,422. W. P. Thompson.—From W. Arnold. Improved apparatus for washing filtering media. December 6.

20,582. F. V. Matton. Pressure devices for retort lids. December 6.

II.—FUEL, GAS, AND LIGHT.

Applications.

21,707. E. Andreoli. Production of ozone and luminosity. Complete Specification. November 14.

21,890. A. Lupton. *See* Class I.

21,891. A. Lupton. *See* Class I.

21,901. T. R. Robinson. Household fuel. November 16.

21,926. F. E. Baron and C. C. Fry. Improvements in liquid fuel, and in means or apparatus employed in the manufacture thereof. November 16.

21,975. F. Holbrook. An improved device for obtaining a more perfect combustion of and illuminating power from gas. November 17.

22,074. J. L. Mortimer and J. H. Williams. Improvements in night-lights, candles, and other lights. November 18.

22,150. W. A. Laurie. Improvements in lids or covers for gas-retort mouthpieces. November 20.

22,159. C. Bollé.—From J. L. S. Joly, France. Improvement in the manufacture of candles. Complete Specification. November 20.

22,169. F. McNamee. Improved fuel for domestic and steam purposes. November 20.

22,185. C. D. Abel. — From M. M. Rotten and Co., Germany. Improved manufacture of fire-lighters. November 20.

22,194. F. W. Clark. An improved method of and apparatus for carburetting or enriching gas. November 20.

22,196. H. Palmer and A. Ware. Improvements in apparatus for the manufacture of candles. November 20.

22,216. R. Middleton. An improved mode of mixing and dealing with certain materials for making blocks or briquettes for fuel or smelting, or analogous purposes. November 21.

22,231. H. Defty. A revolving chamber or disc for disseminating and vaporising oils into gas. November 21.

22,378. E. de Pass.—From L. J. Baptiste, France. Improvements in machines for the manufacture of candles. November 22.

22,396. R. Langhans. Improvements in the manufacture of incandescent bodies for incandescent gas lighting. Complete Specification. November 22.

22,488. J. I. Vaughan. *See* Class I.

22,492. F. Fanta. Improvements in the manufacture of coal gas by the use of oxygen and hydrocarbons. November 23.

22,576. F. D. Marshall. Improvements in apparatus for washing and purifying gas. November 24.

22,596. A. H. B. Sharpe and J. Lock. Improvements in the construction of coal bricks or briquettes as used for fuel, the same being applicable for briquettes composed of other analogous substances. November 25.

22,638. E. de Pass.—From L. J. Baptiste, France. Improvements in machines for the manufacture of hollow candles. November 25.

22,908. H. Fourness. Improvements in or connected with hydraulic mains and valves for gas retorts. November 29.

22,916. R. Middleton. An improved admixture of, and process of, mixing and pressing materials into blocks or briquettes for fuel and analogous purposes. November 29.

22,917. R. Middleton. An improved compound for use in the manufacture of artificial fuel and the like. November 29.

23,146. W. Wood. Fuel. December 2.

23,160. H. J. Saunders. Fuel. December 2.

23,381. T. Deiches and J. Komaike. Improvements in candles and wax and such like matches. December 5.

23,433. W. R. Herring. Improvements in and in apparatus for manufacturing oil gas. December 5.

23,471. C. C. Walker. Improvements in or connected with the lids of gas retorts or the like. December 6.

23,910. F. R. Hartley. An improved ascension pipe for coal, gas, and other retorts. December 12.

23,931. S. Hersey. Improvements in apparatus for washing or scrubbing gas. December 12.

23,950. J. H. R. Dinsmore. Improvements in or connected with apparatus for making gas from coal or analogous material. December 13.

24,150. W. Denton. Improvements in means or apparatus for economising fuel and consuming smoke or other gases arising from the combustion of coal or other fuel. December 15.

Complete Specifications Accepted.

1892.

20,860. J. Love. Improvements in apparatus for carburetting or enriching gas or air. November 22.

23,299. A. M. Chambers and T. Smith. An improved process and apparatus for separating fine coal slack from impurities. November 29.

24,116. J. D. Gilmour. *See* Class VII.

1893.

392. T. W. Lees. Improvements in the manufacture of blocks or briquettes of fuel. December 20.

2155. C. A. Sahlstrom and E. Parr. A new and improved method for saponifying or mixing tars, oils, hydrocarbons, and similar materials, and for using the same for heating, lighting, and other purposes. December 6.

7467. E. J. Duff. Improvements in gas producers. November 22.

8040. D. W. Nightingale and S. G. Wicking. An improved fuel. December 13.

13,069. A. J. Boult.—From E. Cowen. Improvements in the method of and apparatus for manufacturing cyanides, ammonia, and fuel gas. November 29.

19,521. A. Kitson. Improvements in the method of and apparatus for producing gas. December 20.

21,048. F. Coe and R. J. Harrison. Improvements in the construction of an apparatus for automatically registering the pressure of gas. December 13.

IV.—COLOURING MATTERS AND DYES.

Applications.

21,753. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik, Germany. Improvements in the manufacture and production of new azo dyes. November 14.

22,204. H. H. Lake. — From K. Oehler, Germany. Improvements relating to the manufacture of colouring matters. November 20.

22,400. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters and materials therefor. November 22.

22,741. O. Imray. — From The Society of Chemical Industry in Basle, Switzerland. Manufacture of blue acid colouring matters of the triphenylmethan series. November 27.

23,310. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of new bases and their sulpho-acids. December 4.

23,311. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of colouring matters dyeing blue with mordants. December 4.

23,392. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters. December 5.

23,578. J. Imray. — From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France. Manufacture of colouring matters applicable to unmordanted fibres or fabrics. December 7.

23,585. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters derived from anthraquinone. December 7.

Complete Specifications Accepted.

1893.

788. T. R. Shillito.—From J. R. Geigy. Production of orange colouring matters or dyes. November 22.

825. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The production or manufacture of derivatives of betanaphtho-hydraquinone or betanaphthoquinone. November 29.

1280. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis and Dr. Chapius. Manufacture of mono-sulphonated anthracene acid by the direct sulphonation of anthracene. November 22.

1851. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of azo colouring matters. November 29.

2370. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new sulpho acids of certain naphthalene derivatives, and of new colouring matters obtainable therefrom. December 13.

2614. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new azo dyes, and of a component for use in their manufacture. December 20.

2695. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture and production of derivatives of hydroxyanthraquinones. December 13.

2984. C. D. Abel.—From The Actiengesellschaft für Anilin Fabrikation. Manufacture of a new amidonaphthol-disulpho acid. December 6.

3487. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new acid colouring matters. December 20.

4287. H. H. Lake.—From Kalle and Co. Improvements in the manufacture of indigo. December 13.

20,301. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of unsymmetrical diamide bases, and of colouring matters therefrom. December 6.

20,790. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new unsymmetric diamido bases, and of tetrazo colouring matters derived therefrom. December 13.

20,979. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new colouring matters derived from dioxydiphenylmethan. December 13.

V.—TEXTILES, COTTON, WOOL, SILK, Etc.

Applications.

21,557. G. V. Priestley. Improvements in machinery or apparatus for use in treating or preparing silk waste, china grass, flax, and other long-stapled fibres. November 13.

21,660. B. Barraclough. Improvements in certain textile fabrics. November 14.

21,662. J. Walker. Improvements in machines employed in the finishing of calico or other textile fabrics. November 14.

21,976. W. E. Heys.—From E. Godchaux, France. *See* Class XII.

22,729. M. Teichmann. A sliver composed of loose cotton or other textile fabrics. November 27.

22,808. J. C. Pennington and W. O. Allison. Improvements in or relating to the "retting" of fibres. Complete Specification. November 28.

23,052. J. Dawson. Improvements in apparatus for drying wool and other fibres. December 1.

23,063. R. C. Willey. Improvements in the method of and apparatus for finishing yarn. December 1.

23,124. G. Dasse and C. Fettweis. *See* Class I.

24,003. F. Lehner. Improvements in the production of and in apparatus for producing artificial silk. December 13.

24,072. G. Brown. Textile-compo. December 14.

24,144. E. Samper. A new or improved machine for extracting fibrous matters from agaves, aloes, and other similar plants. Complete Specification. December 15.

Complete Specifications Accepted.

1892.

23,983. J. S. Farmer, H. L. Storey, and I. H. Storey. Improvements in the manufacture of linoleum, kamptulicon, and other similar floor-cloths, and in the means employed in such manufacture. December 6.

1893.

744. J. J. Weicher. Improvements in machines for extracting fibre from fibrous plants. November 29.

19,984. E. Maertens. Improvements in the process and apparatus for treating slivers, rovings, yarns, fabrics, and other textile materials for scouring, bleaching, dyeing, and like purposes, and in the manufacture of coloured tops and slivers. December 6.

21,049. G. E. Stead. Improved manufacture of woven cloth. December 13.

21,249. G. J. Junk. A new or improved method of treating canvas, shirting, silk, paper, and like substances for the purpose of rendering the same sensitive to light. December 13.

VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

Applications.

21,843. W. P. Thompson.—From T. Salzmann, Austria. An improved process and apparatus for treating dyed cotton yarns and the like. November 15.

21,915. T. Lye and W. T. Lye. Improvements in colouring, ornamenting, dyeing straw plait or chip plait. November 16.

22,459. J. Walker. Improvements in the process of printing calico. November 23.

22,498. A. J. Boult.—From P. V. Rennard, France. Improvements in or relating to the clouding of textile materials in dyeing. November 23.

22,768. W. H. Hughes. An improved method or process for scouring, cleansing, and disinfecting all raw materials used in the manufacture of woollen, cotton, and linen textile fabrics and the fabrics themselves, and whereby also a great saving of water is effected and the pollution of rivers and streams is prevented. November 28.

23,559. W. P. Thompson.—From E. Holken and Co., Germany. An improved process of dyeing for producing genuine Turkey-red and rose colour in vegetable yarns, in cops, hanks, carded strips, and the like. Complete Specification. December 7.

23,750. M. Williams. Improvements in or appertaining to the bleaching of fibrous or textile materials. December 9.

23,776. W. J. S. Grawitz. Improvements in dyeing and printing textile fibres black, or shades approaching thereto, with aniline, its homologues or derivatives. December 9.

23,777. W. J. S. Grawitz. Method and apparatus for developing and fixing aniline black and the like on textile materials by steaming. Filed December 9. Date applied for, 13th May 1893, being date of application in France.

23,830. W. Köhler. Improved apparatus for producing paper-hangings, coloured posters, and the like. December 11.

Complete Specifications Accepted.

1893.

11,019. E. Gibson. Improvements in apparatus for bleaching minerals. November 29.

19,984. E. Maertens. *See* Class V.

VII.—ACIDS, ALKALIS, AND SALTS.

Applications.

22,327. J. Bradbury. Improvements in apparatus and furnaces for concentrating sulphuric acid and other liquids. Complete Specification. November 22.

22,532. A. Campbell, A. Walker, and J. W. Walker. Improvements in apparatus for impregnating lime with chlorine to form bleaching powder. November 24.

23,682. Count H. P. Syberg. Improvements in the preparation of acetic and oxalic acids. December 8.

23,889. G. Jármay. Improvements in or appertaining to apparatus for drying bicarbonate of soda. December 12.

23,890. G. Jármay. Improvements in the manufacture of refined bicarbonate of soda. December 12.

24,175. E. J. Hunt. Improvements in treating the residual products of certain manufactures, and in treating certain metallic ores for the manufacture of chlorine. December 15.

Complete Specifications Accepted.

1892.

23,342. G. F. Strawson and W. Fream. An improvement in the manufacture of sulphate of copper. November 22.

24,116. J. D. Gilmour. Improvements in the manufacture of cyanide and cyanogen compounds. November 29.

1893.

472. F. W. Petrie. Improvements in apparatus for the making or manufacturing of caustic soda and chloride of lime, being a method of passing the gases to the receivers. November 29.

1214. E. K. Muspratt, E. Carey, and V. C. Driffield. Improvements in and apparatus for the manufacture of bleaching powder. November 22.

2274. A. van Berkel. Improvements in the extraction of carbonic acid from mineral carbonates and in apparatus therefor. December 6.

2476. I. Levinstein. Improvements in the method of and in apparatus for recovering and concentrating waste and diluted sulphuric acid, and for separating and recovering other acids in mixture therewith. December 20.

5620. C. Wehmer. A method for producing artificial citric acid. December 13.

18,169. S. E. Mott, G. W. Wort, S. Wort, and E. W. Wort. "Victoria" extract of soda. December 20.

VIII.—GLASS, POTTERY, AND EARTHENWARE.

Applications.

21,723. W. P. Thompson.—From P. V. Peltier, United States. Improvements in apparatus for rolling glass. Complete Specification. November 14.

22,362. J. H. Bale. Wafer china mosaic. November 22.

22,613. J. Holdcroft, jun. Improved construction of potters' kilns. November 25.

22,637. J. B. Hanquinaux. Improvements in ovens for baking or firing ceramic ware and other refractory products. November 25.

22,929. T. Bevington. Improvements in the manufacture of glaze for pottery. November 29.

23,388. N. M. Miller. Improvements relating to the rolling of glass, and in machinery therefor. Complete Specification. December 5.

23,396. A. Cay. Improvements in the manufacture of lenses. December 5.

23,505. R. Y. Foley and F. L. Carslake. Improvements in or relating to the manufacture of clay goods. December 6.

23,506. G. Roberts. An improved material or composition specially applicable for the manufacture of substitutes for clay pigeons and for other purposes. December 6.

23,753. A. Maw, G. H. Maw, and B. Suart. An apparatus for applying glazes or enamels to tiles or other like goods. December 9.

24,026. P. B. W. Kershaw and B. L. Tottenham. An improved process and apparatus used therein for the mechanical production of glass bottles. December 13.

24,283. J. E. G. Méran. Improvements relating to the manufacture of pottery. December 16.

Complete Specifications Accepted.

1893.

2252. H. L. Doulton and W. P. Rix. Improved means for ornamenting pottery ware. December 13.

10,384. Count Solms-Baruth. Improvements in the manufacture of glass articles in imitation of agate. November 29.

20,533. J. Retzlaff. New or improved process of etching on glass, porcelain, and the like. December 20.

21,723. W. P. Thompson.—From P. V. Peltier. Apparatus for rolling glass. December 20.

IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

Applications.

21,841. M. Smith. A new or improved article of manufacture applicable for use as a ceiling decoration. November 15.

22,103. A. J. Boult.—From A. Tousset, France. Improved manufacture of mortar and the like. November 18.

22,227. M. Williams. Improvement in the manufacture of cement mortar. November 21.

22,782. H. Behrens. Improvements in the manufacture of moulded blocks, slabs, and other articles for use as building materials from cement or other similar substance or composition, and in moulds for producing the same. Complete Specification. November 28.

22,978. T. Potter. Improvements in the construction of fire-resisting floors. November 30.

22,990. W. L. Morcom. A process for making Portland cement, concrete bricks, slabs, mouldings, &c. November 30.

23,168. H. V. Lanchester. Improvements in the construction of fireproof and like floors. December 2.

23,799. W. P. Thompson.—From J. B. Granjon and C. Bellon, France. Improvements in the manufacture of hollow blocks and similar articles for building and decorative purposes. December 11.

Complete Specifications Accepted.

1892.

22,004. F. W. Lohrmann. Improvement in the manufacture of artificial building materials. December 6.

22,784. J. Gaskell and W. Robinson. Artificial stone, bricks, tiles, and the like. December 13.

23,975. W. Horne and F. G. S. Ham. Horneham's non-slippery pavement. November 29.

1893.

2069. J. J. Green. An improved manufacture of sink stones and gullies from clay or other plastic material. December 6.

3356. A. A. Hely. Certain improvements in the preservation of wood. December 20.

17,046. C. A. Allison.—From L. Rieser. An improved process of and apparatus for preparing and seasoning timber. November 22.

19,011. H. J. Haddan.—From C. B. Judd. Improvements relating to the finishing of wood veneers. December 6.

X.—METALLURGY, MINING, Etc.

Applications.

21,558. A. B. A. Sleigh. Improvement in apparatus for working metals. November 13.

21,582. D. M. McKechnie and A. McKechnie. Improvements in the treatment of composite ores containing zinc and lead. November 13.

21,760. S. O. Cowper-Coles and Sir B. W. Walker, Bart. Improvements relating to the deposition of metals and compounds. November 14.

21,823. G. Kynoch and Co., Limited and D. Clerk. Improvements in the manufacture of steel shells. November 15.

21,831. G. Robson. Treatment of finely divided substances, such as slime, tailings, and the like, for the separation and recovery of metals and metallic compounds therefrom, recovering for re-use liquid used in such treatment. November 15.

22,190. J. Solar.—From E. Tarin and R. Pillier, France. An improved process for producing aluminium. November 20.

22,367. H. C. Bull. A. method and apparatus for recovering gold from sea-water. November 22.

22,380. E. Andreoli. Precipitating gold and other metals from cyanide and other solutions. November 22.

22,397. B. Mierisch. Improvements in the extraction of gold and silver from ores or matte. November 22.

22,461. J. Cox. A new or improved metallic alloy. Complete Specification. November 23.

22,751. J. Y. Johnson.—From A. Imbert, France. Improvements in the manufacture of metals from metallic oxides, and in the production of an intermediate product employed in the said manufacture. November 27.

22,763. G. Fisher. Combined pig-iron moulding apparatus and pig carrier for blast furnaces. November 28.

22,825. R. Lewis and G. Morgan. Improvements in apparatus for coating iron and steel plates with tin or other metals or alloys. Complete Specification. November 28.

22,828. R. Haddan.—From B. Jones, United States. Improvements in or relating to cores, moulds, and mould-facings for the manufacture of steel and other metallic castings. Complete Specification. November 28.

23,048. F. Watkins. A process for coating iron, steel, or other metallic plates with tin, terne, and other mixtures, by the application or use of hard paraffin or paraffin wax, osokerit, and earth wax, or a combination of either the above substances, by themselves or in combination with palm oil or palm oil mixtures. December 1.

23,261. W. E. Hatton. The ornamentation of metal plates and other articles of metal. December 4.

23,425. W. P. B. Urick. Improvements in methods of casting solid ingots of steel. Complete Specification. December 5.

23,431. C. Raleigh. Improved means applicable for use in extracting gold and silver from auriferous and argentiferous solutions. Complete Specifications. December 5.

23,492. E. T. Zohrab. An improved method of hardening or converting into steel the surfaces of iron plates and other objects made from iron. December 6.

23,550. H. Turner. Process of mixing and melting pure copper and tin for making sound castings. December 7.

23,619. E. R. Besemfelder. Improvements in the method of separating metals from ores, and from other mixtures of insoluble substances therewith. Complete Specification. December 8.

23,636. T. Hampton. Improvements in the manufacture of armour plates and in ingots therefor. December 8.

23,770. E. G. N. North. Process for the elimination and recovery of arsenic from precipitate and other cupreous products. December 9.

23,825. J. S. MacArthur.—From the Cassel Gold Extracting Co., Limited, and C. J. Ellis. Improvements in precipitating gold and silver from alkaline solutions. December 11.

23,930. R. Pearson. A new or improved process and means for treating quartz containing gold, silver, and other metals. December 12.

23,979. F. W. Golby.—From C. Francisci, Germany. Improvements in furnaces for distilling zinc, cadmium, and the like. Complete Specification. December 13.

24,063. G. Hookham. Improvements in metallic alloys. December 14.

24,230. C. J. L. Leffler. The manufacture of ferro boron. December 16.

24,231. C. J. L. Leffler. Improvements in the manufacture of steel. December 16.

Complete Specifications Accepted.

1893.

751. C. T. J. Vautin. An improved process for the manufacture of aluminium sulphide. December 20.

1385. A. E. Haswell and A. G. Haswell. Improvements in and relating to the coating of metals. November 22.

1437. H. J. Phillips. A process for the elimination of sulphur from iron or steel. November 22.

1470. T. J. Tresidder. Improvements in the manufacture of armour plates. November 22.

1795. S. Chatwood and S. R. Chatwood. Improvements in the manufacture of compound steel ingots and other articles. December 6.

2616. T. J. Tresidder. Improvements in apparatus for use in chilling armour plates. December 13.

19,606. L. Bemelmans. A new process for reducing sulphuretted ore into oxides and sulphur. December 20.

20,024. W. P. Thompson.—From W. Kiesel. An improved process for producing on steel, iron, or other metals a durable and smooth, either glazed or dull black surface. November 29.

XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

Applications.

21,619. J. Nixon. An electro deposit of zinc. November 13.

21,624. E. A. McLachlan. Improvements in or connected with electrical storage batteries. November 13.

21,631. W. H. Caldwell. Improvements in electrolysis and in apparatus therefor. November 13.

22,032. G. R. Blot. Improvements in accumulator batteries. November 17.

22,053. V. C. Doubleday.—From M. Süssmann, Germany. Improvements in or connected with so-called "dry" electrolytes for secondary batteries. November 17.

22,274. A. V. Newton.—From A. Nobel, France. Improvements in primary electric batteries. November 21.

22,311. E. P. Usher. Improvements relating to storage batteries. Complete Specification. November 21.

22,312. E. P. Usher. Improvements in storage batteries. Complete Specification. November 21.

22,379. S. Miller and C. J. Grist. Improvements in charging primary batteries. November 22.

22,674. R. Haddan.—From H. Riguelle, Belgium. Improvements in or relating to electric regenerative batteries or accumulators and in porous cells therefor. November 25.

22,912. E. H. Wheeler. Improvements in electrodes and cells for secondary batteries or accumulators. November 29.

22,956. C. A. J. H. Schroeder and H. E. R. Schroeder. New improved electro-positive galvanic battery electrodes. Complete Specification. November 29.

23,241. W. J. S. Barber-Starkey. Improvements in electric storage batteries. December 4.

23,303. A. J. Boult.—From J. Lecoq, Belgium. Improvements in or relating to accumulators. December 4.

23,364. H. G. Spearing. Improvements in the manufacture or production of electrodes or plates for batteries, especially secondary batteries. December 5.

23,436. H. H. Lake.—From the Union Chemical Co., United States. Improvements in apparatus for electrolytically producing soda and chlorine. Complete Specification. December 5.

23,478. A. Coehn. Improvements relating to the electrolytic preparation of oxygen and the halogens, and to the simultaneous production of electrodes. December 6.

23,669. P. Schoop. Improvements in electrolytic vessels for primary and secondary batteries or accumulators, and other processes of electrolytic decomposition and electrolytic action, such as for the extraction of metals from their ores, electro-depositions, and the like. December 8.

23,684. T. B. Bates and A. E. Leefe. Improvements in connection with the electro-deposition of metals. December 8.

23,881. W. P. Thompson.—From C. L. Coffin, United States. Improved method of and apparatus for heating metals electrically. Complete Specification. December 12.

23,913. R. Haddan.—From H. S. Blackmore, United States. Improved process and apparatus for dissociating soluble salts by electrolysis. Complete Specification. December 12.

24,017. E. Stouls. Improvements in or relating to processes and apparatus for obtaining and depositing metals by electrolysis, and in the treatment of the metals after leaving the electrolytic bath. December 13.

24,131. M. A. Mosley, R. Wright, and J. H. Richardson. Improvements in or appertaining to the electro-deposition of zinc. December 15.

24,241. H. Weymersch and E. Freund. Improvements in primary batteries. December 16.

24,274. C. Kellner. Improvements in apparatus for the electrolytic decomposition of metallic salts. December 16.

24,276. H. Guthrie. Improvements in apparatus for electrolytic purposes. December 16.

Complete Specifications Accepted.

1892.

23,750. A. Hough. An improvement in plates for secondary batteries. December 6.

1893.

259. R. E. B. Crompton and H. J. Dowsing. Improvements in the heating of surfaces for the drying, heating, or other treatment of paints, oxides, or other matters by the aid of electricity, and in the means or apparatus employed therein. December 13.

757. H. T. Barnett. Improvements in platinised electrodes. November 29.

758. H. T. Barnett. Improvements in connection with carbon electrodes. November 29.

813. C. Pollak. Improvements in or connected with the manufacture of electrodes for electric accumulators. November 22.

1661. E. Andreoli. Improvements in electrolytic apparatus. December 20.

3210. S. W. Maquay. Improvements in primary batteries and in miners' and like portable lamps. December 13.

4360. W. P. Thompson. From La Société Electric Phœbus. Improvements in the construction of plates for accumulators or secondary batteries. December 13.

13,723. C. Kellner. Apparatus for the electrolytic production of bleaching liquid. December 13.

19,542. C. Kellner. Improvements in apparatus for the electrolytical decomposition of salt solutions. December 13.

20,023. W. P. Thompson.—From C. L. Coffin. Improvements in the method of heating, welding, or working metals electrically, and in apparatus therefor. December 6.

XII.—FATS, OILS, and SOAP MANUFACTURE.

Applications.

21,849. W. R. Dodd. Improvements in the manufacture of soap. November 15.

21,976. W. E. Heys.—From E. Godchaux, France. Improvements in compounds for oiling or similarly treating wool. November 17.

22,225. E. S. Wilson, E. Stewart, and R. Hunt. Improvements in the separation and purification of colouring matter from crude cotton-seed oil. November 21.

22,853. W. E. Heath and C. Heath. Improvements in scented or perfumed soap tablets or bars. November 28.

23,387. W. T. Forbes. Improvements in the process and apparatus for extracting oil and other solvent matters from fibrous plants and other materials. Complete Specification. December 5.

23,398. A. J. Boult.—From A. Gross, Austria. Improved manufacture of detergent for washing and cleansing dirty linen. Complete Specification. December 5.

23,854. E. J. T. Digby. *See* Class XVI.

Complete Specifications Accepted.

1893.

17,565. M. Ekenberg. An improved method of separating fats. December 6.

19,298. M. J. Palmer. Improved apparatus for and process of making soap. November 22.

20,639. L. Krause and J. Meyer. Improvements in and connected with the separation of cholesterin and fatty acids from wool fats. December 20.

XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

Applications.

21,633. A. Arnaud and A. Houseal. Improved process for the extraction of gutta-percha from gutta-percha trees, also applicable to the extraction of india-rubber or other like gums from their respective gum trees. November 13.

21,719. A. J. Holt and J. Wright. New or improved rubber substitute. November 14.

22,137. L. Paget. Improvements in pyroxyline compounds, solutions, and solvents. November 18.

22,210. F. J. Cox, F. L. Merritt, and M. G. E. Cuddon. Improved composition adapted to replace india-rubber and analogous substances. November 20.

22,294. E. Waller. Improvements in the manufacture of white lead. Complete Specification. November 21.

22,338. H. Smith. Improved preservative paints and coatings for iron and steel. November 22.

22,491. R. Haddan.—From A. Bolard, France. An improved method of preparing charcoal for purifying and decolouring fats, wines, oils, petroleum, alcoholic liquors, and other liquids. November 23.

22,730. A. Buecher. Improvements relating to rust-preventive paints. November 27.

22,731. A. Buecher. Improvements relating to materials or means for the destruction of rust on iron and steel. November 27.

22,961. F. Crane. Improvements in or relating to paints or driers. November 29.

23,028. E. M. Desprez. A new elastic material or manufacture composed chiefly of gutta-percha, india-rubber, or other analogous substance, and the application of the same to various useful purposes. November 30.

23,120. W. V. Wilson and W. B. Priest. Improvements in the manufacture or production of paints or paint materials. December 1.

23,866. J. S. MacArthur. Improvements in making white lead. December 12.

24,025. G. Webb, G. Webb, jun., and A. E. Burton. Improvements in the manufacture of white lead. December 13.

24,184. J. E. Tenison-Woods, A. J. Campion, W. Morgan, A. Moy, and C. Swithenbank. Improvements in the manufacture of commercial india-rubber. December 15.

Complete Specifications Accepted.

1892.

15,544. A. F. S. George. Manufacture of artificial caoutchouc. December 6.

23,206. R. Ripley. An improved or new manufacture of black lead. December 20.

23,548. W. S. Kilpatrick. Improved process for the manufacture of litharge, red lead, and cement from galena or other lead ores, or from sulphate of lead. December 20.

1893.

259. R. E. B. Crompton and H. J. Dowsing. *See* Class XI.

3116. J. V. Walton. Improvements in apparatus employed in the manufacture of white lead. December 20.

19,444. T. Cohn. A new or improved protective paint. November 29.

XIV.—TANNING, LEATHER, GLUE, and SIZE.

Applications.

22,175. B. F. Wickens. An improved method of and apparatus for drying and removing solvents and the like from bones and other materials. November 20.

22,849. W. L. Jackson. An improvement in softening and cleansing hides. November 28.

23,369. T. Hilditch. A substitute for leather for boot uppers. December 5.

23,696. J. Blanc. An improved substance to be used as a glue and for coating and other purposes. December 8.

24,098. H. Neil. Improvements in the waterproofing of leather. December 14.

24,273. O. C. Hagemann. Improvements in the extraction and purification of tannin. December 16.

Complete Specifications Accepted.

1892.

22,480. A. Sinan and H. Sinan. A process for clarifying or decolorising tannic extracts. December 13.

1893.

2545. H. H. Lake.—From A. J. Strauss. Improvements relating to the treatment of hides and skins. December 6.

XV.—AGRICULTURE and MANURES.

Applications.

21,931. J. T. Dinsdale. Improvements in the treatment of sewage sludge to obtain a useful manurial product therefrom. November 16.

22,536. A. Macarthur. A method for obtaining artificial manure from urine and other substances. November 24.

22,559. J. Carter. Improvements in making manure from sewage precipit, sediment, residue after filtration, or from liquid sewage. November 24.

XVI.—SUGARS, STARCHES, GUMS, Etc.

Applications.

22,324. A. R. Grieve. Improvements in the method of and in means and appliances for melting raw sugar. November 22.

22,495. G. Leslie. Improvements in the manufacture of glucose from cotton-seed fibre and the conversion of fibre on cotton-covered seed. November 23.

23,854. E. J. T. Digby. A new or improved manufacture for use in the purification of sugar, syrup, honey, oils, and other substances. December 12.

Complete Specifications Accepted.

1892.

23,748. L. Briant and W. H. Walker. Improvements in the utilisation of flours which are rich in diastase. November 22.

1893.

2597. Siemens Bros. and Co., Limited, and from Siemens and Halske. Process for bleaching raw starch, starch gum, and solutions thereof, by treatment with chlorine and ozone combined. November 29.

XVII.—BREWING, WINES, SPIRITS, Etc.

Applications.

23,069. R. Cunliffe. Improvements in machines for drying brewers' refuse and other substances or materials. December 1.

23,224. A. Collette. *See* Class XVIII.—*A*.

23,367. L. Wagner and J. Marr. Improvements in the methods of treating and drying grain, malt, brewers' grains, and other like substances, and in apparatus therefor. Complete Specification. December 5.

23,846. F. Faulkner and J. E. J. Johnson. Improved manufacture or production of extracts from malted grain. December 11.

23,998. C. Zimmer. Improvements in the process and apparatus used in brewing. Complete Specification. December 13.

Complete Specification Accepted.

1893.

3077. J. Heron. *See* Class XVIII.—*A*.

XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

Applications.

A.—Chemistry of Foods.

22,287. M. Kirchberger.—From Ban Heng Hin and Co., Penang. Improvements in the treatment of pepper. Complete Specification. November 21.

22,402. M. Cathrein. An improved process of and apparatus for preserving meat. November 22.

23,224. A. Collette. Improvements relating to the preservation of yeast and other vegetable and animal substances. December 2.

23,266. E. Krog. Malted provender for horses, cattle, and sheep. December 1.

24,191. R. Haddan. — From La Compagnie du Sel Agglomere, France. Improvements in and relating to the treatment of salt and the formation of blocks thereof by fusion. Complete Specification. December 15.

B.—Sanitary Chemistry.

21,820. T. W. Baker. Cremating and destroying obnoxious gases from dust destructors, &c. November 15.

21,931. T. J. Dinsdale. *See* Class XV.

23,082. S. Smithson. Improvements in or relating to machinery or apparatus for treating, deodorising, drying, and utilising excreta, nightsoil, town's refuse, and the like. Complete Specification. December 1.

23,713. F. Smith and F. W. Smith. Improvements in apparatus employed in the chemical or other treatment of sewage. December 9.

C.—Disinfectants.

21,640. H. Spencer. Improved composition for producing vapour for disinfecting and therapeutic purposes. November 13.

COMPLETE SPECIFICATIONS ACCEPTED.

A.—Chemistry of Foods.

1892.

22,115. M. Julien and A. Brin. A process of enriching milk and producing cream and butter. December 6.

1893.

1954. C. A. Sahlstrom. Improvements in the preservation of alimentary and other substances, and apparatus therefor. December 6.

3077. J. Heron. Improvements in preserving yeast for transport. December 20.

17,205. J. C. W. Stanley. Improvements in or relating to the treatment of fish and fish offal, and in apparatus therefor. December 20.

17,268. J. J. Adkins. Desiccated hop-fodder and litter. December 20.

19,928. W. Gearren. Improved cake or food. November 29.

20,296. J. Nagel. An improved apparatus for obtaining distilled and sterilised water. December 13.

B.—Sanitary Chemistry.

1892.

21,291. A. O. Jones. Improvements in the treatment and utilisation of sewage, and plant therefor. November 22.

1893.

1675. W. Webster. Process for treating the effluent from electrolytically or chemically purified sewage for neutralising its alkalinity, and for the production of by-products therefrom. December 13.

19,216. H. von der Linde and C. Hess. Method of purifying water by oxide of tin. November 29.

C.—Disinfectants.

1893.

1213. W. J. Menzies. Improvements in the treatment of manganates for the production of permanganates suitable for use for disinfecting or other purposes, and in apparatus therefor. November 22.

2694. J. Vigerie. A method of and apparatus for preserving meat, cereals, and other animal or organic substances, destroying parasites, vermin, extinguishing fires, and disinfecting leather, fabrics, and the like. December 13.

XIX.—PAPER, PASTEBOARD, ETC.

APPLICATIONS.

22,415. D. Westad. Improvements in machines for making millboard or pasteboard from wood-pulp. Complete Specification. November 22.

22,842. M. Coulon and R. Godeffroy. Improvements in the manufacture of paper-pulp or cellulose from wood, straw, and other vegetable fibres. November 28.

22,909. J. White. Improvements in reels, rollers, or cylinders for machinery for making and treating paper. November 29.

23,055. G. Castleden. Improvement in and connected with toilet and other papers. December 1.

23,502. W. P. Thompson.—From C. Schauffelen, Germany. An improved finely-granulated paper and process of producing the same. Complete Specification. December 6.

23,560. J. Makin. Improvements in apparatus applicable to paper-making or other machines for regulating the flow of pulp or liquids thereto. December 7.

24,275. C. Kellner. Improvements in the manufacture of cellulose. December 16.

24,287. C. Kellner. Improvements in the manufacture of cellulose. December 16.

COMPLETE SPECIFICATIONS ACCEPTED.

1893.

18,519. L. S. Langville. Improved process for treating the black ash residuum of wood-pulp manufacture. November 29.

21,249. G. J. Junk. *See* Class V.

XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

APPLICATIONS.

21,729. B. J. B. Mills. — From P. Monnet, France. Improvements in apparatus employed in the manufactures of various extracts. November 14.

21,853. J. H. Baum. Improvements relating to the production of pyro-catechine. November 15.

22,114. J. C. W. F. Tiemann. A process for converting compounds of the citral series (geranium series) into isomers having a higher specific weight and a lower boiling-point than the original bodies. November 18.

22,931. F. W. Warwick. An improved pharmaceutical preparation of ferrous salts. Complete Specification. November 29.

24,177. S. Pitt.—From The Chemische Fabrik auf Actien vormals E. Schering, Germany. Improvements in the manufacture of aromatic sulphuryl derivatives of protocatechuic aldehyde and their conversion into vanillin. December 15.

24,178. S. Pitt.—From The Chemische Fabrik auf Actien vormals E. Schering, Germany. Improvements in the manufacture of vanillin. December 15.

24,179. S. Pitt.—From The Chemische Fabrik auf Actien vormals E. Schering, Germany. The preparation of a crystalline polymeric base suitable for medical use from amido-acetic-aldehyde. December 15.

24,183. J. E. Tenison-Woods, A. J. Campion, W. Morgan, A. Moy, and C. Swithenbank. Improvements in the manufacture of English refined camphor and the products therefrom. December 15.

COMPLETE SPECIFICATIONS ACCEPTED.

1893.

2884. W. Webster and T. More. A manufacture of pharmaceutic preparations for use more particularly in case of anæmia and for weak throats. December 13.

3182. C. D. Abel.—From Kochler, Buff, and Co. Manufacture of amidoalkylsalicylic acid and acetamidoalkylsalicylic acid. December 6.

3961. P. Fritsch. Manufacture of salicylic-acid ester of acetol. December 20.

XXI.—PHOTOGRAPHIC PROCESSES AND MATERIALS.

APPLICATIONS.

21,686. W. Fairweather.—From J. Kost, Germany, A reflecting and ventilating device or apparatus for photographic exposure by the magnesium light. November 14.

22,733. C. E. Pettitt. Improvements in the manufacture of positive printing papers, opals, and the like for photographic purposes. November 27.

22,942. A. Hesekiel. Improvement in application of photography to the production of printing surfaces. November 29.

23,490. A. C. Ponton. Improvements in photography and in photographic cameras. December 6.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

23,716. E. T. Powell. Means or apparatus whereby photographers can retouch their negatives or prints with the aid of artificial light. December 6.

1893.

20,042. A. Hesekeil. Improved sensitised paper for photographic purposes. November 29.

XXII.—EXPLOSIVES, MATCHES, ETC.

APPLICATIONS.

21610. J. T. Trench. Improvements in matches. November 13.

21,829. J. T. Trench. Improvements in and relating to matches. November 15.

21,939. S. Rogers. An improvement in or relating to wax and other matches. November 16.

22,384. R. C. Schüpphaus. Improvements in methods of securing the chemical stability of nitro-compounds. Complete Specification. November 22.

22,716. J. T. Trench. Improvements in and relating to matches. November 27.

23,093. H. V. Keeson. Improvements in mechanical time fuses for projectiles. December 1.

23,169. H. Abbott. Improvements in lucifer matches. December 2.

23,381. T. Deiches and J. Komaike. *See* Class II.

23,416. K. C. Edmunds. Improvements in explosives. December 5.

23,579. H. R. von Dahmen. An improved manufacture of explosives. December 7.

23,773. H. H. Lake.—From C. Pieper, Germany. Improvements in the manufacture of explosives. December 9.

COMPLETE SPECIFICATIONS ACCEPTED.

1893.

3267. W. P. Thompson.—From E. Lagneau. Improvements in the manufacture of matches. December 6.

7573. C. D. Abel. From the Westfalisch-Anhaltischen Sprengstoff Actien Gesellschaft. Method and apparatus for charging cartridges with explosives. November 22.

15,620. H. J. Pain. Improvements in pyrotechnic devices. November 29.

19,931. W. Eyelyn-Liardet. An improved safety explosive, and method or process of manufacturing the same. December 6.

20,066. M. E. Leonard. An improved gunpowder. November 29.

XXIII.—ANALYTICAL CHEMISTRY.

APPLICATION.

23,039. R. W. Woosnam and The Dairy Supply Co., Limited. Improvements in apparatus specially suitable for use in estimating the amount of fat in milk and other substances. November 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1892.

23,109. W. Belgrove. An improved means of testing the quality of milk. December 13.

1893.

2542. A. N. Nahm. Improvements in and apparatus for ascertaining the percentage of fat in milk and other like liquids. December 13.

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